



المؤسسة العامة القطرية للكهرباء والماء
Qatar General Electricity & Water Corporation

CONTRACT No GTC 626/2014A

**CONSTRUCTION OF MEGA RESERVOIR PRPSs
(PACKAGE A - UMM BIRKA)**

**CONTRACT DOCUMENTS
(VOLUME 4 OF 19)**



**CONSOLIDATED CONTRACTORS GROUP S.A.L. (OFFSHORE) (CCC) &
TEYSEER CONTRACTING COMPANY W.L.L.
JOINT VENTURE**

TABLE OF CONTENTS

VOLUME	SECTION	ITEM	
VOLUME 1	1	Contract Agreement	
	2	Letter of Award	
	3	Letter of Confirmation	
	4	Secrecy Declaration	
	5	Performance Bond	
	6	Commercial Registration and Power of Attorney	
	7	Summary of Contract	
	8	General Conditions of Contracts	
VOLUME 4 2/6	9	Appendix A: Scope of Work and Specifications	
VOLUME 7	10	Appendix B: Schedule of Prices	
		1. Form of Tender	
		2. Preamble	
		3. Bills of Quantities	
		• Contract BOQ (After Currency Adjustment)	
	11	Appendix C: Insurance	
		1. Preamble	
		2. All Risk Insurance	
	12	3. Workmen's Compensation Insurance	
		Appendix D Administration Instructions	
	VOLUME 8	13	Appendix E Contractor Resources
			Annexure 1: Contractor's Personnel
Annexure 2: Facilities, Plant & Equipment owned by Contractor			
Annexure 3: Facilities, Plant & Equipment proposed by Contractor			
Annexure 4: Subcontractors			
Annexure 5: Suppliers			
Annexure 6: Contractor's Company Organization Chart			
Annexure 7: Contractor's Project Organization Chart			
Annexure 8: QA/QC Procedure			
Annexure 9: Utilization of National Products & National Origin			
VOLUME 9	13	Annexure 10: Contractor's General Information	
		Annexure 11: List of Customers and Projects	
		Annexure 12: List of Current Commitment	
		Annexure 13: Other Annexures	
VOLUME10	14	Appendix F Drawings	
	15	Appendix G Material Equipment Supplied by KAHRAMAA	
	16	Appendix H Contract Execution Plan	
		1. Programme of Work	
	2. Method Statement		
VOLUME 11/15	17	Appendix I Materials Supplied by the Contractor	
VOLUME 16/17	18	Appendix J General Safety Requirements	
	19	Appendix K Departure from or Qualification to the Specification	
VOLUME 18	20	Acknowledgement of Receipt of Tender Documents	
		Circulars No. 1 to 21	
VOLUME 19	21	Commercial Offer BOQ	
		Pre Award Correspondence	
		Minutes of Pre-Award Meeting	



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

APPENDIX A SECTION 5

ELECTRICAL SPECIFICATION



5	ELECTRICAL WORKS	3
5.1	GENERAL REQUIREMENT	3
5.2	MEDIUM VOLTAGE ELECTRICAL MOTOR.....	3
5.2.1	General	3
5.2.2	Standards and Codes	3
5.2.3	Outline of the Project.....	5
5.2.4	Design Consideration.....	5
5.2.4.1	General	5
5.2.4.2	Motor Rating.....	5
5.2.4.3	Duty Type	5
5.2.4.4	Power Factor.....	5
5.2.4.5	Insulation level.....	5
5.2.4.6	Noise Level.....	5
5.2.4.7	System variations	6
5.2.4.8	Cooling	6
5.2.4.9	Starting Condition	6
5.2.4.10	Motor Enclosures.....	6
5.2.4.11	Stator and Rotor	6
5.2.4.12	Bearing	7
5.2.4.13	Vibration	7
5.2.4.13.1	Bearing Vibration Velocity and amplitude	7
5.2.4.13.2	Vibration Monitoring.....	7
5.2.4.14	Shaft and coupling.....	8
5.2.4.15	Terminal Boxes	8
5.2.4.16	Lifting and installation.....	8
5.2.4.17	Monitoring	8
5.2.4.18	Painting	9
5.2.5	Inspection and Testing	9
5.2.5.2.1	Insulation Quality Test	9
5.2.5.2.2	Final Tests	9
5.2.6	Packing and Shipment	10
5.2.7	Quality Requirements	11
5.3	MEDIUM VOLTAGE VARIABLE FREQUENCY DRIVE (VFD).....	11
5.3.1	GENERAL	11
5.3.2	STANDARDS and CODES	12
5.3.3	Design Consideration	13
5.3.4	System Configuration	15
5.4	LOW VOLTAGE VARIABLE FREQUENCY DRIVE (VFD).....	29
5.4.1	General	29
5.4.2	Codes and Standards	30
5.4.3	Design consideration	31
5.4.4	Design Criteria	33
5.4.5	Control and Indications	33
5.4.6	Protection	34
5.4.7	Software Features	34
5.4.8	Optical PC tool Features	35
5.4.9	Control Connections	35
5.4.10	Tropical Protection	36
5.4.11	Painting	36
5.4.12	Installation and commissioning:.....	36
5.4.13	Tests	36
5.4.14	Documentation	39
5.4.15	Packing and Shipment	40
5.4.16	Spare Parts and Accessories	40



5 ELECTRICAL WORKS

5.1 GENERAL REQUIREMENT

Unless otherwise stated in the Project Documentation, the Contractor shall comply with every requirement of the Qatar Construction Specification (QCS) that is relevant to the type of work forming any part of the Contract and shall adopt whichever permissible option or alternative is best suited to the needs of the work being undertaken.

This specification section if for the electrical installation associated with the main process equipment. Further specifications related to electrical equipment are contained in Appendix A7.

5.2 MEDIUM VOLTAGE ELECTRICAL MOTOR

5.2.1 General

5.2.1.1 Abbreviations

BSBritish Standard

CPS Corridor Pumping Station

dB Decibel

ENEuropean Norm

ISO International Organization for Standardization

IP Internal Protection

5.2.1.2 Operating Conditions

5.2.1.2.1 Environmental conditions

The electrical motor shall be designed and be suitable for operation in the climatic conditions of state of Qatar (tropical weather, with excess heat dust and humidity at time)

Followings are the climatic conditions to be considered at site:

- Maximum ambient temperature: 50° C
- Minimum ambient temperature: 5° C
- Design ambient temperature: 50° C
- Maximum ambient relative humidity: 100%
- Minimum ambient humidity: 20%
- Design ambient humidity 100%
- Installed at altitude not more than 1,000 meters above sea-level
- A considerable amount of salt is entrapped in atmosphere, which together with the relative high ambient humidity, can produce sever corrosion problems.

5.2.2 Standards and Codes

The works, equipment and materials shall be designed, manufactured and erected according to the followings applicable codes, standards (in their latest edition where not otherwise specified)

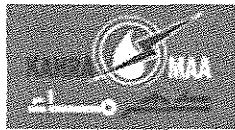


5.2.2.1 Standards

Rotating electrical machines	IEC-60034
Rating and performance	IEC 60034-1
Methods for determining losses and efficiency of rotating electrical machinery from tests	IEC 60034-2
Degrees of protection by enclosure for rotating machinery	IEC 60034-5
Methods of cooling rotating machinery	IEC 60034-6
Classifications of types of construction and mounting arrangements of rotating electrical machinery	IEC 60034-7
Terminal marking and direction of rotation of rotating electrical machines	IEC 60034-8
Noise limits	IEC 60034-9
Built-in thermal protection	IEC 60034-11
Impulse voltage withstand levels of rotating a.c. machines with form-wound stator coils	IEC 60034-15
Mechanical vibration of certain machines with shaft heights 56 mm and higher measurement, evaluation and limits of the vibration severity	IEC 60034-14
International Electrotechnical Vocabulary	IEC 60050
Dimensions and output series for electrical machines	IEC 60072
Part 1 Frame number 56 to 400 and flange numbers 55 to 1080	
Part 2 Frame number 355 to 1000 and flange numbers 1180 to 2360	
Part 3 small built-in motors - Flange numbers BF 10 to BF 50	
Test of insulation of bars and coils of high voltage machines	CENELEC-HD (1976) 345-S1
Roller bearings - Method of evaluating dynamic load ratings	ISO 281

Local Standards

In addition to the international standards motors shall also conform to the local standards / regulations.



5.2.3 Outline of the Project

5.2.4 Design Consideration

5.2.4.1 General

- Manufacturer: Company specialising in manufacturing the Products specified in this section with minimum five years documented experience.
- Motor Supplier/Manufacturer should have a local office with permanent trained engineers and skilled support staff in the country where the goods are delivered in order to prove his commitment for local support and to provide a means of communication. The local representative shall be easily accessible and shall be reachable at site within 24 hours time.
- Motor construction shall be rigid and stiff , precaution shall be taken to avoid any type of corrosion and electrical ionization effects (between different type of material)
- The motor shall be complete with terminal box , cable gland, heater and monitoring instruments
- The motors shall be supplied by the manufacturer of the driven equipment (e.g. pumps manufacturer).
- The motor and VFD shall be supplied from same supplier/ manufacturer in case VFD is required for motor operation /starting.
- Deliver, store, protect and handle products to site with particular reference to Qatar climatic conditions.

5.2.4.2 Motor Rating

- The motor rating shall be adequate as per the load requirement, motor output rating shall be minimum 1.15 times the required power (shaft power) at 110% of duty point considering all derating requirement .Motor manufacturer to indicate the derating factor on the data sheet
- The motor shall be suitable for VFD operation. based on pump operation range requirement.

5.2.4.3 Duty Type

Motors shall be designed for continuous running duty type S1 with variable speed operation S9 (Operated by frequency drive).

5.2.4.4 Power Factor

MV Motor power factor shall not be less than 0.9 under full load operation; power factor shall be indicated on the motor data sheet

5.2.4.5 Insulation level

MV motor insulation shall be suitable for motor operation in the following condition

- System neutral near earth potential
- Unearthed system while one line at earth potential (short duration).

5.2.4.6 Noise Level

MV motor noise level shall not exceed the following level at both mode of operation (no load /full load)



- 82 dB(A) at 1.0 M from equipment (in working area) for motor only
- 85 dB(A) at 1.0M from equipment (in working area) for combined both pump and motor

5.2.4.7 System variations

MV motor shall continuously operate at maximum power while maintaining temperature rise limit during the following variation (percentage)

▪ Voltage	+/- 10%
▪ Frequency	+/- 5%
▪ Transient voltage (startup / running)	80% (200ms)

5.2.4.8 Cooling

IEC 60034-6 shall be consider for motor cooling system , air cooled type motor shall be consider for motor rated up to 1000kw , for motor rated above 1000kw water cooled type shall be consider . Heat exchanger material shall be corrosion –resistance.

Cooling system selection and sizing shall consider pump speed operating range (low speed) where high temperature rise will be expected due to low fan speed (air cooled type motor).

5.2.4.9 Starting Condition

Motor shall be suitable for the following number of start per hour (equal time interval)
3 start per hour. DOL (cold start)
2 successive starts per hour (hot start)

Motor torque characteristics shall match the load starting and running torque characteristics.

5.2.4.10 Motor Enclosures

A. All motor enclosures shall be used on IEC 60034-6 AND 60529

- IP54 for indoor installation
- IP55 for outdoor use or machines subject to splashing or washing down

B. Motor enclosures shall be suitable and certified for the zone of hazard in which they are to be installed

5.2.4.11 Stator and Rotor

- The stator windings shall use a modern synthetic resin insulation system based on mica glass tape continuously wound on the coils to give a void-free homogeneous structure. The end windings shall be securely braced to prevent harmful movement arising from electro-magnetic and mechanical forces. The rotor bars shall be securely keyed into the rotor. The rotor shall be shrunk and keyed onto the shaft.
- Motors shall be provided with Class "F" insulation but limited to Class 'B' temperature rise.
- All motor shall be delta connected, phase terminals shall be extended up to the terminal box and provided with removable links
- Insulation material shall be according to IEC 60085.



- Two resistance temperature detectors per phase shall be installed in pockets within the stator windings to monitor winding temperature. The detectors shall be provided with temperature indicators, alarms and trips for use with motor control protection. The temperature of each bearing shall be monitored by means of Stator winding fixing method shall suitable to withstand forces due to direct on line starting
- Stator winding cross section area shall be sufficient to withstand the maximum prospective fault current for a duration required for clearing the fault by the protection device.
- MV motor rotor winding shall be designed for continuous service including repeated direct-on-line starting.
- The shafts ends shall be provided with a suitably threaded hole or holes to facilitate the assembly or removal of coupling and bearing faces. Shaft extension, keys and key ways shall be in accordance with IEC 60072

5.2.4.12 Bearing

- MV motor shall be provided by self-lubricating ball and roller bearing
- L-10 Lifetime for ball and roller bearing shall be 40,000hours
- Life time calculation shall consider internal forces (magnetic forces).
- Where VFD will be used for pump operation, the motor shall be provided with insulated bearings to prevent bearing failure due to circulating rotor currents.

5.2.4.13 Vibration

5.2.4.13.1 Bearing Vibration Velocity and amplitude

Bearing vibration effective velocity shall be in accordance with IEC 60034-14 and shall not exceed the following:

- (1.8 mm/s RMS) when free suspended
- (2.8 mm/s RMS) when rigid mounted

The amplitude of the shaft vibration (un filtered peak to peak) shall not exceed the following:

- 15 um at 50 Hz
- 7 um at 100 Hz

Please note these limits shall be applicable for all ranges of operation condition (ambient temperature and loads).

The vibration probes shall be installed in the motor by means that will not obstruct dismantling of any other parts (motor cover) during maintenance.

5.2.4.13.2 Vibration Monitoring

The vibration monitoring system shall be as per pump manufacturer recommendation the system shall compromised of the following as minimum

- Proximity transducer for shaft relative vibration measurement.(Two probes per bearing) for vibration measurement in any direction.
- Shaft axial vibration and displacement (Two axial probes at each thrust bearing)



A local Panel for Vibration /temperature / Noise level etc may be provided near the motor.

5.2.4.14 Shaft and coupling

Motor shall be provided with free shaft extension with key and keyway according to IEC 60072-1.

5.2.4.15 Terminal Boxes

- A. Terminal boxes shall be designed to accept the cables as detailed by the contract, terminal boxes shall be mounted on the right hand side when viewed from the driving end of the motor, unless otherwise required by the contract.
- B. Terminals shall be stud-type, substantially designed, anchored to a carrier terminal block and insulated from the motor frame.
- C. Adequate space and gland arrangements shall be provided
- D. space heater shall be completely wired with lead up to a separate terminal box (separated from the power and RTD terminal boxes)
- E. Terminal box covers shall be provide with gasket to provide a degree of protection equivalent to or better than that of the motor.
- F. Power cable termination boxes shall be high fault level type, with segregated phases, suitable for air insulated heat shrinkable termination kits. The design shall provide sufficient space for crossing without damage to core insulation. The terminal box shall be provided with surge arrestors to provide protection against switching surges and over voltage.

5.2.4.16 Lifting and installation

Motor shall be provided with lifting eyes, rings and lugs capable of supporting the motor weight, the equipment shall be supplied with all accessories for installation of the motor.

5.2.4.17 Monitoring

Motor shall be provided with the following as minimum for condition and measuring monitoring purpose

- Stator winding temperature monitoring (each phase)
 - Bearing temperature monitoring (each bearing)
- The minimum requirement details as follows

Stator Winding

- 2 No. thermometers embedded in each phase of stator winding.(double element resistance)
 - 2 No. dial type thermometers for monitoring the cold/warm coolant temperature.
- Sleeve bearing
- 1 No. dial type mercury thermometer for local reading
 - 1 No. thermocouple/resistance thermometer for remote indication



All wiring for measuring and monitoring is to be brought to one common terminal box.

Winding temp sensor should be of three wire type and one set of spare RTD should be provided per phase.

Wiring shall be of the heat resistant type silicone rubber insulation reinforced and protected with metal braid.

5.2.4.18 Painting

Painting and coating shall be as per the pump manufacturer/motor standards.

5.2.5 Inspection and Testing

5.2.5.1 Inspection

Visual inspection of the MV motor shall be carried out during the following stage

- During manufacture
- Before final packing for shipping

5.2.5.2 Testing

Motor manufacturer shall carryout the required testing as specified in standard section 2.1. The following tests shall be performed, registered and made available to the CLIENT / ENGINEER.

5.2.5.2.1 Insulation Quality Test

To determine the insulation system quality the following test shall be performed as a minimum:

- Di-electric loss angle test for MV-motors with a rated voltage exceeding 5 kV.
- For stator winding manufactured by forming and curing the slot parts, before insertion of the winding coils in the stator slots, a minimum of 10% of the coils shall be subjected to the di-electric loss angle test.
- For stator windings insulated according the VPI method or any other method with forming and curing the stator slots, the di-electric loss angle test shall, if requested on the data sheet, be performed on the sample test coils.
- After completion of the stator, each complete stator winding shall be subjected to the dielectric loss angle test. The results will be used for future reference.
- For bars or coils equipped with parallel conductors the insulation of the conductor lamination shall be tested for 5 seconds at 110 V AC. Only coils where no short-circuit appears shall be used in the machine.

5.2.5.2.2 Final Tests

General

Each motor shall have been inspected and tested, the results shall be recorded in the test reports.



Test shall be carried out in accordance with relevant IEC and ISO recommendations, unless otherwise agreed.

Routine Tests

All motors shall be subject to the following routine tests:

- measurement of speed and check of direction of rotation;
- measurement of current input at no load;
- measurement of current input at locked rotor;
- high voltage test according to standard but with a minimum of 2000 V;
- di-electric loss test on the phase winding;
- measurement of insulation and winding resistance;
- measurement of winding resistance;
- measurement of the bearing temperatures;
- functional test for RTD

Type Tests

The VENDOR shall carry out on one motor of each type and range the following type tests if specified on the data sheet:

- Measurement of slip, power factor, current and efficiency at 50-75 and 100% of full load.
- Measurement of locked rotor torque.
- Measurement of temperature rise by winding resistance method at full load conditions (Heat run in short circuit at 100% of rated current).

Special Tests

The following tests shall be carried on the motor:

- Measurement of noise level.
- Measurement of vibration.
- Measurement of motor winding/bearing temperature.

Contractor/Vendor rearrangement to be included to if any of the above measurement is above recommended level.

Performance Values

The information submitted with the tender shall be considered as guaranteed values to which the tolerance limits as given in IEC 60034-1 will be applicable.

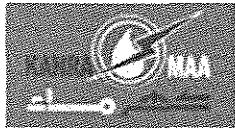
5.2.6 Packing and Shipment

Motor packing shall be wooden type seaworthy crates.

The crates shall be marked with the following as minimum

- Destination
- Client Name
- Project No.
- Order number
- Equipment Type.
- Crate Weight

The packing should also include the following documents:



- Electrical wiring /connection diagram.
- General arrangement drawings.
- Installation instructions.

5.2.7 Quality Requirements

The Supplier shall comply with the requirements of ISO 9002 module for quality assurance.

5.2.7.1 Vendor Documentation

The following documents and drawings shall be submitted by Vendor

- Foundation details drawings
- Fixing details drawings
- General arrangement drawings
- Name/tag plate lists
- Material lists
- Motor data sheets
- Performance curves
- Connection diagrams
- Type test certificates
- Routine test certificates
- Operation and Maintenance Manual

5.3 MEDIUM VOLTAGE VARIABLE FREQUENCY DRIVE (VFD)

5.3.1 GENERAL

5.3.1.1 Abbreviations

BSBritish Standard

CPS Corridor Pumping Station

dB Decibel

ENEuropean Norm

ISO International Organization for Standardization

IP Internal Protection



5.3.1.2 Operating Conditions

5.3.1.2.1 Environmental conditions

The MV VFD shall be designed and be suitable for operation in the climatic conditions of state of Qatar (tropical weather, with excess heat dust and humidity at time)

Followings are the climatic conditions to be considered at site:

- Maximum ambient temperature: 50° C
- Minimum ambient temperature: 5° C
- Design ambient temperature: 50° C
- Maximum ambient relative humidity: 100%
- Minimum ambient humidity: 20%
- Design ambient humidity 100%
- Installed at altitude not more than 1,000 meters above sea-level

A considerable amount of salt is entrapped in atmosphere, which together with the relative high ambient humidity, can produce sever corrosion problems

5.3.2 STANDARDS and CODES

The works, equipment and materials shall be designed, manufactured and erected according to the following applicable codes, standards (in their latest edition where not otherwise specified)

5.3.2.1 Standards

The design, manufacturing, construction, installation, test and commissioning of variable speed drives shall be in accordance with the following codes and standards, at least. The latest revision of the publication referred to shall apply.

IEC 60034 Rotating electrical machines

IEC 60071 Insulation co-ordination

IEC 60072 Dimensions and output series for rotating electrical machines

IEC 60076 Power transformers

IEC 60085 Electrical insulation – Thermal evaluation and designation

IEC 60146 Semiconductor converters

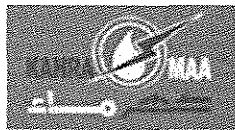
IEC 60214 Tap changers

IEC 60296 Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear

IEC 60529 Degrees of protection provided by enclosures (IP-Code)

IEC 61000 Electromagnetic compatibility

IEC 61800 Adjustable speed electrical power drive systems



IEEE 519 Recommended practices and requirements for harmonic control in electrical power systems

5.3.3 Design Consideration

5.3.3.1 General

- Manufacturer: Company specialising in manufacturing the Products specified in this section with minimum five years documented experience.
- The VFD and MV motor shall be supplied from the same manufacturer.
- VFDs Supplier/Manufacturer should have a local office with permanent trained engineers and skilled support staff in the country where the goods are delivered in order to prove his commitment for local support and to provide a means of communication. The local representative shall be easily accessible and shall be reachable at site within 24 hours time.
- The selection of motor /VFD and co-ordination shall be responsibility of the VFD vendor. The Contractor shall be responsible for matching the motor and the drive, and for coordinating the collection of data and the design effort required to limit harmonics, noise & temperature to levels. The Contractor shall submit the necessary documentation that these requirements have been satisfied and the VFD has been approved by the driven equipment supplier.
- The variable speed drives shall be of a well-tested and proven industrial design which ensures maximum safety to personnel, service reliability and economic operation for an operational life time of at least 20 years. Even under extreme conditions of major short circuit, there shall be no danger to persons in the vicinity of the assembly.
- The Contractor has to take care that all components and equipment are selected considering easy maintenance, simple and quick diagnosis and long maintenance intervals.
- All components and equipment shall be designed for continuous duty at rated load and under the given climatic conditions. Standard industrial high performance systems and components of proven manufacturer standard shall be used only. Components and equipment of same kind and type shall be selected for equivalent functions. The interchangeability must be guaranteed
- All internal components should be marked with identification number and it should be reflected in respective drawings
- All individual VFD cubicle should be equipped with internal lighting
- All terminal should have proper identification mark and it should be reflected in respective drawings
- All wires should have ferrule number and it should be reflected in respective drawings
- All installed VFD should have proper designation in front and rear of each cubicle along with number on rear and front panel respective of their pump assignment.
- The VFD system shall meet local and international standards for Noise level & susceptibility, noise shall be limited to 85dBA when measured at one meter from the edge of the VFD panel.
- The component layout/arrangement of installed components in each VFD cubicle shall be pasted with parts identification and labeling.



- Pouch shall be provided inside the VFD for keeping the drawings.
- Deliver, store, protect and handle products to site with particular reference to Qatar climatic conditions.

5.3.3.2 Performance Requirement

The variable speed drives shall control the speed between 40 and 100% of the rated maximum speed. Speed accuracy within this range shall be $\pm 0.5\%$ without encoder or tachometer feedback. Any deviation of more than 2% shall raise an alarm after a 20 sec. time delay. The power or torque shall reduce, if the speed exceeds 102% of the maximum operational speed, till the maximum speed is attained. Increase beyond 105% speed or decrease below 95% beyond 10 sec. shall trip the system.

The variable speed drives shall be rated 15% above the pump power at the duty point. Temperature derating as applicable shall be applied for the converter and the motor. Calculations shall be provided for the basis of the rating selected for approval of Owner/Engineer.

The variable speed drives shall have at least:

1. 120 % maximum rated torque for 10 sec. for starting and re-starting,
2. 110 % maximum rated torque for 60 sec. for starting, re-starting and acceleration.

During continuous operation, the variable speed drives shall be capable of developing sufficient torque under load conditions to respond to 20% alteration in set point within a time of not more than 30 sec.

The minimum time interval between set point changes will be not less than 30 sec.

The system shall be suitable for continuous repeated start/ stop operations without any adverse effect on the motor or frequency converter.

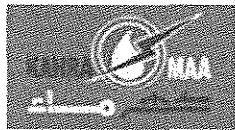
The power factor of the output shall be maintained at 0.95 lag from 40 to 100% speed. The estimated total running up time shall be stated by the manufacturer at rated voltage at the line terminals of the variable speed drives. The pump and motor inertia shall be estimated or be based on data given in IEC 60034-12, Table III.

The maximum voltage (crest voltage plus spike) supplied by the converter to the motor shall be < 2 times the crest value of the rated motor voltage. The voltage spikes of current source converters shall not exceed the crest value of the motor voltage and, for voltage source converters, the nominal r.m.s. value of the motor voltage.

5.3.3.3 Supply System and Variations

The input power supply voltage to the transformer shall be as follows:

1. Supply voltage 11kV, 50Hz 3 Phase, resistance earthed
2. Voltage variations $\pm 10\%$
3. Frequency variations $\pm 5\%$
4. Allowable voltage dip 80% for 200ms



5.3.3.4 Harmonics Effects

Variable Speed Drive shall meet the international requirements for voltage and current harmonic distortion according to IEEE 519 with all the duty pumps running. Local network provider requirements must be considered.

Requirements for both current and voltage distortion shall be satisfied. If required suitable harmonic mitigation system (filters) shall be provided.

5.3.3.5 Radio Interference

Variable speed drives shall meet the requirements of the relevant IEC Standards regarding the emission of radio frequencies.

5.3.4 System Configuration

The following components shall be considered for variable speed pump operation system:

1. Phase shift transformer,
2. Frequency converter,
3. Induction motor ,
4. Harmonic filter units.

5.3.4.1 Converter (phase shift) Transformer

Phase shift transformer shall be oil-immersed type, natural air cooling and suitable for outdoor installation.

Transformer secondary winding shall be arranged in a form that can suppress the harmonic (4 secondary).

Transformer capacity shall be based on load requirements. Calculations for capacity selection shall be provided for review and approval by Owner/ Engineer.

All required protection shall be considered, for protection requirement please refer to transformer technical specification.

5.3.4.2 Frequency Converter

5.3.4.2.1 General

Although VFD panels are located indoor (controlled climate condition), the equipment shall be suitable for operation at ambient temperature of 46 °C the noise level generated by the unit shall not exceed 70 dB(A) under any load and frequency within the operational speed (measured at 1 m distance from the unit).

The VFD unit shall be suitable for operation on medium voltage and produce a variable voltage and variable frequency output required for the operation of the connected motor within the required operating speed range.

Start and speed adjustment of the connected motor shall be carried out with nominal current.



The unit enclosure construction shall be metal enclosed cabinet with a minimum degree of protection IP42 with hinged and lockable doors; the enclosure sheet steel shall 2mm thickness minimum. Screws, nuts and washers shall be galvanised. The unit shall be suitable for cable entries from the bottom.

Front access panel for components removal and replacement is preferred as well as the use of modular draw-out assemblies for electronic equipment (for both control and power). Converter elements shall be arranged in a way to allow safe maintenance work. Power equipment and devices for control, operation and monitoring shall not be placed in the same cabinet otherwise they shall be clearly separated. If required Back panel access for VFD panels for filter cleaning and future maintenance shall be provided.

The doors with integrated safety locks shall be provided for rectifier, intermediate DC link and inverter cabinet in order to prevent door opening before the unit is earthed.

For other cabinet that can be accessed during operation, insulating barrier for live parts shall be provided to prevent accidental access.

The converter shall consist of the following:

1. Incoming feeder,
2. Rectifier unit ,
3. intermediate DC link,
4. inverter unit ,
5. output sine filter,
6. cooling unit,
7. protection system (motor and transformer) ,
8. Control and operation section.

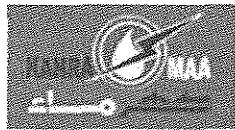
5.3.4.2.1.1 Internal wiring circuits

PVC insulated single core, stranded copper conductors with the following minimum conductor cross-sections should be used:

- | | |
|---------------------------------------------------------------------|---------------------|
| 1. power circuits (acc. to rated current and voltage drop) at least | 2.5 mm ² |
| 2. measuring circuits | 2.5 mm ² |
| 3. current transformer circuits | 4 mm ² |
| 4. auxiliary power circuits | 2.5 mm ² |
| 5. control, signalling and annunciation circuits | 1.5 mm ² |

The following shall be considered while doing the internal wiring.

- Wires shall be bundled and fixed.
- The wiring shall be laid inside of wiring ducts or channels (20% spare capacity shall be consider).
- All circuits shall be terminated on terminal stripes (10 % spare terminals shall be consider)



- VFD's printed circuit boards shall be coated to increase reliability and lifetime of the VFD by protecting the boards from moisture and dust particles.

5.3.4.2.1.2 Earthing

All exposed conductive parts likely to be accidentally charged shall be joined together by an earthing circuit. For this purpose a minimum 100 mm² cross section bare copper earthing bus shall be installed. This earthing bus shall be connected to the general grounding system by means of conventional cable connection terminals.

For the removable panels, electric continuity shall be ensured by fastening screws and bolts. The opening type panels, assembled on hinges shall be bonded to the enclosure by a tinned copper braid, or hinges shall be certified for this purpose.

The following shall be also connected to the earthing circuit:

1. secondary windings of the instrument transformers,
2. neutral point of the potential transformers,
3. armours or screens of cables,
4. operating handles, mounting plates, doors, etc.

In addition, both ends of the complete converter assembly shall be terminated to the general grounding system by separate cables.

5.3.4.2.1.3 Auxiliary Voltage

VFD auxiliary devices shall be fed by redundant source (240/415V) from the main supply via UPS.

5.3.4.2.1.4 Anti-Condensation Heaters

The converter shall be equipped with anti-condensation heater(s) to be fed from the 240/415 V, 50 Hz level. Heaters operation shall be limited if the VFD main circuit is switched off, the heater shall be controlled by means of hygrostat and thermostat.

For stand-still heater of motor the respective auxiliary circuits shall be provided, too. The heater shall be supplied via a miniature circuit breaker and controlled via contactor.

A failure of heater circuits shall be indicated on indicator board/operator panel and wired in the summary alarm for transfer to the remote control system.

5.3.4.2.1.5 Rectifier

The rectifier shall be equipped with an 18-pulse diode or diode/thyristor bridge, at least.

5.3.4.2.1.6 Intermediate DC Link

DC link shall be equipped with capacitors. Earthing switch shall be provided For the DC bus bar

5.3.4.2.1.7 Inverter

The inverter shall be equipped with semiconductor bridges



The semiconductor type shall be one of the following:

- Insulated Gate Bipolar Transistor (IGBT) type
- Integrated Gate Commutated Thyristor (IGCT).

As mitigation method for the Harmonic contents on the output voltage, sine filters shall be installed.

5.3.4.2.1.8 Cooling

Converter cooling shall be by means of close circuit water cooling system, the cooling system shall be equipped with two circulation pumps, one duty and one standby.

For other parts that cannot be cooled directly by water, a combination of internal fans and air/water heat exchanger shall be used for cooling. Cooling network water quality and leakage shall be monitored.

5.3.4.2.1.9 Control Unit

The control unit shall include all facilities for operation, control and supervision of converter transformer, converter and motor.

Programmable logic controllers or microprocessor-based systems shall be used for carrying out the entire requirement for control and supervision process related to control section.

Control and monitoring of the converter shall be possible from the operator panel and from remote control system.

For control of converter from its operator panel a key-operated switch with the following positions shall be provided:

LOCAL Position	Operation of variable speed drive from converter
OFF Position	No operation
REMOTE Position	Manual/ Automatic operation from the station control system with full protection for motor

The converter shall be equipped with a protection and alarm system shall be of the numerical type. The system should provide sufficient detailed information to enable maintenance personnel familiar with this type of equipment to troubleshoot the variable speed drives down to the printed circuit board or power semiconductor level.

The minimum protection should include for:

Inverter	DC bus over voltage/under voltage, over temperature, over current, short circuit at start up, electronic circuit fault, suppression of frequency bond, flying
----------	---------------------------------------------------------------------------------------------------------------------------------------------------------------



	restart, automatic restart,
Motor	Short circuit, earth fault, motor stall, overload, output phase loss, differential protection, motor RTD protection (winding and bearing),
Filter Unit	Fuse protection, thermal protections, unbalance protections, overvoltage protection, protection against resonance, discharge resistors, etc.

Alarms shall be segregated in Alarm (A) and Trip (T) as following:

- a) Converter transformer
 - (1) short circuit in windings (T)
 - (2) earth fault (T)
 - (3) oil temperature high (A+T)
- b) Motor
 - (1) short circuit (T)
 - (2) earth fault in the stator windings (T)
 - (3) differential protection (T)
 - (4) stator (T)
 - (5) bearing temperature, vibration (A+T)
 - (6) cooling water leakage (T)
- c) Converter (VFD)
 - (1) under voltage incoming side (A+T)
 - (2) internal short circuit (T)
 - (3) d.c. link over voltage (T)
 - (4) loss of control voltage (T)
 - (5) earth fault main circuits (T)
 - (6) earth fault secondary circuits (T)
 - (7) power electronics enclosure (T)
 - (8) failures of auxiliaries together with identification of the failing unit (A)
 - (9) one-phase interruption motor side (T)
 - (10) motor current protection (A)
 - (11) converter current protection (T)
 - (12) 5% measured value deviation from the set point (A)
 - (13) u/f ratio incorrect (A)



- (14) 105% over speed (T)
- (15) 95% under speed (T)
- (16) motor stalled (T)

The external alarm signal shall be 10 seconds time-delayed. The external trip signal shall be direct-acting. Alarm indication shall be with First Failure feature.

For control and monitoring from remote control system the following signals shall be transferred:

- a) Commands from remote control system to converter
 - (1) pre-start (if necessary),
 - (2) motor start,
 - (3) motor stop,
 - (4) 4 – 20 mA speed set point value,
 - (5) emergency shutdown.
 - (6) The loss of 4 – 20 mA signal shall result in operation at lowest speed.
- b) Messages/ alarms/ values from converter to remote control system
 - (1) ready for charge of capacitors (if necessary),
 - (2) ready for operation (speed control active),
 - (3) motor is running,
 - (4) motor speed,
 - (5) motor torque,
 - (6) failure control voltage,
 - (7) failure auxiliary voltage,
 - (8) failure cooling system,
 - (9) alarm, caused by transformer failure,
 - (10) alarm, caused by converter failure,
 - (11) alarm, caused by motor failure,
 - (12) variable speed drive tripped, caused by transformer failure,
 - (13) variable speed drive tripped, caused by converter failure,
 - (14) variable speed drive tripped, caused by motor failure.

For switching the variable speed drive via the 11 kV switchgear the following signals shall be transferred:

- c) Commands from converter to switchgear
 - (1) circuit breaker On,
 - (2) circuit breaker Off,
 - (3) emergency shut down/stop.



d) Messages from switchgear to converter

- (1) circuit breaker open,
- (2) circuit breaker closed,
- (3) circuit breaker released.

The signal transfer between converter and remote control system, with exception of the commands from remote control system and the signal "failure control voltage", which will be hardwired, shall be carried out via serial link.

The signal transfer between converter and 11kV switchgear shall be performed hardwired via digital inputs and outputs.

For the digital inputs and outputs the necessary floating contacts or couple relays shall be provided.

The devices of the control unit shall be protected against overvoltages by means of suitable measures.

5.3.4.2.1.10 Operator Panel

The operator panel shall be placed in the hinged door of the control cabinet. The panel shall consist of a multilingual alphanumeric display with user menu and the respective operation elements.

In minimum the following operation elements shall be provided:

- (1) variable speed drive On/Off
- (2) speed higher/ lower,
- (3) reset of alarms,
- (4) deletion of messages

and all elements for operation of the menu.

All messages, measuring values and alarms, which will be transferred to the remote control system, shall be indicated on the display.

In addition the following messages and values shall be indicated, at least:

- (1) operating hours with calendar date and time
- (2) VFD On/Off (LED indication),
- (3) VFD Trip (LED indication)
- (4) power factor,
- (5) DC link voltage,
- (6) input voltage, current, power and frequency,
- (7) kilowatt-hours,
- (8) output voltage, current, power and frequency,
- (9) heat sink temperature,
- (10) Failure message (Faults and alarm) with real time and details,



The failure message shall be indicated as a common alarm. By means of the user menu the kind of failure shall be indicated.

The following signals shall be shown via indication lights:

- (1) ready for operation,
- (2) running,
- (3) alarm,
- (4) trip.

The use of filament lamps for indication lights is not allowed.

In addition, it shall be possible to adjust the parameters from the operator panel. Adjustment of parameters and operation shall only be possible with input of a user code.

5.3.4.2.1.11 Filters

The harmonic filters (when provided) shall be low loss type with minimum active power consumption. Contractor shall justify the selection of components with required options to provide a techno-commercially acceptable rating. The filters shall be provided to cover the whole speed range of the converter.

5.3.4.2.1.12 Marking of the Converter Components

All components such as thyristors diodes, switching devices protection relays, instruments, instrument transformers, fuses and fuse holders, shall be identified in accordance with the schematic diagrams supplied by vendors by means of permanent labels.

In addition, all components shall be marked according to manufacturer standard with their ratings and all other essential data as required, following IEC recommendations.

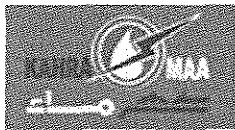
The following information shall be provided as a minimum:

- (1) manufacturers name or trade mark and type designation,
- (2) rated main and auxiliary operational voltages, frequency and number of phases,
- (3) rated currents or rated powers,
- (4) accuracy class and accuracy limit factor, e.g. for instruments and instrument transformers.

On withdrawable type units, identification labels shall be mounted on both the fixed and withdrawable parts.

5.3.4.2.1.13 Rating Plates

The rating plates shall be made of corrosion resistant metal and be fixed to a non-removable part of the frame. If additional rating plates are mounted on removable parts, the manufacturers serial number and reference shall be repeated on these rating plates.



Rating plates shall give the following data, as far as possible actually measured:

- a) Rating plate mounted on the outside of the converter cabinet with following data relating to the VFD panel:
 - (1) manufacturer's name,
 - (2) manufacturer's serial number and year of manufacture,
 - (3) type of converter and mass,
 - (4) the degree of protection,
 - (5) maximum primary voltage,
 - (6) maximum primary current,
 - (7) maximum secondary voltage,
 - (8) maximum secondary current,
 - (9) pulse system primary side,
 - (10) pulse system secondary side.
- b) Rating plate mounted on the outside of the converter cabinet, with data referring to the total variable speed drive system:
 - (1) supply system (voltage, frequency, minimum short circuit capacity, maximum short circuit capacity),
 - (2) speed (minimum operation speed, maximum operation speed),
 - (3) output power at minimum and maximum operation speed,
 - (4) torque at 0 rpm, minimum and maximum operation speed.
- c) Rating plate, mounted on the inside of the converter cabinet, with data of the motor based on sine wave currents and voltages. This will allow for repair and test data on sinusoidal supply.

5.3.4.3 Painting

All components and devices shall have a resistant, long term stable, high quality painting. At least two layers have to be applied. The colour of painting shall be RAL 7032.

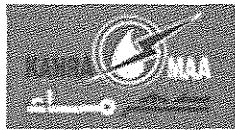
Damages, caused by transport, installation, cabling or commissioning shall be repaired in a way, that the original quality is restored.

An additional painting at location of installation is not allowed.

5.3.4.4 Installation

The delivery, installation and commissioning of variable speed drives shall include, but not be limited to the following items:

- (1) transport of converter transformers, converters and motors to location of installation (if necessary storage), and the complete mounting,



- (1) supporting of Pump Supplier for alignment of motors on common pump/motor unit base frame,
- (2) grounding and potential equalisation for all components of variable speed drives, including connection with the next grounding bus bars,
- (3) termination of all cables at the components of variable speed drives,
- (4) commissioning of the functioning variable speed drives, including final adjustment and setting of parameters,
- (5) briefing of the operation personnel in operation and maintenance during installation and commissioning phase and detailed familiarisation during a special training on site.

The installation and as well the tests and the commissioning shall be carried out with Contractors own staff, under manufacturers supervision and with own tools and measuring/ test devices.

5.3.4.5 Tests

5.3.4.5.1 Workshop Test

5.3.4.5.1.1 General

All components of the variable speed drives shall be tested completely and detailed in manufacturers workshop. All tests required by the codes and standards as well as all manufactures tests have to be performed.

The test notification and the test program for the workshop tests has to be submitted to Owner/ Engineer at least three (3) weeks prior to start of the tests to enable them to attend the test.

Detailed test protocols of all tests performed have to be submitted prior to shipment.

The workshop tests shall include the following:

- (1) routine tests,
- (2) performance tests.

All tests to be witnessed by Owner/ Engineer

5.3.4.5.2 Routine Tests

The following tests shall be carried out, at least:

- a. Converter transformer

For tests please refer to "Specification for Transformers".

- b. Converter with filter

- (1) visual inspection,
- (2) test of all functions,
- (3) check of protection against touching,



- (4) check of mechanical details,
- (5) compliance with the specifications,
- (6) short circuit withstand test, *
- (7) test of warming, *
- (8) check of degree of protection,
- (9) power frequency voltage dry test, 1 minute,
- (10) voltage test on auxiliary circuits, 1 minute 2 kV r.m.s.

*only type test certificates necessary

c. Motor

For tests please refer to "Specification for Medium Voltage Motors".

In addition the following tests shall be performed over the whole speed range:

- (1) motor shaft voltage,
- (2) motor noise test,
- (3) vibration severity measured at bearing housing.

5.3.4.5.3 Performance Test

performance test shall be carried out in manufacturer's workshop. For motors up to 4000 kW the test shall be performed under full load conditions. Depending on the size of working machine in manufacturer's test bed the test for larger motors shall either be carried out under full load conditions or performed with maximum available load (at least 4000 kW) and interpolation on the values for full load.

During the load test the manufacturer shall demonstrate, that the produced units fulfil the specified requirements and the data, guaranteed by Contractor.

The performance test shall include but not limited to the following tests:

a) Heat run

The variable speed drive shall run under the load and speed conditions until the temperature of motor has reached and stabilised, and continue for a minimum of 2 hours.

b) Measurements

- (1) current unbalance,
- (2) motor winding temperature rise (by resistance methods and by thermistors),
- (3) bearing temperatures (at maximum speed),
- (4) shaft vibration (in case of proximity probes).

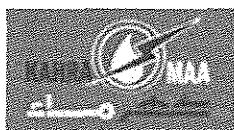
c) Loads tests

- (1) overall efficiency determination at full and half load curve both at minimum operational speed and at maximum operational speed of the total unit and converter and motor individually,
- (2) ditto for power factor,



- (3) ditto for harmonic distortion in the current on the line side,
 - (4) ditto for harmonic distortion in the current on the motor side,
 - (5) noise level of transformer, converter and motor,
 - (6) output voltage characteristics,
 - (7) output current characteristics,
 - (8) 110% nominal current test for at least 10 minutes,
 - (9) linearity between set point signal and output.
- d) Functional tests at 100 % supply voltage
 - (1) locked rotor,
 - (2) speed protection:
 - at 102% of the maximum operational speed (for power at torque controlled variable speed drives),
 - at 105% of the maximum operational speed,
 - at 95% of the minimum operational speed.
 - (3) response times and the adjustability (ramp times) within the operational speed range,
 - (4) capability to ride through voltage dips less than 20 %,
 - (5) capability to restart variable speed drive and resynchronise converter onto a
 - (6) running motor after a voltage interruption,
 - (7) (6) 4-20 mA speed reference signal,
 - (8) remote control, start, stop,
 - (9) output frequency/ voltage reduction initiated by motor current limitation,
 - (10) 5% "set point - measured point' deviation alarm,
 - (11) component/ auxiliary component failure,
 - (12) protection, alarm and trip functions.
- e) Fault condition tests
 - (1) two phase short circuit at motor terminals at no-load,
 - (2) earth fault at the motor,
 - (3) one phase interruption of the motor cable at full-load condition,
 - (4) one phase interruption of the supply cable at full-load condition,
 - (5) three phase interruption of the motor cable at full-load condition,
 - (6) earth fault in the control supply system,
 - (7) interruption in the 4-20 mA control signal,
 - (8) short circuit in the 4-20 mA control signal.

Note: For any of the tests mentioned above, the protection devices of the variable speed drive may be activated. After resetting/ replacing these devices, the variable speed drive shall be fit for operation again.



5.3.4.5.4 Site Tests

Site test and commissioning should be carried out by manufacturer trained technical personal

The site tests shall include the following steps:

1. pre-installation testing,
2. pre-commissioning (including "loop testing"),
3. commissioning and test on completion,
4. test runs,
5. performance test.

The aim of the tests is to ensure the proper function of the complete scope

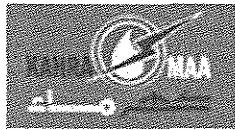
5.3.4.6 Documentation

Complete documentation shall be provided for the design, manufacturing, testing, commissioning, start-up, operation, maintenance and repair of the variable speed drives and their components.

All documents shall be in English language.

The documentation of the variable speed drives shall include the following documents and drawings (minimum requirements):

- (1) technical data sheets,
- (2) torque/ speed/ current/ power factor curves,
- (3) outline and arrangement drawings for all converters and devices, including masses and floor cut out drawings,
- (4) layout drawing showing the location of equipment, distance and cable routing,
- (5) single line diagrams showing the main and auxiliary circuitry, including main circuit breaker, unit transformer, DC link, system earthing and auxiliary supplies,
- (6) P & I diagrams for cooling water system,
- (7) block diagrams showing the basic control and protection systems specifying the protection, control, trip and alarm functions at the different locations, the reference signals and commands and the auxiliary supplies,
- (8) protection coordination diagram showing all protection curves of the relays,
- (9) wiring diagrams,
- (10) termination drawings,
- (11) cable lists,
- (12) list of used devices with manufacturer,
- (13) spare parts list,
- (14) start-up and commissioning instructions and data,



- (15) software and software description (especially for fault diagnosis and repair instructions),
- (16) operation and maintenance manuals,
- (17) fault diagnostic instructions and data,
- (18) manufacturer's proposed service and repair support after warranty,
- (19) Reports of tests and commissioning with protocols.

For document requirements for converter transformer and motor please refer to the respective specifications.

The documents listed above (except test reports) shall be handed over for review and approval of Owner/ Engineer.

Special attention has to be given to the fact, that documentation must be submitted with sufficient time allocated for approval prior to manufacturing/ assembly.

Documentation has to be prepared in accordance with the relevant ISO standards or in the absence of relevant details in those standards the DIN standards shall apply. The final documentation shall be delivered on paper in sufficient number and with exception of the signed protocols in electronic form, also. The type of the electronic files shall be agreed with the Owner.

5.3.4.7 Packing and Shipment

All equipment, material and spare parts shall be sufficient packaged and should be shipped as a common delivery. The material, especially loose parts and spare parts shall be clearly marked with client name and address, order number, type of equipment, etc. Erection instructions and any special tools or instruments required for the erection and maintenance shall be packed with each order.

The converter transformers and frequency converters shall be packed in wooden type seaworthy crates having sufficient strength to withstand normal ship handling and transport. The motors shall be vacuum packed suitable for sea transport.

Enclosed with the board, the following documents shall be included in suitable wrapping:

- (1) electrical schematic diagram,
- (2) electrical wiring diagram,
- (3) general arrangement drawing,
- (4) foundation plan including foundation loadings,
- (5) operation and maintenance manual,
- (6) list of the shipped material and equipment,
- (7) Installation instruction.

5.3.4.8 Spare Parts and Accessories

The Contractor shall deliver all spare parts and consumables, which are necessary for testing, precommissioning and commissioning.



Any of the spares if used during testing and commissioning must be replaced at no extra cost to the client.

In addition to the above the contractor shall provide spare parts required for two years operation time; depending on the total number of installed units.

The spares should be submitted as per KM /OCS/Manufacturers requirement.

A priced list of recommended spare parts for the subsequent 5 years operation shall be quoted by the Contractor.

Spare parts shall be available until ten (10) years after commissioning.

All necessary accessories for operation and maintenance shall be supplied for each station location where variable speed drives will be installed, at least consisting of:

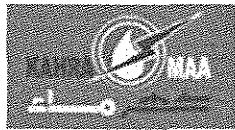
- (1) One (1) set of all special tools required for operation and maintenance,
- (2) One (1) set of diagnostic and programming tool with all auxiliaries (PC, Software, interface cords) should be provided along with VFD .
- (3) One (1) set high voltage fuse tongs (if any),
- (4) Key set for doors and locks,
- (5) One (1) set magnetic labels "HIGH VOLTAGE – ATTENTION DANGER FOR YOUR LIFE" in sufficient number, Arabic and English.

Engineering tools and test equipment (i.e. laptop, measuring instruments, etc.) used for commissioning/ testing/ maintenance shall be provided for the variable speed drives along with the relevant software and shall be included in the price of the units.

5.4 LOW VOLTAGE VARIABLE FREQUENCY DRIVE (VFD)

5.4.1 General

- a) VFDs Supplier/Manufacturer should have a local office with permanent trained engineers and skilled support staff in the country where the goods are delivered in order to prove his commitment for local support and to provide a means of communication. The local representative shall be easily accessible and shall be reachable at site within 24 hours.
- b) All internal components should be marked with identification number and it should be reflected in respective drawings
- c) All individual VFD cubicle should be equipped with internal lighting
- d) All terminal should have proper identification mark and it should be reflected in respective drawings
- e) All wires should have ferrule number and it should be reflected in respective drawings
- f) All installed VFD should have proper designation in front and rear of each cubicle along with number on rear and front panel respective of their pump assignment.
- g) The VFD system shall meet local and international standards for Noise level & susceptibility; noise shall be limited to 85dBA when measured at one meter from the edge of the VFD panel.



- h) The component layout/arrangement of installed components in each VFD cubicle shall be pasted with parts identification and labeling.
 - i) Pouch shall be provided inside the VFD for keeping the drawings.

5.4.1.1 Abbreviations

- BS British Standard
- CPS Corridor Pumping Station
- dB Decibel
- EN European Norm
- ISO International Organization for Standardization
- IP Internal Protection

5.4.1.2 Operating Conditions

5.4.1.2.1 Environmental Conditions.

The Low Voltage VFD designed and be suitable for operation in the climatic conditions of state of Qatar (tropical weather, with excess heat dust and humidity at time)

Followings are the climatic conditions to be considered at site:

- Maximum ambient temperature: 50° C
- Minimum ambient temperature: 5° C
- Design ambient temperature: 50° C
- Maximum ambient relative humidity: 100%
- Minimum ambient humidity: 20%
- Design ambient humidity 100%
- Installed at altitude not more than 1,000 meters above sea-level

A considerable amount of salt is entrapped in atmosphere, which together with the relative high ambient humidity, can produce sever corrosion problems

5.4.1.2.2 EMC Compatibility

VFD shall be able to operate satisfactorily in electromagnetic environment, thus it shall be immune to electromagnetic emissions. The drive shall comply with EMC requirements such as EC directive 89/336/EEC.

VFD shall be able to be equipped with an inbuilt EMC filters to reduce high frequency emissions produced by the VFD shall be provided as an option. EMC filter for 1st environment and 2nd environment defined in EN 61800-3 standard, shall be available.

The inbuilt EMC filters eliminate the need for any extra space.

5.4.2 Codes and Standards

The VFD shall meet the requirements of this specification and latest edition of all applicable standards.



5.4.2.1 Standards

VFD shall comply with following standards

IEC 60034 Rotating electrical machines

IEC 60085 Electrical insulation – Thermal evaluation and designation

IEC 60146 Semiconductor converters

IEC 60529 Degrees of protection provided by enclosures (IP-Code)

IEC 61000 Electromagnetic compatibility

IEC 61800 Adjustable speed electrical power drive systems

IEEE 519 Recommended practices and requirements for harmonic control in electrical power systems

EN 50178 (1997) Electronic equipment for use in power installations

EN 60204-1 (1997) Safety of machinery. Electrical equipment of machines

IEC 60664-1 (1992) Insulation coordination for equipment within low-voltage systems.

5.4.3 Design consideration

5.4.3.1 General

Variable frequency drives (VFD) shall be of the AC 415 volts, 50 hertz, IGBT based active front end drive with in built harmonic filter to mitigate harmonics (under 5% at the VFDs input terminals) and the drive units Shall comply to G5/4 or IEEE519-1992 with separate incoming and outgoing power supply cable Compartments.

VFD shall be inverter type based on the pulse width modulation principle of operation, capable of controlling the speed, torque and current of standard AC induction motors.

The VFD and associated control equipment shall be housed in a IP54 cubicle.

VFD shall meet the harmonics reduction demand with in built solutions, therefore eliminating the need for multi-pulse transformer or external filters.

The fundamental power factor of the VFD shall be 0.99 or better at all operating loads.

The complete VFD system/cabinet shall be factory assembled and system tested by the VFD manufacturer to ensure a fully co-ordinated system.

All components of the drive shall be designed and sized for the continuous operation of the driven equipment specified at load up to 15 % above the rated motor full load

VFDs most common spare parts covering fuses, IGBTs plus main control and 10 boards shall be supplied as spare for maintenance purpose.



Motor shall be of same make of variable speed drive and at least one motor shall be tested at variable speed drive factory to verify compatibility and noise level & temperature rise.

The selection of motor and co-ordination shall be responsibility of the VFD vendor. The Contractor shall be responsible for matching the motor and the drive, and for coordinating the collection of data and the design effort required to limit harmonics, noise & temperature to levels. The Contractor shall submit the necessary documentation that these requirements have been satisfied and the VFD has been approved by the driven equipment supplier.

The VFD compartments shall be with continuous power supply for cubicle condensation heaters even the VFD main disconnect switch is switched-off. Independent power supply shall fed by MSB/MCC branch feeder.

5.4.3.2 VFD Accuracy

To ensure high process quality the VFD shall have minimum speed control accuracy without a pulse encoder feedback $\pm 10\%$ of the nominal slip of the motor. When motor speed feedback is provided from a suitable encoder, closed loop speed regulation shall be 0.01 % of the motor nominal speed or better.

VFD shall be capable of open loop dynamic speed accuracy of at least 0.3 % seconds and closed loop dynamic accuracy shall be at least 0.1 % sec.

5.4.3.3 Starting torque and torque step rise

The starting torque of the motor unit without a pulse encoder feedback in constant torque applications shall be at least 150 % of the rated motor unit torque. The starting torque of the motor unit without a pulse encoder feedback in variable torque applications shall be at least 100 % of the rated motor unit torque.

In case of need of fast torque rise time, the torque step rise time from 10 % to 90 % of the full nominal torque should be less than 5 ms, when the motor is fully magnetized. If the motor mechanical time constants are longer than that, the torque step rise time shall be according to the mechanical time constant.

5.4.3.4 Energy optimization

VFD shall have an energy optimization feature, which provides the optimum magnetic flux for any given speed/torque operating point. The feature improves energy efficiency especially in partial loads and reduces motor noise.

5.4.3.5 Coated boards

VFD's printed circuit boards shall be coated to increase reliability and lifetime of the VFD by protecting the boards from moisture and dust particles.

5.4.3.6 Common mode filters

If required VFD shall have common mode filters to protect motor bearings against common mode current.

5.4.3.7 Redundant module

- To ensure the process availability, high power VFD shall have an in-built



redundancy through parallel connected modules. Each module shall be a complete three phase inverter, if one module become defective, the VFD should be able to be configured to run with reduced power.

5.4.4 Design Criteria

- a) Input Supply: 415V (+5%, -5%), TPN, 50KA for 1-sec
- b) Input frequency: 50 Hz ± 3%
- c) Fundamental PowerFactor: 0.99 or better at all Operating Loads
- d) Efficiency (at nominal power): 96 % or better
- e) Ambient temperature: 50 deg C
- f) Output Voltage: 0- input Voltage 3 Phase
- g) Output Frequency: 0- 300 Hz adjustable.
- h) Resolution: 0.01 Hz.
- i) Inputs and Outputs: Digital & Analogue as required
- j) Short time Overload Capacity: 150% for 1 min. every 10 min. (constant torque)
110% for 1 min. every 10 min. (squared torque) and meet the requirement of the driven equipment
- k) Total Harmonic Distortion: As per IEEE-519

5.4.5 Control and Indications

The following drive control functions at least shall be available from the keypad:

- a) Run
- b) Stop
- c) Local/remote selection
- d) Forward/reverse
- e) Accelerate (manual/mode) f) Decelerate (manual/mode)
- f) Parameter setting
- g) Scrolling & viewing through actual values
- h) Reset
- i) VFD Ready indication in fascia

The control panel shall have at least 3-line display. The parameters shall be displayed in numerical format. Following signals shall be possible to observe.

- a) Input Voltage
- b) Input Frequency
- c) Output Voltage
- d) Output Frequency
- e) DC Bus Voltage
- f) Output Power
- g) Output Torque
- h) Output Current
- i) Motor Speed
- j) KW
- k) KWH



The following parameters shall always be displayed during normal operation.

- Speed Reference
- Run | Stop | Fault
- Remote | Local

5.4.6 Protection

The speed Controller system shall be equipped with but not limited to the following protections and adjustment:-

1. Over current protection.
2. Quick acting fused protection.
3. Over temperature protection reacting to the failure of thyristor cooling fan.
4. Over speed protection.
5. Earth fault protection.
6. Starting current limit adjustment.
7. Visual means to show any thyristor which has become defective similarly any Component or a printed circuit board.
8. Motor stalled protection

5.4.7 Software Features

5.4.7.1 Standard features

- ID function & Start up Assistant

To save commissioning time and costs, the VFD shall have a start-up motor identification function, which optimizes the motor control with motor rating plate information. VFD shall also have start up assistant which will guide the user through the start-up procedure, helping the user to feed the requested data to the drive.

- Application macros

To save the commissioning time a selection of pre-programmed application macro parameter sets. Macros will optimize parameters for different functions.

- Start and stop control functions

VFD shall have selection for stop functions; coast stop or ramp stop.

VFD's acceleration/deceleration control functions shall include two sets of ramp time

Selections; linear and s-curve ramp.

- Sleep function

VFD software shall have programmable "Sleep" and "Wake up" functions, which allows the drive to be started and stopped from the level of a process feedback signal. These functions help saving energy and thereby reduce costs of the plant.

- Critical speed function

VFD shall have programmable critical frequency lock-out ranges that prevent e.g. mechanical resonance problems at certain speeds.



5.4.8 Optical PC tool Features

- Windows based software

Supplier shall have MS Windows based PC software available for monitoring and controlling the VFDs. The software shall be supplied with the necessary hardware and a provision for connecting a PC with the VFD. Fibre optic cable shall be used for communication between PC and the drive to ensure high speed communication. It shall be possible to set and modify and save parameters, control the drive, read actual values and make trend analysis using the software.

Supplier shall have a programming tool for creating, editing and documenting adaptive programs.

Supplier shall have an OPC based software package which allows communication between windows applications and drive.

Supplier shall have a MS Windows based PC software available helping users to select their optimal motor, frequency converter and transformer. In addition, the software shall enable to compute currents, network harmonics and to create documents about the dimensioning, based on actual load.

5.4.9 Control Connections

- Standard features

Inputs and Outputs

Inputs shall have galvanic isolation from ground.

The control interface shall have at least seven digital inputs, three relay outputs, and three analog inputs and two outputs. All inputs and outputs shall be independently programmable. The following specification on Inputs and Outputs shall be provided:

- Optional features

I/O extension modules

Standard I/O shall be able to be extended with analogue, digital and pulse encoder interface modules. The standard VFD shall have slots on the control board for extension modules.

- Serial Communication

VFD shall comply with following field bus protocols:

- Profibus-DP
 - Modbus
 - Ethernet (Profinet 10, MBitTCP)
 - DeviceNet
 - LONWorks
 - CANOpen
- Remote Monitoring

The supplier/contractor shall provide remote access to controlling and monitoring via digital/ analogue I/O. As well as Ethernet that enables controlling and monitoring the VFD through internet standard web browser.

The controlling features shall include also configuration of the drive, remote start & stop.



Monitoring features shall include standard parameters, diagnostics, alarming of fault and process related information such as load level, run time, energy consumption and the bearing temperature of the driven machine.

The system shall operate without a PC at the pump station. It shall be possible to connect several drives to the remote monitoring system.

5.4.10 Tropical Protection

All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion.

5.4.11 Painting

All metal surfaces shall be thoroughly cleaned and degreased, pickled and phosphatized. Thereafter, a coat of phosphate paint and a coat of zinc chromate primer shall be applied. After removing all imperfections, all metal surfaces shall be sprayed with two coats of final paint as per color shade RAL 7032. Final coat shall be of epoxy based. All unpainted parts shall be plated to prevent corrosion.

5.4.12 Installation and commissioning:

5.4.13 Tests

5.4.13.1 Workshop Test

5.4.13.1.1 General

All components of the variable speed drives shall be tested completely and detailed in manufacturers workshop. All tests required by the codes and standards as well as all manufactures tests have to be performed.

The test notification and the test program for the workshop tests has to be submitted to Owner/ Engineer at least three (3) weeks prior to start of the tests to enable them to attend the test.

Detailed test protocols of all tests performed have to be submitted prior to shipment.

The workshop tests shall include the following:

- (1) routine tests,
- (2) performance tests.

All tests to be witnessed by Owner/ Engineer

5.4.13.2 Routine Tests

The following tests shall be carried out, at least:

- a. Converter transformer

For tests please refer to "Specification for Transformers".

- b. Converter with filter

- (1) visual inspection,
- (2) test of all functions,



- (3) check of protection against touching,
- (4) check of mechanical details,
- (5) compliance with the specifications,
- (6) short circuit withstand test, *
- (7) test of warming, *
- (8) check of degree of protection,
- (9) power frequency voltage dry test, 1 minute,
- (10) voltage test on auxiliary circuits, 1 minute 2 kV r.m.s.

*only type test certificates necessary

c. Motor

For tests please refer to "Specification for Medium Voltage Motors".

In addition the following tests shall be performed over the whole speed range:

- (1) motor shaft voltage,
- (2) motor noise test,
- (3) vibration severity measured at bearing housing.

5.4.13.3 Performance Test

Performance test shall be carried out in manufacturer's workshop. For motors up to 4000 kW the test shall be performed under full load conditions. Depending on the size of working machine in manufacturer's test bed the test for larger motors shall either be carried out under full load conditions or performed with maximum available load (at least 4000 kW) and interpolation on the values for full load.

During the load test the manufacturer shall demonstrate, that the produced units fulfil the specified requirements and the data, guaranteed by Contractor.

The performance test shall include but not limited to the following tests:

a) Heat run

The variable speed drive shall run under the load and speed conditions until the temperature of motor has reached and stabilised, and continue for a minimum of 2 hours.

b) Measurements

- (1) current unbalance,
- (2) motor winding temperature rise (by resistance methods and by thermistors),
- (3) bearing temperatures (at maximum speed),
- (4) shaft vibration (in case of proximity probes).

c) Loads tests

- (1) overall efficiency determination at full and half load curve both at minimum operational speed and at maximum operational speed of the total unit and converter and motor individually,
- (2) ditto for power factor,



- (3) ditto for harmonic distortion in the current on the line side,
 - (4) ditto for harmonic distortion in the current on the motor side,
 - (5) noise level of transformer, converter and motor,
 - (6) output voltage characteristics,
 - (7) output current characteristics,
 - (8) 110% nominal current test for at least 10 minutes,
 - (9) linearity between set point signal and output.
- d) Functional tests at 100 % supply voltage
- (1) locked rotor,
 - (2) speed protection:
 - at 102% of the maximum operational speed (for power at torque controlled variable speed drives),
 - at 105% of the maximum operational speed,
 - at 95% of the minimum operational speed.
 - (3) response times and the adjustability (ramp times) within the operational speed range,
 - (4) capability to ride through voltage dips less than 20 %,
 - (5) capability to restart variable speed drive and resynchronise converter onto a
 - (6) running motor after a voltage interruption,
 - (7) (6) 4-20 mA speed reference signal,
 - (8) remote control, start, stop,
 - (9) output frequency/ voltage reduction initiated by motor current limitation,
 - (10) 5% "set point - measured point" deviation alarm,
 - (11) component/ auxiliary component failure,
 - (12) protection, alarm and trip functions.
- e) Fault condition tests
- (1) two phase short circuit at motor terminals at no-load,
 - (2) earth fault at the motor,
 - (3) one phase interruption of the motor cable at full-load condition,
 - (4) one phase interruption of the supply cable at full-load condition,
 - (5) three phase interruption of the motor cable at full-load condition,
 - (6) earth fault in the control supply system,
 - (7) interruption in the 4-20 mA control signal,
 - (8) short circuit in the 4-20 mA control signal.



Note: For any of the tests mentioned above, the protection devices of the variable speed drive may be activated. After resetting/ replacing these devices, the variable speed drive shall be fit for operation again.

5.4.13.4 Site Tests

Site test and commissioning should be carried out by manufacturer trained technical personal

The site tests shall include the following steps:

- (1) pre-installation testing,
- (2) pre-commissioning (including "loop testing"),
- (3) commissioning and test on completion,
- (4) test runs,
- (5) performance test.

The aim of the tests is to ensure the proper function of the complete scope

5.4.14 Documentation

Complete documentation shall be provided for the design, manufacturing, testing, commissioning, start-up, operation, maintenance and repair of the variable speed drives and their components.

All documents shall be in English language.

The documentation of the variable speed drives shall include the following documents and drawings (minimum requirements):

- (1) technical data sheets,
- (2) torque/ speed/ current/ power factor curves,
- (3) outline and arrangement drawings for all converters and devices, including masses and floor cut out drawings,
- (4) layout drawing showing the location of equipment, distance and cable routing,
- (5) single line diagrams showing the main and auxiliary circuitry, including main circuit breaker, unit transformer, DC link, system earthing and auxiliary supplies,
- (6) P & I diagrams for cooling water system,
- (7) block diagrams showing the basic control and protection systems specifying the protection, control, trip and alarm functions at the different locations, the reference signals and commands and the auxiliary supplies,
- (8) protection coordination diagram showing all protection curves of the relays,
- (9) wiring diagrams,
- (10) termination drawings,
- (11) cable lists,
- (12) list of used devices with manufacturer,
- (13) spare parts list,
- (14) start-up and commissioning instructions and data,



- (15) software and software description (especially for fault diagnosis and repair instructions),
- (16) operation and maintenance manuals,
- (17) fault diagnostic instructions and data,
- (18) manufacturer's proposed service and repair support after warranty,
- (19) Reports of tests and commissioning with protocols.

For document requirements for converter transformer and motor please refer to the respective specifications.

The documents listed above (except test reports) shall be handed over for review and approval of Owner/ Engineer.

Special attention has to be given to the fact, that documentation must be submitted with sufficient time allocated for approval prior to manufacturing/ assembly.

Documentation has to be prepared in accordance with the relevant ISO standards or in the absence of relevant details in those standards the DIN standards shall apply. The final documentation shall be delivered on paper in sufficient number and with exception of the signed protocols in electronic form, also. The type of the electronic files shall be agreed with the Owner.

5.4.15 Packing and Shipment

All equipment, material and spare parts shall be sufficient packaged and should be shipped as a common delivery. The material, especially loose parts and spare parts shall be clearly marked with client name and address, order number, type of equipment, etc. Erection instructions and any special tools or instruments required for the erection and maintenance shall be packed with each order.

The converter transformers and frequency converters shall be packed in wooden type seaworthy crates having sufficient strength to withstand normal ship handling and transport. The motors shall be vacuum packed suitable for sea transport.

Enclosed with the board, the following documents shall be included in suitable wrapping:

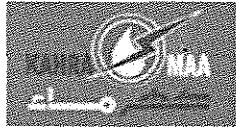
- (1) electrical schematic diagram,
- (2) electrical wiring diagram,
- (3) general arrangement drawing,
- (4) foundation plan including foundation loadings,
- (5) operation and maintenance manual,
- (6) list of the shipped material and equipment,
- (7) Installation instruction.

5.4.16 Spare Parts and Accessories

The Contractor shall deliver all spare parts and consumables, which are necessary for testing, precommissioning and commissioning.

Any of the spares if used during testing and commissioning must be replaced at no extra cost to the client.

In addition to the above the contractor shall provide spare parts required for two years operation time; depending on the total number of installed units.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

The spares should be submitted as per KM /OCS/Manufacturers requirement.

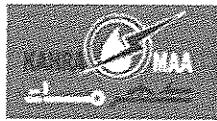
A priced list of recommended spare parts for the subsequent 5 years operation shall be quoted by the Contractor.

Spare parts shall be available until ten (10) years after commissioning.

All necessary accessories for operation and maintenance shall be supplied for each station location where variable speed drives will be installed, at least consisting of:

- (1) One (1) set of all special tools required for operation and maintenance,
- (2) One (1) set of diagnostic and programming tool with all auxiliaries (PC, Software, interface cords) should be provided along with VFD .
- (3) One (1) set high voltage fuse tongs (if any),
- (4) Key set for doors and locks,
- (5) One (1) set magnetic labels "HIGH VOLTAGE – ATTENTION DANGER FOR YOUR LIFE" in sufficient number, Arabic and English.

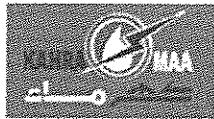
Engineering tools and test equipment (i.e. laptop, measuring instruments, etc.) used for commissioning/ testing/ maintenance shall be provided for the variable speed drives along with the relevant software and shall be included in the price of the units.



Qatar General Electricity & Water Corporation
Tender No. GTC 626/2014
Construction of Mega Reservoirs PRPSs
(Package A, B, C, D & E)

APPENDIX A SECTION 6

INSTRUMENTATION SPECIFICATION



6	INSTRUMENTATION WORKS	3
6.1	GENERAL REQUIREMENT	3
6.2	CONTROL AND INSTRUMENT CABLE SPECIFICATION FOR MAIN PROCESSES	3
6.2.1	General	3
6.2.2	Applicable Standards and Codes	3
6.2.3	Site Conditions	4
6.2.4	Design Considerations and Technical Requirements	4
6.2.5	Fabrication Requirements	6
6.2.6	Inspection and Testing	8
6.2.7	Sealing and Drumming	9
6.2.8	Packing and Shipment	9
6.3	INSTRUMENTS SPECIFICATION FOR MAIN PROCESSES.....	9
6.3.1	General	9
6.3.2	Design Considerations	9
6.3.3	Technical Requirements for Flow Instruments	11
6.3.4	Technical Requirements – Pressure Instruments	15
6.3.5	Technical Requirements – Level Instruments	18
6.3.6	Temperature Instruments	22
6.3.7	Condition Monitoring System	24
6.3.8	Water Quality Analysers	25
6.3.9	Inspections and Testings	31
6.4	ELECTRICAL INSTRUMENTATION AND CONTROL	32
6.4.1	Earthing	32
6.4.2	Cabling Installation up to PLCs	32
6.5	INSTRUMENTATION IDENTIFICATION	32
6.5.1	Instrument Identification	32
6.6	LEAK DETECTION SYSTEM	33
6.6.1	General	33
6.6.2	Leak Detection system Requirements	34
6.6.3	Installation	35



6 INSTRUMENTATION WORKS

6.1 GENERAL REQUIREMENT

Unless otherwise stated in the Project Documentation, the Contractor shall comply with every requirement of the Qatar Construction Specification (QCS) that is relevant to the type of work forming any part of the Contract and shall adopt whichever permissible option or alternative is best suited to the needs of the work being undertaken.

6.2 CONTROL AND INSTRUMENT CABLE SPECIFICATION FOR MAIN PROCESSES

6.2.1 General

This covers the requirements of the Control and Instrument Cables as listed but not limited to the following main process components of the PRPS:

- Main Pumps (Corridor Pumps and Transmission Pumps);
- Recirculation and Drain/Scour Pumps;
- Surge Suppression System (Surge Vessels, Compressed Air Systems, etc.);
- Disinfection System;
- Tanker Filling Pumps; and
- Potable Water, Irrigation and Fire Fighting Pumps.

Power cables shall be in accordance with Clause 7.4.3 of Appendix A7.

6.2.2 Applicable Standards and Codes

A. Codes and Standards

The CONTRACTOR shall adhere to the Codes and Standards as applicable from Institutions and Organizations listed below.

The following list of standards indicate the requirements as minimum any other standard not listed below or elsewhere in this tender documents shall be subject to review and approval by KAHRAMA/ENGINEER.

Document No	Document Title
N/A	KAHRAMA Standards
British Standard BS 50288-7	Multi element metallic cables used in analogue and digital communication and control. Sectional specification for instrumentation and control cables.
British Standard BS 6360	Specification for Conductors in Insulated Cables and Cords
British Standard BS 50290-2-23	Communication cables common design rules and construction. Polyethylene insulation for multi-pair cables used in access telecommunication networks: Outdoor cables



B. Electric Cables

The CONTRACTOR shall also note that it is not the intent of this specification to deviate from good engineering practices. The absence of specifications shall imply that the best engineering practices shall prevail, utilising first quality materials and workmanship.

The CONTRACTOR shall seek clarification from KAHRAMA/ENGINEER of any confusing or conflicting information contained in this specification and the accompanying documents.

Any deviation from this specification shall be indicated by the CONTRACTOR/VENDOR along with his bid. Otherwise KAHRAMA/ENGINEER shall assume full compliance with this specification while accepting the bid.

C. Units

The instrumentation cables specifications and signals shall be according to the international system of units (SI).

6.2.3 Site Conditions

It is the CONTRACTOR's responsibility to design, furnish and install the instrumentation cables and wires to withstand and operate properly under the prevailing ambient conditions as described in the project General Technical Requirements of this Contract. This Specification serves as a guideline to the CONTRACTOR. The CONTRACTOR shall recommend and include all the necessary equipment or protecting devices based on his previous experience on similar installations.

6.2.4 Design Considerations and Technical Requirements

A. Signal Categories

Analogue Signal cables shall be used for carrying low voltage, low power instrumentation signals between various field, plant and control room locations. In general the signals will fall into one of the following categories:

- Profibus DP;
- HART / Analogue, 4-20 mA; and
- Resistance Thermometer Device (motor windings) .

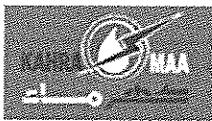
Digital Signal cables shall be used for carrying low voltage, low power digital signals between various field, plant and control room locations. In general the signals will fall into one of the following categories:

- Digital 24V DC ; and
- Pulsed D.C.

All cables shall be suitable for operation under the following conditions :

- Directly buried in ground;
- Run in buried P.V.C., concrete or all steel ducts; and
- Runs fastened to cable rack or tray in open air.

The cables shall be capable of continuous operation at highest system voltage as specified with maximum conductor operating temperature of 90°C and maximum temperature under fault conditions of not more than 250°C.



B. General

This Cable Specification is based on BS50288- 7.

The insulation of these cables shall be suitable for operation at voltages up to and including 300 V R.M.S. core to earth and 500 V R.M.S. core to core and at a maximum temperature of 65°C

C. Conductors

Conductors shall be stranded annealed copper wire in accordance with BS6360 class 2.

D. Insulation

The insulation of these cables shall be Polyethylene as specified in BS 50290-2-23

E. Pairs (Analogue Signal Cables)

Two insulated conductors shall be uniformly twisted together to form a pair. The length of lay shall be such that the two wires forming each pair are not dissociated by normal handling. The maximum pair lay length shall be limited to 100mm (minimum 10 twists per meter).

F. Core Identification

Cores shall be identified as by numbering, e.g.: -1/+1, -2/+2 and so on specified in the Standard BS 5308 Part 2. The cable shall be constructed such that the pairs are in concentric layers.

G. Collective Screen and Drain Wire

Laminated Screening Tape shall comprise aluminium bonded to polyester, the tape having a minimum thickness of aluminium of 0.008mm and a minimum thickness of polyester of 0.010mm. The tape shall be applied with a minimum overlap of 25% and with the metallic side down in contact with a tinned Copper drain wire (cross section not less than 0.5mm²) run longitudinally over the Binder Tape.

H. PVC Bedding

An extruded sheath of PVC Compound in accordance with BS 50290-2-22 shall be applied over the collective screen. Sheath colour shall be Black.

I. Armour

A single layer of round galvanised steel wire armour with properties in compliance EN 50288-1 and EN 10218-1 shall be applied spirally over the outer PVC bedding. A plastic counter spiral may be applied over the armour.

J. Outer Sheath

PVC Outer Sheath, to EN 50290-2-22 shall be provided. In addition outer sheath shall display the following characteristics:

Min. oxygen index=30%

Max. HCL emission @ 8000C=15%---

Cable outer sheath shall be gray.

K. Other Properties

Halogen free flame retardant in accordance with EN 50290-2-27.



- L. Cable Identification:
PE/MS/PVC/LS/PVC/SWA/PVC
Size: 1.0mm² for Analogue
1.5mm² for Digital

- M. End Sealing
After completion of the Factory Tests, the ends of the cable shall be sealed to prevent ingress of moisture.

N. Marking of Supplies

The external surface of the over sheath shall be embossed and/or printed with:

- Manufacturer's Name;
- Year of Manufacture;
- Size and Type of cable; and
- Length marking.

This identification is to be repeated at intervals of not more than 1 meter.

The minimum character size shall be 3mm. The accuracy of the length marking shall be within the limits of + 1%. The colour of the initial printed marking shall be white. In case of a defective initial marking, the cable shall be remarked in yellow.

6.2.5 Fabrication Requirements

Analogue Signal Cable:

- Single copper conductor 1/0.8m;
- Polyethylene insulation;
- Individual screen of aluminium backed polyester tape with tinned copper stranded drain wire;
- Collective screen of aluminium backed polyester tape with tinned copper stranded drain wire;
- Extruded PVC bedding;
- Galvanised steel wire armour;
- PVC outer sheath, gray; and
- Core identification numbered, -1/+1, -2/+2 and so on.

Digital Signal Cable:

- Single copper conductor 1/0.8mm;
- Polyethylene insulation;
- Collective screen of aluminium backed polyester tape with tinned copper stranded drain wire;
- Extruded PVC bedding;
- Galvanised steel wire armour;
- PVC outer sheath, gray; and



- Core identification numbered, -1/+1, -2/+2 and so on.

Cable Type	RTD Cable - 1
Application	RTD Extension Cables
Size	1 Triad or 1 Quad (Between Motor/Pump to Junction Box)
Voltage Grade	300 VRMS Core to Earth, 500 VRMS Core to Core
Type	PE-MS-PVC-SWA-PVC
Conductor construction (min.)0.5 mm², annealed Copper Per BS 1904	
Conductor insulation	PE
Inner sheath	PVC
Conductor Identification	1 Triad: Black, White, Red 1 Quad: Black, White, Red
Core Construction	1 Triad: Twisted to 10 twists per metre 1 Quad: Layed up in quad formation
Core screening	Yes, as specified herein
Communications wire	N/A
Overall screen	N/A
Ripcord	N/A
Armor	Galvanised Steel Wire Armor
Outer sheath	Flame retardant PVC
Color, outer sheath	Yellow
UV radiation protection	Yes
Cable Dimensions	Diameters under sheath: VENDOR to state Diameter over sheath: VENDOR to state

Cable Type	RTD Cable - 2
Application	RTD Extension Cables
Size	Multiple Cores (JB to DCS)



Voltage Grade	300 VRMS Core to Earth, 500 VRMS Core to Core
Type	PE-MS-PVC-SWA-PVC
Conductor construction (min.)	0.5 mm ² , annealed Copper Per BS 1904
Conductor insulation	PE
Inner sheath	PVC
Conductor Identification	1 Triad: Black, White, Red 1 Quad: Black, White, Red
Core Construction	1 Triad: Twisted to 10 twists per metre 1 Quad: Layed up in quad formation
Core screening	N/A
Communications wire	Required
Overall screen	Required
Ripcord	Required
Armor	Galvanised Steel Wire Armor
Outer sheath	Flame retardant PVC
Color, outer sheath	Yellow
UV radiation protection	Yes
Cable Dimensions	Diameters under sheath: VENDOR to state Diameter over sheath: VENDOR to state

6.2.6 Inspection and Testing

Performance and acceptance tests for electrical power and control cables shall be carried out at manufacturer's works which shall be witnessed by KAHRAMA/ENGINEER or alternatively subject to KAHRAMA/ENGINEER'S prior approval, factory test certificates shall be accepted.

The required tests, test conditions and acceptance criteria for the cables shall be in accordance with the latest edition of the standards as per Clause 6.2.2.

The required tests on the cables shall include but not limited to the following:

- High Voltage Test
- Conductor Resistance Test
- Armour Resistance Test
- Thickness of Insulation



- Test for Flame Retardance
- Insulation Resistance Test

Test certificates must be approved by KAHRAMA/ENGINEER before cables are despatched from place of manufacture.

6.2.7 Sealing and Drumming

Both ends of every length of cable shall be sealed properly immediately after tests at manufacturer's premises.

The cables shall be rolled on suitable wooden or steel drums. The drum shall be marked to indicate the size of conductor, number of cores, direction of rolling, type of cable, voltage and cable length. For all cut lengths of cables which are to be delivered to KAHRAMA/ENGINEER, approved sealing caps of correct size shall be supplied and properly mounted immediately after the respective cable length is cut.

6.2.8 Packing and Shipment

The cable wooden or steel drums shall be packed in wooden type seaworthy crates having sufficient strength to withstand normal ship handling and transport.

The crates shall be marked with KAHRAMA's name and address, order number, type of equipment, etc.

Project number and project name to be printed on the packing and shipment list. Factory test certificates shall be included in the packing list as well.

6.3 INSTRUMENTS SPECIFICATION FOR MAIN PROCESSES

6.3.1 General

This covers the requirements of the Instruments as listed but not limited to the following main process components of the PRPS:

Main Pumps (Corridor Pumps and Transmission Pumps)

Recirculation and Drain/Scour Pumps

Surge Suppression System (Surge Vessels, Compressed Air Systems, etc.)

Disinfection System

Tanker Filling Pumps

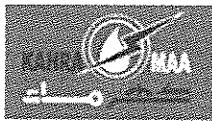
Potable Water, Irrigation and Fire Fighting Pumps

6.3.2 Design Considerations

A. General

The CONTRACTOR shall, where possible, use one instrument manufacturer of International standing for the supply of all similar instrumentation (e.g. all analysers from one vendor, all pressure gauges from one vendor, all level transmitters from one vendor, etc.) included in the Contract and shall obtain the maximum uniformity of equipment.

The equipment shall be constructed to operate accurately and safely under the operating conditions described in Clause 1.1 of Appendix A1 of the



Qatar General Electricity & Water Corporation
Tender No. GTC 626/2014
Construction of Mega Reservoirs PRPSs
(Package A, B, C, D & E)

project specifications, without undue strain, wear, heating, vibration, corrosion or other operating troubles.

All parts shall be made accessible and capable of convenient removal. Parts subject to wear shall have adequate means of adjustment and replacement.

Parts subject to substantial temperature changes shall be designed and supported to permit free expansion and contraction without causing fluid leakage, harmful distortion or misalignment.

The CONTRACTOR shall design all the transmitters, receiving instruments and electrical control devices to have one (1) standard signal range. Analogue signals shall be one of four types:

- Thermocouples–ISA Type E (chromel – constantan).
- RTD's-100 ohm Platinum.
- Electric Control Signals, 4 - 20 mA with HART or Profibus as required by the SCADA Communication System
- Special volts, 1 – 10 VDC (only inside control panels).

Conservative electronic design is required. All components shall be suitable for use at less than 60% rating unless specified approval for otherwise is obtained, or if the device will not function at the low values of energy, as in the case with lights.

Where more than one device utilizes the same measurement or control signal, the transmitter or other signal source shall be fully equipped to provide all signal requirements. The system shall be arranged so that failure of any recorder, indicator, control component, etc. shall not open the signal loop nor cause loss or malfunction of signal to other devices using the same signal. The design shall permit removal from service of any indicating or recording device without upsetting the control systems or requiring readjustment.

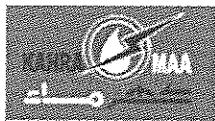
All instrument parts (such as Bourdon tubes, pressure capsules, bellows, etc.) shall be compatible with potable water containing Chlorine Dioxide and Chlorine disinfectants as per KAHRAMA's standards.

Dissimilar metals, where galvanic action may occur, shall be electrically insulated.

All pipe threads shall be protected by Teflon tape. (First 3 threads shall be left bare).

Locally mounted instruments shall be provided to indicate pressure, temperature, liquid levels, etc., where necessary for maintenance, local monitoring and control valve bypass operation.

Laser engraved I.D. tags made of Stainless Steel and clearly showing the instrument identification/tag number as shown in the P&ID drawings, make, model, order codes, accuracy, pressure ratings, instrument range, operating range, etc. shall be permanently affixed to all instruments. The Contractor shall submit for approval full details required for each instrument tag in the form of drawings which show the tag plate dimensions, material, label fonts height, type, etc. I.D. tags shall be affixed to instruments by stainless steel ties or chains. Where use of stainless steel is unsuitable as in the case of Chlorine Store, Chlorinator Room, etc. the I.D. tags shall be



embossed or engraved type non-metallic material and affixed by UV stabilized nylon ties.

B. Selection of Equipment

During engineering, the instruments, materials and systems, shall be properly selected to provide suitable, reliable and fail safe instrumentation, requiring only a minimum of maintenance; moreover, the variety in type shall be held to a minimum. Use shall be made of exclusively new and modern materials suitable for the intended purpose. The selection of equipment shall be subject to approval of KAHRAMA/ENGINEER.

Samples (where requested) and documents of selected equipment shall be submitted to KAHRAMA/ENGINEER.

All instruments shall be suitable for continuous operation at the ambient temperatures and humidity.

Every precaution shall be taken in the installation of the instruments to protect them and their electronic components against the extremely harsh weather condition prevailing in QATAR. All instruments selected shall be suitable for tropical conditions and resistant to corrosion.

Transmitters shall be suitable for field installation, and when mounted outside - shall be housed in GRP boxes (double enclosure type) sunshades to protect them against direct sun radiation.

The process and instrument connections of pressure gauge, transmitters and switches should be to NPT standards as specified in the project data sheets.

Panel mounted instruments shall be suitable for flush mounting.

Generally indicators shall have dials with white facing and bear black figures and graduations.

The selection of materials for the wetted parts of instruments, including equipment such as orifice plates, switch floats, etc. shall be compatible with the operating conditions.

The material and rating of the instrument piping shall, in general, conform to the relevant piping specification. The choice of other materials shall be considered in special cases.

Mercury-containing instruments shall not be used.

Instruments shall have suitably threaded openings to accommodate the required cable gland. Cable glands shall be M20 X 1.5.

Glass cover shall be provided on membrane transmitter to avoid accidental touch to the membrane.

Instruments susceptible to ingress of water shall be of IP68 grade of protection. All transmitters shall be installed above pump hall ground level, and shall be IP67.

Transmitters shall be of the latest technology with setting/calibration key pad and local digital display.

6.3.3 Technical Requirements for Flow Instruments

- A. Electromagnetic Flow Meter
 - 1. General



Qatar General Electricity & Water Corporation
Tender No. GTC 626/2014
Construction of Mega Reservoirs PRPSs
(Package A, B, C, D & E)

Electromagnetic flow meters shall be of a robust construction; generally with the requirements of BS EN ISO 6817. Materials of construction shall have a high level of corrosion resistance, be durable and where normally exposed, be resistant to degradation by sunlight and high temperatures.

The flow meter shall comprise of a flow sensor and a transmitter unit. The transmitter shall be supplied as remotely mounted from the flow sensor, subject to KAHRAMA/ENGINEER approval unless otherwise specified on the Instrument Datasheet.

The flow meter shall be of the electromagnetic type utilizing pulsed DC excitation and shall be microprocessor based.

The flow meter dimensions shall be in metric units. The flow meter shall be calibrated at the factory to its actual flow range in m³/hr as specified in the data sheets. A factory calibration certificate shall be provided with the meter.

Accuracy shall be equal or better than $\pm 0.2\%$ of reading (actual flow rate) at flow velocity >1 m/s with repeatability within $\pm 0.1\%$ of flow rate.

The flow meter shall have on-site validation capability for sensor and transmitter. This shall either come through built-in feature within the meter's advanced electronics or by a dedicated field portable validator connected to the meter under test with or without cable.

The pipes on the upstream or downstream side of all flow meters shall be provided with 2" NPT(F) threaded boss connection facility for insertion of portable insertion type magnetic flow meter for verification of the inline unit.

2. Flow Sensor

Construction shall comply with the following:

- Sensor tube - stainless steel
- Sensor tube lining - inert plastic material approved for use in contact with potable water dosed with Chlorine and Chlorine Dioxide disinfectants.
- Flanges - carbon steel drilled to suit pipe flanges and coated with an approved corrosion protection
- Terminal Box: Aluminium
- Ambient Temperature Limits: 70 Deg C
- Process Temperature Limits: 70 Deg C
- Electrode Material: SS 316L

The flow sensor tube shall be manufactured from AISI 316 stainless steel with a non-conductive liner to withstand process temperatures up to 70 °C. The liner material shall be abrasive resistant and approved for KAHRAMA potable water use by WR-UK or equivalent internationally recognized authority.

The flow sensor lining has to be WRAS listed for water applications. The cable has to be armoured, fitted and potted to the sensor prior to shipping from the manufacturer's location. The electrical connection should be 20 mm armoured glands. The totalizer value has to be independently stored both in the sensor and the transmitter.



There shall be 2 nos. of measuring electrodes with built-in reference electrode. The reference electrode shall ensure potential equalization between the sensor and the fluid and proper grounding of the installation. Electrode material shall be SS 316L.

Flow meters shall have inbuilt facility to detect the empty pipe condition. The method shall be elaborated in material submittal for review & approval by KAHRAMA / Engineer.

The end connections of the flow tube shall be flanged to suit the pipe flanges and rated at PN10/PN16/PN25 to suit project piping specifications.

The input impedance shall be 1015 ohms or greater so that electrode fouling does not affect signal and electrode seal integrity. The sensor data shall be stored in a built-in EPROM module.

The manufacturer shall provide necessary type test certificates for the enclosure. It shall be possible to validate the instrument on site without removal of the sensor for ease of fault diagnosis and maintenance.

A minimum of twenty (20) metres of interconnecting cable between sensor and the remote transmitter unit shall be included in the scope of supply of the Bidder. The interconnecting special cable shall be supplied from the manufacturer of the flow meter and any additional length as per site requirements shall be included in the scope of supply.

The sensor's straight-run requirements shall satisfy minimum 5 X Diameter upstream and 2 X Diameter downstream.

3. Transmitter Unit

The meter installation shall include a microprocessor transmitter of a similar durable construction to that of the meter. The transmitter shall incorporate a display indicating a four digit flow rate.

All connections shall be watertight and be of a heavy duty design with high reliability.

The transmitters shall be protected to IP67.

Manufacture/vendor clearance shall be obtained for flow meter installation drawings with respect to its performance for the selected range.

The installation shall be powered at 240V AC unless indicated otherwise.

The transmitter has to be mounted away from the sensor and shall be housed in GRP boxes (double enclosure type) sunshades to protect them against direct sun radiation.

Transmitters have to be interchangeable with different sensors without the need of being reconfigured. No matching of the sensor and transmitter required.

Totalizers have to be backed up every second in transmitter NVRAM and every 5 seconds in the sensor as minimum.

The LCD display has to be with backlit graphical display.

The display should be capable of having an HMI for intuitive navigation.



Qatar General Electricity & Water Corporation
Tender No. GTC 626/2014
Construction of Mega Reservoirs PRPSs
(Package A, B, C, D & E)

The navigation, reconfigurations and settings should be carried out even without opening the transmitter housing. Infra-red service port should be available for the transmitter.

Diagnostic Messages has to be as per NAMUR NE107. The transmitter has to have an environmental protection of IP 67, NEMA 4X and should withstand 100% humidity.

The pulse/ frequency alarms have to be programmable.

Provision of service passwords for security should be an essential feature of the transmitter to prevent tampering of the transmitter configuration. Write access should be prevented by an internal switch.

The transmitter should have a simulation mode wherein simulation for Velocity, Q, Q%, Iout, Pulse, Logic2 / Pulse 2, Logic 3 and HART can be carried out.

The transmitter should have inbuilt option of continuous calibration self-verification without the use of external calibration verification hardware.

The verification should read all the diagnostics for preventive maintenance.

The verification should be supported by necessary verification software and shall be able to be printed as a certificate to prove that the meter is within the limits of all parameters as the finger print.

All inputs and outputs shall be galvanically isolated from the power supply, the measuring circuit and each other.

The following outputs shall be available and configurable by the user:

- i. Analogue, 4-20 mA signal proportional to flow rate or two independent field configurable 4-20 mA analogue signals output.
- ii. HART communication port as required by the SCADA Communication System.
- iii. Active / Passive (open collector) selectable to Pulse/Frequency output.
- iv. Status configurable for limit values, end value switching, empty pipe detection, flow direction over ranging or instrument fault.

The unit shall have a rangeability of 1000:1 to measure fluid velocities from 10mm/sec. to 10m/sec. with a specified accuracy.

The transmitter unit shall be suitable for operation in an ambient temperature range of 0 to 55 °C.

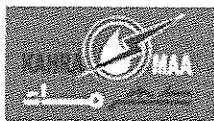
The communication should be HART based and should additionally possess an infrared link.

An accuracy alarm is necessary as per OIML R49, Type 'P' standards.

Ambient Temperature Limits: 70 Deg C

Process Temperature Limits: 70 Deg C

The pipes on the upstream or downstream side of all flow meters shall be provided with 2" NPT(F) threaded boss connection facility for insertion of portable insertion type magnetic flow meter for verification of the inline unit.



6.3.4 Technical Requirements – Pressure Instruments

A. Pressure Gauges

1. General

The gauges shall be circular dial, industrial type and be of the safety pattern design.

The pressure gauges shall be of 'BOURDON TUBE' type with concentric scale in accordance with BS EN 837-1 and additional requirements specified below.

2. Case

The gauges shall be suitable for direct mounting. The nominal size shall be 150 mm.

The range shall be as per data sheet. While selecting the maximum range it should be ensured that the normal operating pressure is at approximately 60% of the range.

The case material including blow-out plate shall be stainless steel. A full blow-out device shall be fitted to the back of the pressure gauge case, to prevent the pressure in the gauge from exceeding 0.3 bar g (30KPa) in case of tube rupture.

The blow-out back plate shall be provided with a flexible compensation facility and sealing ring, both made of a hydrocarbon resistant synthetic rubber.

The window shall be of shatterproof glass.

The case shall be suitable for liquid filling according to BS EN 60529, IP65 protection.

The case shall be glycerine filled.

3. Pressure Sensing Element

The pressure sensing element shall be of minimum AISI 316 SS Bourdon tube welded to AISI 316 shank and tube end piece. Both welds shall be full argon-arc welds (TIG welding) and shall be made with the use of AISI consumables. The Bourdon tube shall be placed at least 7 mm inside the shank.

4. Connection

The gauges shall have a bottom connection as specified. Connection size shall preferably be ½ inch NPT (M).

5. Pointer Movement

The movement shall be of corrosion and wear-resisting material e.g. stainless steel. Pressure gauges shall have zero adjustment facility externally without the necessity for opening the case or draining the fill fluid.

6. Pointer and Dial

A stainless steel flexible pointer stop on the dial shall be provided.

7. Safety Factor

Pressure containing parts shall be designed with a safety factor of 4 to 1.

8. Accuracy

Accuracy of the gauge shall be better than +1% of f.s.d.



9. Accessories

Each gauge shall be supplied with a gauge cock and a sample cock which shall be fitted between the gauge and the discharge pipe according to the approved primary connection diagram. Also a pulsation damper / snubbers shall be supplied with each gauge if mounted in highly pulsating process and discharge side of pumps. Diaphragm seals shall be provided where the process media is unsuitable for direct connection of gauge such as chlorine service.

A. Pressure Switches

The pressure-sensing element may be of the Bourbon tube, spiral, helical, bellows or diaphragm type, depending upon the application requirements. The pressure sensing element shall be of AISI 316 SS. Pressure switches shall withstand the maximum pressure of the system to which it is connected. In addition, over range protection, (at least 1.3 times the maximum scale reading), shall be included for all instruments. Gauge protectors shall be included wherever required to withstand maximum surge pressure. The Vendor shall indicate the proof pressure for the proposed model in the material submittal.

Set point for pressure switches shall be adjustable throughout the operating range.

Pressure switches shall have ½" NPT (M) process connection.

Pressure switches generally be used for "ON-OFF" applications with an adjustable set point and a differential gap with a reference or calibrated scale. The switch type shall be snap action DPDT, rated for 5 A at 240V AC or 1 A 30V DC. The switch shall also be hermetically sealed with gold plated contacts. Degree of protection shall be IP65 or better.

B. Pressure Transmitters

Pressure transmitters shall be of the direct sensing type with the sensing element as per manufacturer's standard. The diaphragm shall be hermetically welded to the measuring element assembly, which shall be suitable for the operating temperature limits of 0 to 55 °C unless otherwise specified.

The transmitter shall be of a smart type with modular design and capacitive sensor. The measuring element shall be able to withstand a temporary/permanent overpressure to at least 33% of the specified range limits without calibration shift.

All wetted parts and the diaphragm shall be compatible with the process fluid and shall be of minimum AISI 316 or ceramic. The measuring assembly fill fluid shall be silicon oil, unless otherwise specified, a non-toxic certificate shall be provided for filling fluid. Alternatively dry capacitance sensor shall also be acceptable.

PTFE gaskets shall be applied as a standard, unless otherwise specified. The bolts and nuts shall be high tensile stainless steel ASTM A564 - T630 - H1150 unless otherwise specified.

The transmitter enclosure class shall be to IP67 of BS 60529, as a minimum.



Qatar General Electricity & Water Corporation
Tender No. GTC 626/2014
Construction of Mega Reservoirs PRPSs
(Package A, B, C, D & E)

The process connection shall be 1/2" NPT (M) and the electrical signal cable entry connection shall be M20 x 1.5 metric, unless otherwise specified in the data sheet. Unused electrical connections shall be plugged off with a recessed head screw in compliance with the specified electrical safety requirements. The screw material shall be of stainless steel for stainless steel enclosures. The signal cable termination points shall be of the screw type.

The transmitter output signal shall be 4-20 mA with Hart protocol, required by the SCADA Communication System.

The transmitter power supply voltage shall be 24 VDC, for two-wire transmission system with a minimum power supply voltage of 12.5 VDC.

The transmitter electronics shall be microprocessor based. Printed circuit board(s) should be of replaceable modular construction, shall be hermetically sealed or protected by a corrosion-resistant coating (tropicalized) and vibration-free supported in case of plug-in type circuit boards.

Signal wiring terminals and electronics shall be housed in separate compartments, so that the electronics remained sealed during electrical connection of the transmitter to the signal cable.

The electronics system shall be provided with a reverse polarity protection circuit.

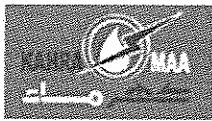
Zero and span shall be non-interacting, easily and continuously accessible. The external adjustment(s) should be provided with an environmental protection cover. It shall be possible to calibrate the transmitter locally through dedicated push buttons for zero and span with digital accuracy.

The transmitter shall be provided with integral digital indicator with scale identical to the calibrated range as indicated in the instrument data sheet.

The performance of the transmitter shall be as follows:

- The transmitter accuracy including combined effect of linearity, hysteresis and repeatability shall be equal to or better than $\pm 0.1\%$ of calibrated span.
- The dead band shall be equal to or better than $\pm 0.05\%$ of span.
- Stability (not including temperature or pressure effect) shall be better than $\pm 0.1\%$ of the minimum span per 30 days or $\pm 0.2\%$ of URL for one year.
- The total dynamic effect of the temperature including span and zero error:
 - At maximum span - equal or less than $\pm 1.5\%$ of the span
 - At minimum span - equal or less than $\pm 4.5\%$ of the span, unless otherwise specified

The total effect of the radio frequency interference's shall be equal or less than 0.1% of the output span, with the transmitter enclosure cover in place. The transmitter shall be provided with EMI/RFI



integral transient protection also when the cover has been removed. The protection level shall be as per NAMUR recommendations and EMC directive compliance.

6.3.5 Technical Requirements – Level Instruments

A. Level Gauges

Local level gauges for the surge vessels shall be of the direct reading magnetic type where a permanent magnet mounted in a float drives a series of bi-coloured magnetic flaps. The two colours of the flaps shall be bright and clearly different in order to provide clear visibility of the level from a distance. Accumulation of sand and dust shall not impede reading. A small permanent magnet shall be attached to each flap to ensure that the flaps remain in a given position even when severe vibration occurs. The float shall be concentric magnetic design with unsupported sections to provide a strong and uniform magnetic field. The external mounted float guiding tube / chamber shall be of 304 SS and the float shall be AISI 316 SS. The housing of the flaps shall be dust and watertight. A graduated scale made of stainless steel with 1 cm division shall be fixed adjacent to the float guiding tube/chamber.

Only one (1) level gauge shall preferably be used on a vessel. If, however, two (2) or more level gauges are required, they shall be installed in such a way that the visible lengths overlap by at least 100 mm.

The level gauges shall be fitted with field adjustable snap acting micro switches for high-high, high, normal, low and low-low level alarms. The alarm contacts shall be gold plated and rated for 5 A at 240 V AC. The switch enclosure shall be weather proof to IP65. Electrical connections shall be M20 x 1.5 with cable glands.

B. Level Switches

Level switches for all dewatering sumps shall be float operated.

The switching element shall be rated for 24 V DC with gold plated contacts integrally mounted in the float. Each switch shall be provided with DPDT contact arrangements.

The switches shall be connected to a junction box by an appropriate integral waterproof cable. The floats shall be clipped onto a weighted chain allowing adjustments to be made to the set points by changing the position of the clips.

Sufficient cable length shall be provided to facilitate termination in a junction box and set point adjustments.

The float shall be to IP-68 of IEC 60529.

C. Level Transmitter – Ultrasonic Type

All level sensors shall operate on the Ultrasonic principle except the level sensors for reservoirs. The unit shall comprise of a sensor and a field mounted Transmitter unit, interconnecting cable and accessories such as sensor flanges, mounting frame, alignment unit and protective cover as required for a complete installation.

1. Sensor

The sensor shall be suitable for a measuring range as per the process data sheet.



Qatar General Electricity & Water Corporation
Tender No. GTC 626/2014
Construction of Mega Reservoirs PRPSs
(Package A, B, C, D & E)

The probe shall be provided with a built-in temperature sensor for the compensation of sound velocity.

The sensor shall be flange mounted on top of the storage tank and supplied with a mounting flange or threaded. For easy mounting and accurate positioning of the sensor an alignment unit shall also be supplied, if required by the application (i.e. when process connection is threaded).

The sensor shall be located so that the acoustic signal path is free of obstruction from side walls, ladder, pipes, mixers and other instruments.

The sensor housing shall be of polypropylene (PP) and shall be certified to IP68 enclosure class.

The sensor shall operate satisfactorily under ambient and operating temperature limits of 0 °C to 55 °C, a relative humidity of 0 to 100% RH and maximum operating pressure of 2 Bars (absolute).

The following accessories shall be supplied with the sensor unit:-

- All weather Protective Cover
- Interconnecting cable between the sensor and transmitter (as required by the application). The cable shall be supplied from the manufacturer of the instrument. A minimum of twenty (20) metres of interconnecting cable between sensor and the remote transmitter unit shall be included in the scope of supply of the Bidder. The interconnecting special cable shall be supplied from the manufacturer and any additional length as per site requirements shall be included in the scope of supply.

2. Transmitter

The transmitter unit shall be of single channel version suitable for field mounting compatible with the Ultrasonic Level Sensor. The transmitters shall be mounted on ground level.

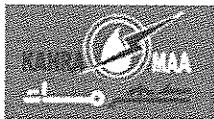
The unit shall be microprocessor based and of modular construction. The operation shall be based on intelligent software using fuzzy logic for echo analysis and rejection of sporadic reflections, interference echoes and multiple reflections.

The transmitter enclosure shall be certified to IP67 of IEC-60529.

The unit shall be provided with a keypad on the front panel to be used for configuration purposes together with an illuminated LCD display and bar graph segment display for level in steps of 10% or better.

Configurations shall be carried out by the use of standard operating matrix and the time required for starting minimized by the use of pre-set operating parameter values. Data storage shall be in EEPROM non-volatile memory to avoid requirement of battery backup. A keypad locking facility to prevent unauthorised access to program changes shall be provided.

The unit shall be suitable for operation in a temperature range of 0 °C to 55 °C with 95% average RH.



The outputs shall be programmable through the keypad and the input, outputs and power supply shall be electrically isolated from one another.

The transmitter has to be mounted away from the sensor and shall be housed in GRP boxes (double enclosure type) sunshades to protect them against direct sun radiation.

The following outputs shall be available and configurable by the user:

- i. 4 Nos. programmable Digital Output contacts as back-up level reference.
- ii. Analogue, 4-20 mA signal proportional to level
- iii. HART communication port as required by the SCADA Communication System.

The unit shall operate on a power supply of 240 V AC.

The measuring uncertainty shall be within 0.2% for maximum measuring span.

D. Level Transmitter – Radar

1. General

The sensor shall be used for the reservoirs only and shall comprise a downward looking time-of-flight radar antenna suitable for mounting on a flange through a roof opening on the reservoirs.

Each reservoir cell shall be provided with two level transmitters for redundancy. Both shall be connected to the SCADA system. The operator shall be able to disable one of the transmitters from the SCADA HMI in case of any faults.

2. Design Features

The level sensor shall operate on the time-of-flight method by measuring the distance from a reference point to the water surface in the reservoir. Radar impulses shall be emitted by an antenna and reflected off the water surface and received again by the radar system. A microprocessor based transmitter shall evaluate the signal and identify the level echo caused by the reflection of the radar impulse at the water surface. In order to achieve very high accuracy level of $\pm 1\text{mm}$, the installation shall be stable and the radar beam shall not suffer interference from columns/beams in the reservoir. Hence the location of the mounting shall be chosen carefully on the reservoir roof.

3. Sensor

The sensor shall be suitable for the measuring range as per the process data sheet. The antenna shall be selected to counter the effects of condensation. Built in temperature and pressure compensation and anti-condensation heater shall be provided. The sensor shall be flange mounted on top of the reservoir and supplied with a mounting flange. The sensor housing shall be of stainless steel and shall be certified to IP68 enclosure class. The sensor shall operate satisfactorily under ambient and operating temperature limits of 0 °C to 55 °C and a relative humidity of 0 to 100% RH.

The following accessories shall be supplied with the sensor unit:



- All weather Protective Cover
- Interconnecting cable between the sensor and transmitter (for remote transmitter models). The cable shall be supplied from the manufacturer of the instrument. A minimum of twenty (20) metres of interconnecting cable between sensor and the remote transmitter unit shall be included in the scope of supply of the Bidder. The interconnecting special cable shall be supplied from the manufacturer and any additional length as per site requirements shall be included in the scope of supply.

4. Transmitter

The transmitter unit shall be separately mounted on the ground level. The transmitter housing material shall be made of die-cast aluminium. Enclosure class shall be according to IP67 of IEC 60529, as a minimum.

The electrical signal cable entry connection shall be M20 x 1.5 metric, unless otherwise specified in the data sheet. Unused electrical connections shall be plugged off with a recessed head screw in compliance with the specified electrical safety requirements. The screw material shall be of stainless steel for stainless steel enclosures. The signal cable termination points shall of the screw type.

The unit shall be microprocessor based and of modular construction. The operation shall be based on intelligent software to calculate the water level with very high accuracy based on the radar echo and capable of analysis and rejection of sporadic reflections, interference echoes and multiple reflections.

The unit shall be provided with a keypad on the front panel to be used for configuration purposes together with an illuminated LCD display and bar graph segment display for level in steps of 10% or better.

Configurations shall be carried out by the use of standard operating matrix and the time required for starting minimized by the use of pre-set operating parameter values. Data storage shall be in EEPROM non-volatile memory to avoid requirement of battery backup. A keypad locking facility to prevent unauthorised access to program changes shall be provided.

The unit shall be suitable for operation in a temperature range of 0 °C to 55 °C with 95% average RH.

The outputs shall be programmable through the keypad and the input, outputs and power supply shall be electrically isolated from one another.

The transmitter has to be mounted away from the sensor and shall be housed in GRP boxes (double enclosure type) sunshades to protect them against direct sun radiation.

The following outputs shall be available and configurable by the user:

- i. 4 Nos. programmable Digital Output contacts as back-up level reference.
- ii. Analogue, 4-20 mA signal proportional to level



iii. HART communication port as required by the SCADA Communication System.

The unit shall operate on a power supply of 240 V AC.

5. Materials

- Sensor Horn : AISI 316L Stainless Steel
- Flange : AISI 316L Stainless Steel

6.3.6 Temperature Instruments

A. Platinum Resistance Thermometer (RTD) Elements for Pressure Vessels

1. General

This specification covers sheathed platinum resistance elements for temperature measurements in pressure vessels.

2. Requirements

Resistance thermometer shall consist of an outer metal sheath, containing a sensing element of annealed platinum resistance wire. The resistance and connecting wires shall be electrically insulated from the outer sheath by compacted magnesium oxide or suitable alternative compatible with the RTD operating temperature. The sheath end closure by seal welding shall be impervious to gases and liquids. Cracks, holes or defects penetrating the wall shall not be permitted. The tip shape is optional, rounded, flat or conical; the other end shall be hermetically sealed, suitable for an operating temperature of minimum 60 °C, to prevent the ingress of moisture. The sealed end of the element shall be provided with flange in accordance with DIN 43734 or as specified in the data sheets, for terminal block and/or transmitter mounting and spring loaded screws for adjustment. A positive means of preventing strain on the connecting wires emerging from the sheath material shall be provided. Terminals shall be suitable for solid wires or wire pins of maximum 1.2 mm diameter.

RTD elements shall be offered in 3-wire duplex configuration. For 3-wire configuration the lead wire terminals shall be color coded red, red, and white.

3. Dimensions

The sheath shall have a nominal outside diameter of 6 mm ±0.1 mm.

4. Mounting

The probe shall have a flanged connection to the pressure vessel flange.

5. Materials

Sensing element shall be annealed platinum, sheath shall be austenitic stainless steel or high nickel alloy tubing, grade determined subject to the limit of the operating temperatures.

Insulating material within the sheath shall be compatible with the platinum resistance thermometer operating temperature. Hermetically sealing compound shall be compatible with the environmental conditions specified in the purchase order. Connecting



wire joining materials shall withstand the RTD maximum operating temperature.

6. Performance

The platinum resistance thermometer performance shall be in accordance with the requirements of IEC 60751, Pt 100 elements, having a resistance of 100 ohms at 0 °C and a temperature coefficient of 0.003851 °C-1.

The resistance tolerance shall comply with Class A according to IEC 60751, where Class A tolerance (°C) is $0.15 + 0.002 [t]$. Where [t] = modulus of temperature in degrees Celsius without regard to sign.

The insulation resistance of the compacted ceramic material shall have a minimum resistance of 100 MΩ at ambient temperature (15-35 °C) and a relative humidity of minimum 80%, with an applied 10 to 100V DC voltage in accordance with IEC 60751. Any decrease in insulation resistance at elevated temperatures shall be in accordance with IEC 60751.

7. Transmitters

The transmitter shall be of a smart type with modular design and compatible with 3-wire RTD sensor. The transmitter shall be attached directly to the sensor assembly.

The transmitter housing material shall be made of die-cast aluminium. Enclosure class shall be according to IP67 of IEC 60529, as a minimum.

The electrical signal cable entry connection shall be M20 x 1.5 metric, unless otherwise specified in the data sheet. Unused electrical connections shall be plugged off with a recessed head screw in compliance with the specified electrical safety requirements. The screw material shall be of stainless steel for stainless steel enclosures. The signal cable termination points shall be of the screw type.

The following outputs shall be available and configurable by the user:

- i. Analogue, 4-20 mA signal proportional to level
- ii. HART communication port as required by the SCADA Communication System.

The unit shall operate on a power supply of 24 V DC loop powered.

The transmitter electronics shall be microprocessor based. Printed circuit board(s) should be of replaceable modular construction, shall be hermetically sealed or protected by a corrosion-resistant coating (tropicalized) and vibration-free supported in case of plug-in type circuit boards.

Signal wiring terminals and electronics shall be housed in separate compartments, so that the electronics remained sealed during electrical connection of the transmitter to the signal cable.

The electronics system shall be provided with a reverse polarity protection circuit.



Zero and span shall be non-interacting, easily and continuously accessible. The external adjustment(s) should be provided with an environmental protection cover.

The performance of the transmitter shall be as follows:

- The transmitter accuracy shall be equal to or better than $\pm 0.1\%$ of span
- The dead band shall be equal to or better than $\pm 0.05\%$ of span.
- Stability (not including temperature or pressure effect) shall be better than $\pm 0.1\%$ of the reading or 0.1°C , whichever is greater, for 24 months.

The total effect of the radio frequency interference's shall be equal or less than 0.1% of the output span, with the transmitter enclosure cover in place. The transmitter shall be provided with EMI/RFI integral transient protection also when the cover has been removed. The protection level shall be as per NAMUR recommendations and EMC directive compliance.

6.3.7 Condition Monitoring System

Refer to Clause 4.2.2 of Appendix A4 and Clause 5.2.4 of Appendix A5 for more details of vibration and temperature monitoring requirements for the Pumps and Motors.

Vibration and temperature transducers shall be selected based on the recommendation of the equipment vendor. The transducer selected shall be reliable, accurate and well proven in similar applications elsewhere. A compatible vibration and temperature monitor to match the transducer selected shall be included along with the interconnecting cables between the sensor and the monitoring unit. The monitoring unit shall be provided with its own power supply unit and relay contact outputs for alarm and trip.

The unit should feature a bar graph display with graduated scale for vibration and temperature; and LED's for status, alarm & trip indications. The monitor shall be supplied with all the mounting accessories. The monitor shall also be provided with PROFIBUS interface to SCADA Communication System.

The vibration transducers shall be piezo-electric accelerometers of compression type with built-in electronics designed for vibration monitoring of industrial machinery. The electrical signal shall be galvanically isolated from the transducer housing. The transducer shall be mounted on the X and Y axis of the bearing housings of the pump and motor in a smooth and flat surface drilled and threaded to accept the sensor. The transducer shall be tressed and shall have a captive bolt for mounting and removing. The signal cable shall be removable via pin type connector. The connector shall be IP 67 rated.

Vibration Sensor Data:

Nominal sensitivity, main axis: 10mV/m/s^2

Transverse sensitivity: max. 10%

Typical base strain sensitivity: $0.01\text{m/ s}^2/\mu\text{strain}$

Linear frequency range: 2 Hz to 10 kHz ($\pm 3\text{ dB}$)

Max peak acceleration: 600 m/s^2

Settling time: 3 Seconds



Bias point: 11V to 14 V

Temperature range: -5°C to 125°C

Power requirements: 24V / 2 to 5mA

Casing: Stainless Steel

Sealing: IP67

Isolation: > 1M ohm

Torque limit 10Nm

Refer to Clause 4.2.2 of Appendix A4 and Clause 5.2.4 of Appendix A5 for more details on temperature sensor data.

6.3.8 Water Quality Analysers

A. General

The Contractor shall propose one vendor for all the Water Quality Analysers in order to have uniformity of design, calibration procedures and one point of contact for after sales services requirements. The vendor selected shall have proven local capability to provide sufficient professional service throughout the lifetime of the system.

The following quality analysers shall be provided at the main inlets and the main outlets of the PRPS:

- Chlorine
- Chlorine Dioxide
- ORP
- pH
- Turbidity
- Conductivity
- Temperature

All the above sensors shall be flow cell type (except Temperature which shall be Thermowell type) installed on Analyser Racks located in the Water Quality Analyser rooms located in the Chlorine Plant. Sampled water shall be drawn from the locations as shown on the drawings and routed via sampling pipes to the Water Quality Analyser room.

The following quality analysers shall be provided at the inlets and the outlets of all the cells of each reservoir:

- Chlorine
- Chlorine Dioxide

All the above sensors shall be flow cell type installed on Analyser Racks located in the Water Quality Analyser rooms located near the sampling points in the reservoir area.

It shall be noted that for the reservoirs, the sampling points are below ground level at the inlet and outlet pipes. These locations will provide sufficient sample pressure to the analysers. However, when water levels in the reservoir drop below ground level (during emergency supply), sufficient



pressure will not be available to push water to the analysers located above ground level in the Water Quality Analyser rooms. As such, sample pumps shall be provided at the sampling points which shall come into operation during these times. The starting and stopping of the sampling pumps shall be determined by the flow sensor in the Chlorine Flow Cell and Chlorine Dioxide Flow Cell.

B. Water Quality Analyser Transmitters

The unit shall be microprocessor based and of modular construction. The operation shall be based on intelligent software to allow conversion of the sensor signals, temperature (where required) to accurate readings.

The transmitter enclosure shall be certified to IP67 of IEC-60529.

The unit shall be provided with a keypad on the front panel to be used for configuration purposes together with an illuminated LCD display and bar graph segment display for level in steps of 10% or better.

Configurations shall be carried out by the use of standard operating matrix and the time required for starting minimized by the use of pre-set operating parameter values. Data storage shall be in EEPROM non-volatile memory to avoid requirement of battery backup. A keypad locking facility to prevent unauthorised access to program changes shall be provided.

The unit shall be suitable for operation in a temperature range of 0°C to 55°C with 95% average RH.

The outputs shall be programmable through the keypad and the input, outputs and power supply shall be electrically isolated from one another.

The following outputs shall be available and configurable by the user:

- i. Analogue, 4-20 mA signal proportional to level
- ii. Profibus, port as required by the SCADA Communication System.

The unit shall operate on a power supply of 240 V AC.

Transmitters shall be modular single or dual channel controller that works with digital sensors and analogue sensor modules. They shall be microprocessor-based and allow replacement of digital and analogue sensors connected to the controller by unplugging and plugging sensors as necessary.

Parameter-specific controllers that do not allow changing of parameter configurations in the field are unacceptable.

C. Residual Chlorine

The analyser unit shall consists of flow cells, sensors, transmitter, associated pipework, valves, cabling, etc. all factory pre-fitted on a stainless steel back panel. The sensor shall measure Total Chlorine which is Free Chlorine plus Combined Chlorine.

The unit shall have a pH sensor to correct for changes in the pH based on the pH/Free Chlorine disassociation curve.

The sensor shall be a three electrode amperometric type whereby the anode is split into two parts to provide stable measurement and longer electrode life. The measuring electrode shall be gold, the reference electrode shall be silver with silver halide and the counter electrode shall be stainless steel.



The method of measurement shall be reagent-free and continuous in accordance with US EPA Method 334.0.

The sensors shall be digital type which allows plug and play capability whereby they can be calibrated in the lab and plugged into the controllers at the analyser racks without any additional calibration, settings, software configurations, etc.

The analyser unit shall have self-diagnostics alerts to advise on servicing requirements due to changes in process and warn of pH and chlorine calibration deviations. A non-contacting sample flow sensor shall be incorporated to provide alarm for insufficient flow. All warning shall be easily configurable.

The sensor characteristics shall be as follow:

- Measurement range: 0 to 2ppm
- Lower limit of detection: 90ppb
- Resolution: 0.001ppm
- Accuracy: ±5%

D. Chlorine Dioxide

The analyser unit shall consists of flow cells, sensors, transmitter, associated pipework, valves, cabling, etc. all factory pre-fitted on a stainless steel back panel. The sensor shall measure Chlorine Dioxide.

The sensor shall be a three electrode amperometric type whereby the anode is split into two parts to provide stable measurement and longer electrode life. The measuring electrode shall be gold, the reference electrode shall be silver with silver halide and the counter electrode shall be stainless steel. The method of measurement shall be reagent-free and continuous in accordance with US EPA Method 327.0.

The sensors shall be digital type which allows plug and play capability whereby they can be calibrated in the lab and plugged into the controllers at the analyser racks without any additional calibration, settings, software configurations, etc.

A non-contacting sample flow sensor shall be incorporated to provide alarm for insufficient flow. All warning shall be easily configurable.

The sensor characteristics shall be as follow:

- Measurement range: 0 to 2ppm
- Lower limit of detection: 90ppb
- Resolution: 0.001ppm
- Accuracy: ±5%

E. Conductivity

The measuring principle of the sensor shall be based on induction and conduction. An alternating magnetic field generated in a primary coil shall induce a current in the process media. Whereby, the strength of the induced current will be proportional to the ion concentration and thus the conductivity of the media. The current flow in the media shall generate another magnetic field in a secondary coil which is then measured to determine the conductivity.

The sensor characteristics shall be as follow:

- Measurement range: 50 µS/cm to 500 µS/cm



- Accuracy: $\pm 0.5\%$

F. pH Analyser

The sensor shall have an electrode with a glass membrane which supplies an electrochemical potential dependent upon the pH value of the medium. This potential shall be generated by the selective penetration of positive hydrogen ions (H^+) through the outer layer of the membrane which causes an electrochemical boundary layer with an electrical potential. The measured value of the electrical potential gives a measure of the pH. A reference electrode shall be provided as well.

The sensor characteristics shall be as follow:

- Measurement range: 0 pH to 14 pH
- Accuracy: $\pm 0.5\%$

G. Turbidity

The turbidity measurement shall be based on the measurement of light scattered by suspended particles when a light beam is shone through the medium. The amount of scatter gives a measurement of the turbidity of the medium.

The sensors shall use a dual-beam infrared/scattered light photometer to measure turbidity. An LED light source shall transmit a beam of infrared light into the medium at an angle to the probe face. The scattered light shall be detected by a pair of photoreceptors in the sensor face.

A backscatter photoreceptor shall be provided to accurately measure suspended particles.

The sensor characteristics shall be as follow:

- Measurement range: 0 NTU to 5 NTU
- Accuracy: $\pm 1\%$

H. ORP Analyser

The sensor shall have an electrode which supplies or accepts electrons. The electrochemical potential developed as a result of the accumulation of charge will be equal to the reduction potential of the medium. The measured value of the electrical potential gives a measure of the ORP. A reference electrode shall be provided as well.

The accuracy of measurement shall be better than $\pm 0.5\%$ of the measured value. The range of the sensor shall be as indicated in the Instrument Data Sheet.

The ingress protection of the sensor shall be IP68.

I. Temperature Transmitter for Water Quality

This specification covers sheathed platinum resistance elements for temperature measurements in main inlet and outlet pipes.

Resistance thermometer shall consist of an outer metal sheath, containing a sensing element of annealed platinum resistance wire. The resistance and connecting wires shall be electrically insulated from the outer sheath by compacted magnesium oxide or suitable alternative compatible with the RTD operating temperature. The sheath end closure by seal welding shall be impervious to gases and liquids. Cracks, holes or defects penetrating the wall shall not be permitted. The tip shape is optional, rounded, flat or conical;



Qatar General Electricity & Water Corporation
Tender No. GTC 626/2014
Construction of Mega Reservoirs PRPSs
(Package A, B, C, D & E)

the other end shall be hermetically sealed, suitable for an operating temperature of minimum 60 °C, to prevent the ingress of moisture. The sealed end of the element shall be provided with flange in accordance with DIN 43734 or as specified in the data sheets, for terminal block and/or transmitter mounting and spring loaded screws for adjustment. A positive means of preventing strain on the connecting wires emerging from the sheath material shall be provided. Terminals shall be suitable for solid wires or wire pins of maximum 1.2 mm diameter.

RTD elements shall be offered in 3-wire duplex configuration. For 3-wire configuration the lead wire terminals shall be colour coded red, red, and white.

The sheath shall have a nominal outside diameter of 6 mm ±0.1 mm. Sensing element shall be annealed platinum, sheath shall be austenitic stainless steel or high nickel alloy tubing, grade determined subject to the limit of the operating temperatures.

Insulating material within the sheath shall be compatible with the platinum resistance thermometer operating temperature. Hermetically sealing compound shall be compatible with the environmental conditions specified in the purchase order. Connecting wire joining materials shall withstand the RTD maximum operating temperature.

The platinum resistance thermometer performance shall be in accordance with the requirements of IEC 60751, Pt 100 elements, having a resistance of 100 ohms at 0 °C and a temperature coefficient of 0.003851 °C-1.

The resistance tolerance shall comply with Class A according to IEC 60751, where Class A tolerance (°C) is $0.15 + 0.002 [t]$. Where [t] = modulus of temperature in degrees Celsius without regard to sign.

The insulation resistance of the compacted ceramic material shall have a minimum resistance of 100 MΩ at ambient temperature (15-35 °C) and a relative humidity of minimum 80%, with an applied 10 to 100V DC voltage in accordance with IEC 60751. Any decrease in insulation resistance at elevated temperatures shall be in accordance with IEC 60751.

The RTD elements shall be supplied with thermowells of 316 SS. The thermowells shall be drilled from barstock. Insertion length shall be to suit the application requirements. Thermowell Test Pressure shall be 100barg.

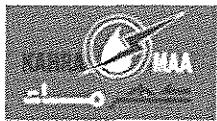
The transmitter shall be of a smart type with modular design and compatible with 3-wire RTD sensor. The transmitter shall be attached directly to the sensor assembly.

The transmitter housing material shall be made of die-cast aluminium. Enclosure class shall be according to IP67 of IEC 60529, as a minimum.

The electrical signal cable entry connection shall be M20 x 1.5 metric, unless otherwise specified in the data sheet. Unused electrical connections shall be plugged off with a recessed head screw in compliance with the specified electrical safety requirements. The screw material shall be of stainless steel for stainless steel enclosures. The signal cable termination points shall be of the screw type.

The following outputs shall be available and configurable by the user:

- iii. Analogue, 4-20 mA signal proportional to level



- iv. HART communication port as required by the SCADA Communication System.

The unit shall operate on a power supply of 24 V DC.

The transmitter electronics shall be microprocessor based. Printed circuit board(s) should be of replaceable modular construction, shall be hermetically sealed or protected by a corrosion-resistant coating (tropicalized) and vibration-free supported in case of plug-in type circuit boards.

Signal wiring terminals and electronics shall be housed in separate compartments, so that the electronics remained sealed during electrical connection of the transmitter to the signal cable.

The electronics system shall be provided with a reverse polarity protection circuit.

Zero and span shall be non-interacting, easily and continuously accessible. The external adjustment(s) should be provided with an environmental protection cover.

The performance of the transmitter shall be as follows:

- The transmitter accuracy shall be equal to or better than $\pm 0.1\%$ of span
- The dead band shall be equal to or better than $\pm 0.05\%$ of span.
- Stability (not including temperature or pressure effect) shall be better than $\pm 0.1\%$ of the reading or 0.1°C , whichever is greater, for 24 months.

The total effect of the radio frequency interference's shall be equal or less than 0.1% of the output span, with the transmitter enclosure cover in place. The transmitter shall be provided with EMI/RFI integral transient protection also when the cover has been removed. The protection level shall be as per NAMUR recommendations and EMC directive compliance.

J. Analyser Rack

Analyser racks shall be completely factory assembled units whereby all sensors, sensor holders, flow cells, piping, isolation/control/pressure reducing valves, strainers, rotameters, sample temperature conditioners, cabling, transmitters, etc. are pre-installed by the manufacturer in the factory.

The racks shall be floor standing units with ready field connection points for samples piping, drain, flushing water, signal/data cables termination junction box, power cables junction box, etc. Field piping and cabling shall be kept to a minimum. All power, control and signal cables from the transmitter units shall be neatly routed to junction boxes mounted on the rear of the rack in separate PVC cable conduits/trunkings, i.e. power cables, control cables and signal cables shall not be mixed in the same conduit/trunk. Racks requiring field wiring to transmitters/sensors will not be accepted. All field wiring shall be carried out at junction boxes only. Each transmitter unit shall be protected with a separate MCB.

The complete rack including frames, back panel, stiffeners, tundish, etc. shall be stainless steel construction. All piping and valves shall be PVC. Cable junction boxes shall be die-cast aluminium. All bolts, nuts, cable conduit and pipe brackets/holders shall be stainless steel.



Racks which are more than 3 meters in length shall be transported to the site as separate shipping units and assembled at site by the instrument vendor.

Racks shall be installed in air-conditioned analyser rooms.

6.3.9 Inspections and Testings

The Inspection Data Sheets for each instrument shall be prepared by the CONTRACTOR and submitted for approval.

CONTRACTOR shall submit to KAHRAMA/ENGINEER a detailed Inspection and Test Plan (ITP) for approval with all activities and acceptance criteria.

The ITP shall include detailed FAT and SAT procedures to be submitted to KAHRAMA/ENGINEER for approval.

A. Pressure Tests

Instrument process piping up to the first block valve shall be tested with the piping or equipment to which it is connected.

For remote installations, testing of the lead line from the first block valve up to the secondary block valve at the instrument can be done simultaneously, provided the instrument is blocked off from the source of pressure and vented to atmosphere.

B. Instrument Calibration

All the instruments shall be function tested on site before installation. The test report format shall be submitted to KAHRAMA/ENGINEER and approval should be sought from KAHRAMA/ENGINEER before proceeding with the work. The test equipment's to be used shall have better accuracy than the instrument and should have a test certificate from independent certified testing authority, which is currently valid. The factory calibration certificate of each instrument shall be submitted to KAHRAMA/ENGINEER prior to installation.

C. Cable Continuity and Insulation Resistance

All the cables laid shall be thoroughly checked for continuity and insulation resistance before termination. The cable continuity and insulation resistance report shall be submitted as a final documentation by the MANUFACTURER/CONTRACTOR.

D. Loop-Checking and Functional Testing

Loop checking and functional testing will be done by the CONTRACTOR and witnessed by KAHRAMA/ENGINEER. The procedures and results of the loop checks shall be recorded in formats to be prepared by the CONTRACTOR and approved by KAHRAMA/ENGINEER.

E. Nameplates and Tagging

Laser engraved I.D. tags made of Stainless Steel and clearly showing the instrument identification/tag number as shown in the P&ID drawings, make, model, order codes, accuracy, pressure ratings, instrument range, operating range, etc. shall be permanently affixed to all instruments. The Contractor shall submit for approval full details required for each instrument tag in the form of drawings which show the tag plate dimensions, material, label fonts height, type, etc. I.D. tags shall be affixed to instruments by stainless steel ties or chains. Where use of stainless steel is unsuitable as in the case of



Chlorine Store, Chlorinator Room, etc. the I.D. tags shall be embossed or engraved type non-metallic material and affixed by UV stabilized nylon ties.

F. Labelling

All field-mounted junction boxes shall be provided with nameplates. Titles on nameplates shall be as per approved panel shop drawings which shall incorporate the approved numbering/tagging system.

The material of the nameplate shall be laminated white plastic with black engraved text in upper case.

The nameplates shall be fixed to the mounting plate, the mounting bracket or the junction boxes door/cover with industrial glue, stainless steel (type AISI 316), M4 bolts and nuts, self-tapping screws or pop-rivets, subject to KAHRAMA/ENGINEER approval.

Note: Fixing arrangements for nameplates installed on junction boxes provided with protection', for e.g. Type IP65, shall not adversely affect the type of protection.

The CONTRACTOR shall design and requisition mounting brackets for instruments and/or components such as manual-operated switches, displacer-type level instruments and those for temperature measurements, etc. which are not installed on a mounting plate.

6.4 ELECTRICAL INSTRUMENTATION AND CONTROL

6.4.1 Earthing

Common Plant Earth Grid shall be provided as per the standards and all instrument housing and cable armoring shall be connected to this earth only.

6.4.2 Cabling Installation up to PLCs

Power and Instrumentation cabling shall be done in accordance with KAHRAMA Regulations and Qatar Construction Specifications. Instrumentation cabling is recommended to be installed in perforated metallic cable tray with covers. Instrumentation cabling shall be kept separate from power cabling at all time.

Instrumentation Cable shields shall be earthed as per the manufacturer's recommendations or the protocol specifications. Where no recommendations are made, the shield shall be single point earthed, on the source end.

Standalone processes such as the individual Chemical dosing plants and Motor starters have internal parameters to monitor. While not all the internal parameters are required by the central SCADA control, certain parameters will be required to be interfaced with the central control.

6.5 INSTRUMENTATION IDENTIFICATION

6.5.1 Instrument Identification

All instrumentation should be identified with equipment and tag numbers in the same way as for equipment described above. However, in many field locations the use of nameplates would be impractical. Equipment tags made of stainless steel ribbon tape is a more practical approach. The stainless steel ribbon tape is embossed with the instrument name. The ribbon has a hole for attaching it with stainless steel wire to the instrument. This type of stainless steel ribbon provides the most indestructible and long lasting nameplate.



For all other requirements related to equipment tagging and identification, refer to Appendix A8.

6.6 LEAK DETECTION SYSTEM

6.6.1 General

A Scope

This briefing note includes specifications for Leak Detection System, their design, manufacture, installation and commissioning.

Qatar Construction Specifications (QCS) 2010 Section 10 – All parts

B Reference Standards and related specifications

The following standards are referred to in this Part:

- i. BS EN 61000 – Electromagnetic Compatibility
- ii. BS EN 50014 to BS EN 50020 - Protection
- iii. BS EN 60529 - Ingress Protection

C Submittals

Submittals shall be in accordance with Part 1 of QCS Section 10.

Manufacturer's literature, illustrations, specifications and engineering data including dimensions, weight, instrument set point and range, ambient temperature and humidity rating, process pressure rating, enclosure specifications, installation and wiring diagrams shall be included.

All submittals shall be submitted for Kahramaa review and Approval.

D Quality Standards

Manufacturer. In addition to requirements of QCS Section 10 Part 1, instrumentation and controls equipment furnished shall be manufactured by a Company regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design. The manufacturer shall be approved and designated in the Project Specification.

Maintainability. All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major dismantling. Internal field adjustments, where permitted or required herein, shall be easily accessible upon removal of a panel or cover.

Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified in the Project Specification.

E Warranty

The equipment shall carry a Manufacturers guarantee for a minimum of 2 years and shall be guaranteed for manufacturer of parts for 10 years minimum from installation.



The Contractor shall furnish the Employer with manufacturer's guarantee and warranty certificates for all equipment, duly registered with the manufacturer.

6.6.2 Leak Detection system Requirements

A. System Description

The leak detection system shall be a distributed temperature sensing system type with a temperature resolution up to 0.01 °C at every 1m along the entire installed length of the sensing cable. The system shall be able to provide a complete temperature profile of each sensing cable every 60 seconds.

The system shall be provided with a fully functional GIS based user interface indicating the temperature profiles of the whole length of the sensor superimposed on the Geographical map of the plant. The user interface shall be provided in accordance to QCS 2010 part 2.

B. Fibre Optic Detection Cable

The Fibre sensing cable shall have the following specifications:

- i. Fibre Type: Single Mode 9 / 125µm ITU-T G.652.D Compliant
- ii. Number of Cores: 4
- iii. Cable Type: Stainless steel loose tube gel filled, Stainless Steel Wire Armour, with Halogen free PA thermoplastic sheath
- iv. Sensing Range: 0 to 8,000m
- v. Operating Temperature Range: -40° C to +80° C
- vi. Short Term Temperature withstand: -50° C to +150° C @ 1 hour
- vii. Crush Resistance: 800 N/cm
- viii. Tensile Strength: 1300 N – During Installation; 900 N – During operation
- ix. Hydrostatic Pressure withstand: 300 kPa
- x. Certified to IEC 60794-1-2

C. Data Acquisition Unit

The Data Acquisition Unit (DAU) shall have the following specifications:

- i. Alarm Functionality with user configurable zones and alarms
- ii. SCADA interoperability using OPC data format
- iii. Modular output channels with 4 fibre channels per DAU, expandable up to 8 channels
- iv. Remote Operation and Configuration
- v. Required interfaces: Fast Ethernet, Modbus, Volt free contacts
- vi. Operating Temperature and Humidity Range: +5° C to +40° C; 5% to 95% RH non condensing



- vii. Power Supply Characteristic: 240V, Single Phase 50Hz
- viii. Rack Mountable

6.6.3 Installation

A. General

Installation, testing and commissioning shall be in accordance with Part 1 of QCS Section 10.

B. Testing and Final Acceptance

All the primary elements shall be calibrated and tested prior to final acceptance, in accordance with QCS Section 10 Part 1.

C. Spare Parts and Tools

Spare Parts for all instruments listed in the schedules shall be provided for two (2) years of normal service.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

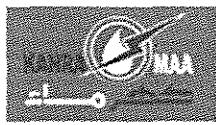
APPENDIX A SECTION 7.1
MEPF SPECIFICATION
LOSS PREVENTION



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

CONTENTS

7. MECHANICAL, ELECTRICAL, PLUMBING AND FIRE FIGHTING	3
7.1 Division 21 – Loss Prevention	3
7.1.1 104413 - Fire Extinguisher Cabinets	3
7.1.2 104416 - Fire Extinguishers	5
7.1.3 21 0100 – Operation and Maintenance of Fire systems	8
7.1.4 21 0200 – Submittal and Approval	12
7.1.5 21 0500 – Common Works Results for Fire Suppression.....	38
7.1.6 21 0513 – Common Motor requirements for Fire Suppression.....	45
7.1.7 21 0516 – Expansion fitting and Loops for Fire Piping.....	48
7.1.8 21 0517 ~ Sleeves and Sleeve Seals for Fire Suppression Piping and Equipment	52
7.1.9 21 0548 – Vibration and Seismic Control for Fire Suppression Systems.....	53
7.1.10 21 0553 – Identification for Fire Suppression Piping and Equipment.....	56
7.1.11 21 0900 – Instrumentation and Control for Fire Suppression Systems.....	58
7.1.12 21 1200 – Fire Suppression Standpipes	62
7.1.13 21 1300 – Fire Suppression Sprinkler Systems.....	66
7.1.14 21 1313 – Wet Pipe Sprinkler Systems.....	72
7.1.15 21 1339 - Foam Water System	86
7.1.16 21 2000 – Fire Extinguishing System.....	94
7.1.17 21 3113 – Electric-Drive, Centrifugal Fire Pumps.....	104
7.1.18 21 5000 – Fire-fighters Override Control Panel	111
7.1.19 26 0509 - Fire Barriers and Cable Transitions.....	120
7.1.20 28 3111 - Digital, Addressable Fire-Alarm System.....	123



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7. MECHANICAL, ELECTRICAL, PLUMBING AND FIRE FIGHTING

GENERAL REQUIREMENT

Unless otherwise stated in the Project Documentation, the Contractor shall comply with every requirement of the Qatar Construction Specification (QCS) that is relevant to the type of work forming any part of the Contract and shall adopt whichever permissible option or alternative is best suited to the needs of the construction work being undertaken.

7.1 Division 21 – Loss Prevention

7.1.1 104413 - Fire Extinguisher Cabinets

GENERAL

7.1.1.1 SUMMARY

Section includes fire protection cabinets for fire hose reels and extinguishers.

7.1.1.2 SUBMITTALS

Product Data: For each type of product indicated.

Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

Samples: For each exposed product and for each color and texture specified.

Maintenance data.

7.1.1.3 QUALITY ASSURANCE

Fire-Rated, Fire Protection Cabinets: Listed and labelled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

Coordinate sizes and locations of fire protection cabinets with wall depths.

PRODUCTS

7.1.1.4 MATERIALS

Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

Sheet: ASTM B 209

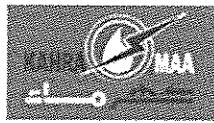
Extruded Shapes: ASTM B

Stainless-Steel Sheet: ASTM A 666, Type 304.

Copper-Alloy Brass Sheet: ASTM B 36/B 36M, alloy UNS No. C26000 (cartridge brass, 70 percent copper).

Copper-Alloy Bronze Sheet: ASTM B 36/B 36M, alloy UNS No. C28000 (muntz metal, 60 percent copper).

Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3, [3] [6] mm thick.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick,

Break Glass: Clear annealed float glass, ASTM C 1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.

Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

Wire Glass: ASTM C 1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.

Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), [1.5] [3] [6] mm thick,

Acrylic Bubble: One piece.

7.1.1.5 FIRE PROTECTION CABINET

Cabinet Type: Suitable for fire extinguisher, fire hose reel .

A. Products: Subject to compliance with requirements

Cabinet Construction: 1-hour fire rated

A. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 1.1-mm- thick, cold-rolled steel sheet lined with minimum 16-mm- thick, fire-barrier material. Provide factory-drilled mounting holes.

Cabinet Material: Stainless-steel sheet.

Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

A. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box

B. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.

C. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim. Provide where walls are of insufficient depth for semi-recessed cabinet installation.

Cabinet Trim Material: Same material and finish as door.

Door Material: Stainless-steel sheet

Door Style: Fully glazed panel with frame

Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

Accessories:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- B. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
- C. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle
- D. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

Identify fire extinguisher in fire protection cabinet with the words "FIRE HOSE REEL CABINET"

- A. Location: location indicated on Drawings.
- B. Lettering Color: White
- C. Orientation: Horizontal As indicated on Drawings

7.1.1.6 FABRICATION

Fire Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smooth.

The Contractor shall be required to seek clarification and approval from the appointed Architect regarding associated materials, colors, and finishing prior to ordering.

EXECUTION

7.1.1.7 INSTALLATION

Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.

Install fire protection cabinets in locations and at mounting heights indicated which is acceptable to authorities having jurisdiction.

Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

Identification: Apply vinyl lettering at locations indicated.

Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

7.1.2 104416 - Fire Extinguishers

GENERAL

7.1.2.1 SUMMARY

Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

Owner-Furnished Material: Hand-carried fire extinguishers.

Related Sections:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Division 10 Section "Fire Extinguisher Cabinets."
- B. Division 21 Section "Water-Based Fire-Suppression Systems" for hose systems, racks, and valves.
- C. Division 23 Section "Commercial-Kitchen Hoods" for fire extinguishing systems provided as part of commercial-kitchen exhaust hoods.

7.1.2.2 SUBMITTALS

Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Remaining paragraphs are defined in Division 01 Section "Submittal Procedures" as "Informational Submittals."

Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

Warranty: Sample of special warranty.

7.1.2.3 QUALITY ASSURANCE

NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

Fire Extinguishers: Listed and labelled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

- 1. Provide fire extinguishers approved, listed, and labeled by FMG.

7.1.2.4 COORDINATION

Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

7.1.2.5 WARRANTY

Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

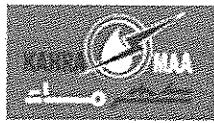
- A. Failures include, but are not limited to, the following:
 - i. Failure of hydrostatic test according to NFPA 10.
 - ii. Faulty operation of valves or release levers.

PRODUCTS

7.1.2.6 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

Fire Extinguishers: Type, size, and capacity for each fire protection cabinet mounting bracket fire protection cabinet and mounting bracket indicated.

- A. Manufacturers: Subject to compliance with requirements,
- B. Valves: Nickel-plated, polished brass body.
- C. Handles and Levers: Stainless steel.
- D. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Dry chemical extinguishers shall be 4.5 kg capacity type; 4A-30BC UL rating, red enameled housing; squeeze handle with pull pin; discharge nozzle; cartridge charged complete; and with hanger bracket.

Carbon dioxide (CO₂) extinguishers shall be provided, specific to the type and classification of fire; class B and Class C fires; stell, red enamel finish tank; 4/5 kg capacity; squeeze handle with pull pin; discharge nozzle; and with hanger bracket.

Dry chemical extinguishers trolley type 25 kg capacity shall be provided as indicated on the drawings.

Carbon dioxide (CO₂) extinguishers trolley type 12 kg shall be provided as indicated on the drawings.

It is the requirement that the Contractor consults all drawings in order to ascertain type, construction and location in accordance with the following schedule:

Fire Extinguisher Schedule:

- A. Dry chemical, ABC powder extinguisher mounted on surface/recessed of wall with mounting bracket shall be provided as indicated on the drawings.
- B. Carbon dioxide mounted on surface/recessed of wall with mounting bracket shall be provided as indicated on the drawings.
- C. Dry chemical, ABC powder extinguisher trolley type shall be provided as indicated on the drawings.
- D. Carbon dioxide trolley type shall be provided as indicated on the drawings.

Extinguishers shall be mounted at a height not more than 1530 mm from the top of the said extinguisher to the finished floor level.

7.1.2.7 MOUNTING BRACKETS

Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

- A. Manufacturers: Subject to compliance with requirements,

Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

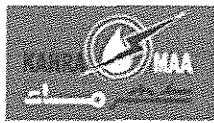
- A. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
- B. Orientation: Vertical

7.1.2.8 FIRE BLANKETS

All fire blankets shall be NFPA 10 listed and labelled accordingly.

Fire blankets shall not be used for the purpose or requirement of temporary facilities or for the purpose of providing fire protection for the construction works.

It is a requirement that the Contractor submits all product literature and shop drawings indicating and detailing all fire blankets, cabinets and all associated ancillaries for approval and prior to ordering.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

It is a requirement that the Contractor submit all certificates from the manufacturer as evidence that the products meet these specifications and the referenced standards.

All fire blankets shall come complete with proprietary monthly inspection tags and shall be correctly located in designated locations as indicated on the tender drawings, unobstructed and visible with all operating instructions kept clean, legible and facing outwards.

Fire blankets shall be supplied complete with and housed in, a proprietary box, packet or cabinet in accordance and compliance with the requirements of NFPA 10 and shall be securely mounted on a wall, ensuring that the hand held device(s) are readily accessible and unrestricted as designed.

Fire blankets shall be set true and level and mounted so as to position the hand held device(s) approximately 1500mm from the top of the box, packet or cabinet, as supplied and in accordance with NFPA 10 with the finish floor level.

The positioning of furniture and/ or equipment shall not preclude access to the blanket and it is the responsibility of the Contractor to ensure compliance and coordination with same during the construction works.

EXECUTION

7.1.2.9 EXAMINATION

Examine fire extinguishers for proper charging and tagging.

- A. Remove and replace damaged, defective, or undercharged fire extinguishers.

Proceed with installation only after unsatisfactory conditions have been corrected.

7.1.2.10 INSTALLATION

General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

- A. Mounting Brackets: 1372 mm above finished floor to top of fire extinguisher.

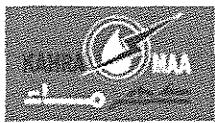
Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

7.1.3 21 0100 – Operation and Maintenance of Fire systems

7.1.3.1 OPERATING INSTRUCTIONS

Provide as necessary for a complete system of fire protection equipment, as indicated on the Drawings and as specified. Provide operations & maintenance (O&M) manuals in accordance with the Contract Documents. Provide five (5) copies of each manual. Manuals shall be 8.27 inches X 11.69 inches (A4 – size) in hard cover 3-ring loose-leaf binders. Manuals shall be complete and in Client's hands prior to turning building over to Client and at least 10 days prior to instruction to operating personnel.

7.1.3.2 PRODUCT LITERATURE



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Provide manufacturer's literature as regularly published by the respective manufacturers for proper preventative and comprehensive maintenance.

7.1.3.3 PROVIDE O&M MANUALS INCLUDING BUT NOT LIMITED TO THE FOLLOWING:

Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.

Operating instructions for complete system including: Normal starting, operating, and shut-down; Emergency procedures for fire or failure of major equipment; summer and winter special procedures, if any; Day and night special procedures, if any.

Maintenance instruction including: proper lubricants and lubricating instructions for each piece of equipment, and date when lubricated. Necessary cleaning, replacement and/or adjustment schedule.

Manufacturer's data for each piece of equipment including: Installation instructions; Drawings and specifications; Parts list, including recommended items to be stocked; Complete wiring diagrams; Marked or changed prints locating all concealed parts and all variations from the original system design; Test and inspection certifications; Refer to individual specification sections for additional O&M requirements.

Employ a specialist to prepare the operating and maintenance manuals. Submit details of the proposed specialist to the CONSULTANT for approval. Provide details of the proposed specialist as part of the tender submission

Agree format and contents of the operation with the Consultant. Provide the operating and maintenance manuals in the following form:

Ensure the manuals in A4 size, plastic-covered, loose leaf, and four ring binders with hard covers, each indexed, divided and appropriately cover-titled. Fold drawings larger than A4 and include in the binder so that they may be unfolded without being detached from the rings.

Provide an electronic format of the operation and maintenance manual stored on CD. Number of full copies shall be 10. Provide copies of the operating and maintenance manual as follows Draft copies for comment (5no)

Final copies for Client use (5no). The time slated for supplying these, please refer to contract conditions Division 1.

7.1.3.4 THE OPERATION AND MAINTENANCE MANUALS REQUIREMENTS

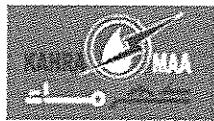
A full description of each of the systems installed, written to ensure that the Employer's staff fully understand the scope and facilities provided.

A description of the mode of operation of all systems including services capacity and restrictions.

Diagrammatic drawings of each system indicating principal items of plant, equipment, valves etc.

A photo-reduction of all record drawings together with an index. Reduced size of drawings to be A3 for the manual and a set of full size drawings.

Legend of all colour-coded services.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Schedules (system by system) of plant, equipment, valves, etc., stating their locations, duties and performance figures. Each item must have a unique number cross-referenced to the record and diagrammatic drawings and schedules.

The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue list numbers.

Manufacturer's technical literature for all items of plant and equipment, assembled specifically for the project, excluding irrelevant matter and including detailed drawings, electrical circuit details and operating and maintenance instructions.

A copy of all test certificate, inspection and test Records, commissioning and performance test records including, but not limited to, electrical circuit tests, corrosion tests, type tests, start and commissioning tests, for the installations and plant, equipment, valves, etc., used in the installations.

A copy of all manufacturer's guarantees or warranties, together with maintenance agreements offered by subcontractors and manufacturers.

Copies of insurance and inspecting Authority certifications and reports.

Starting up, operating and shutting down instructions for all equipment and systems installed.

Control sequences for all systems installed.

Schedules of all fixed and variable equipment settings established during commissioning.

Procedures for seasonal change-over's and/or pre-consultations necessary for the consultant of apparatus subject to seasonal disuse.

Detailed recommendations for the preventative maintenance frequency and procedures which should be adopted by the Employer to ensure the most efficient operation of the systems.

Details of lubricants for lubricants items including schedules of lubricant type, frequency, etc.

Details of regular tests to be carried out (e.g. water analysis for pseudomonas.)

Details of procedures to maintain plant in safe working conditions.

Details of the disposal requirements for all items in the works.

A list of normal consumable items.

A list of recommended spares to be kept in stock by the Employer, being those items subject to wear or deterioration and which may involve the Employer in extended deliveries when replacements are required at some future date.

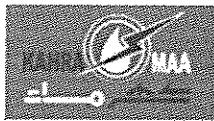
A list of any special tools needed for maintenance cross-referenced to the particular item for which required.

Procedures for fault finding.

Emergency procedures, including telephone numbers for emergency services.

Hospital Operational Policy.

Back-up copies of any system software.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Documentation of the procedures for updating and/or modifying software operating systems and control programmes.

Instructions for the creation of control procedure routines and graphic diagrams.

Details of the software revision for all programs provided.

Two back-up copies of all software items, as commissioned.

Copies of relevant HSE/CIBSE/IEE Guidance notes etc.

Contractual and legal information including but not limited to details of location and public authority consents, details of design team, consultants, installation contractors and associated subcontractors start date for installation, date of completion and expiry date for the defects liability period details of warranties for plant and systems including expiry dates, addresses and telephone numbers.

7.1.3.5 PROVISION OF INFORMATION

Co-operate with the specialist firm in the compilation of the manuals and provide them with copies of the following:

Diagrammatic drawings of each system indicating principal items of plant, equipment, valves etc.

As installed drawings, together with an index.

Plant room and switch room drawings, schedules and schematics, together with an index.

Legend for all colour-coded services.

Schedules (system by system) of plant, equipment, valves etc, stating their locations within the building, duties and performance figures.

All Test certification, Inspection and Test Records, Commissioning and Performance Test Records (including, but not limited to, electrical circuit tests, corrosion tests, type tests, start and commissioning tests) for the installations and plant, equipment, valves, etc., used in the installations.

All manufacturer's guarantees or warranties.

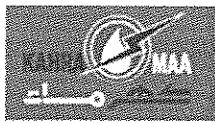
Copies of insurance and inspecting Authority certification and reports.

Schedules of all fixed and variable equipment settings established during commissioning.

Back-up copies of any system software.

Two back-up copies of all software items, as commissioned.

General operating instructions are required. In addition to specific training of the Client's operating personnel specified in the individual sections, and in addition to preparation of written operating instructions and complied maintenance manuals specified elsewhere in these specifications, the Contractor shall provide general operating instructions for each operational system and equipment item of electrical work, and coordinate instructions with instructions for mechanical work, and other equipment where associated with electrical systems or equipment.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.3.6 SYSTEM DESCRIPTION AND OPERATION.

Shall be performed by the Contractor in the presence of the Client, the Client's operating personnel and the Consultant.

The Contractor shall describe each basic electrical system and shall explain identification system, displayed diagrams, signals, alarms and audio visual provisions.

The Contractor shall describe interfaces with mechanical equipment, including interlocks, sequencing, start up, shutdown, emergency, safety, system failure, security and similar provisions.

The Contractor shall, in the presence of the Client's personnel, display and conduct an explanation of maintenance manuals, record drawings, space parts inventory, storage and extra materials, meter readings and similar service items.

7.1.3.7 RECOMMENDED SPARE PARTS.

Contractor shall provide a list of recommended spare parts for all equipment on the basis of on going equipment performance, including the anticipated frequency of change. The contractor shall include in his submission a recommended list of spare parts including associated costs for Client consideration.

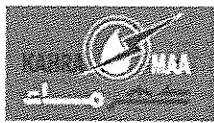
7.1.4 21 0200 – Submittal and Approval

This section outlines the requirements and procedures for submittals to the consultant.

7.1.4.1 GENERAL REQUIREMENT OF WORK

General

- E. The Contractor shall be responsible for all works detailed in the Mechanical and Electrical Engineering Specifications and in particular the following items:-
- F. Liaising with statutory bodies including those supplying services to the site
- G. Ensuring that all equipment provided is 'type approved' for the completion of the installation and, if not, obtaining the necessary approvals in time to suit the installation
- H. Providing builders work fabrication and co-ordinated drawings for all services and detailed wiring diagrams for all equipment.
- I. Inspecting all plant, equipment and materials as delivered or where specified at the Manufacturer's works.
- J. Fixing or installing correctly all plant, equipment and materials.
- K. Ensuring all associated works such as electrical wiring, connecting pipework, builders work etc., are properly executed and co-ordinated.
- L. Testing and commissioning the complete installation, including making adjustments and balancing as necessary.
- M. Demonstrating that the equipment is capable of the performance and method of operation specified to the satisfaction and acceptance of the Engineer.
- N. Providing samples, where requested, of all materials exposed to view in the finished works for comment.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- O. Demonstrating that the overall and completed systems perform correctly in the required manner and as intended by the Specification to the satisfaction and acceptance of the Engineer.
- P. Providing record drawings of the completed installation.
- Q. Providing operating instructions and maintenance manuals for the completed systems.
- R. Providing a full set of test results in an approved format for all tests, commissioning and balancing operations.
- S. The Contractor shall supply, install and commission and make necessary arrangements with respective Statutory Undertakings for the completed and working systems associated with the specified Work Package that he is commissioned to undertake.

Contractor's Design Responsibility

- A. This contractor shall hire the services of an acoustic and vibration engineer to ensure that the final installation meets with the operational requirements of these specifications. This contractor shall then implement all (at no extra cost) recommendations made by the specialist third party acoustic consultant.
- B. Where separate work elements have been identified the contractor who is appointed as the general mechanical installation contractor shall be responsible for the coordination of the complete engineering services' installation including the coordination and management of the testing and commissioning, where interfacing is required, for all mechanical and electrical works element contractors.
- C. All contractors shall be totally responsible for the design of all support systems associated with the works which are required to provide a fully functional installation.
- D. All contractors shall be responsible for ensuring that the engineering services comply with all statutory requirements, together with the requirements of all mechanical and electrical engineering specifications.
- E. The contractor shall be deemed to have included within his tender submission for all services to move by up to 3m in any direction prior to installation at no extra cost to the contract.
- F. The co-coordinating contractor shall ensure that he has adequately co-ordinated and liaised with all individual work element contractors and shall ensure that he has included for all items necessary to provide a fully complete installation. Any additional costs resulting from failure to comply with this clause shall be borne by the coordinating contractor.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Responsibility for Plant and Equipment

- A. The Contractor shall ensure that the suppliers are provided with all performance data, specification and standards, necessary for the provision of equipment but able for the specified duty and purpose.
- B. Where plant and equipment is pre-tendered the Contractor shall ensure that his tender complies with all relevant technical information contained in the specification irrespective of any pre-tender information suppliers provided to the Engineer.
- C. The Contractor shall give supervision, inspection, and testing reports during manufacture or fabrication at works or on site, as and when required; and is to ensure that delivery, assembly and completion of the order and amendments or modifications thereto comply with the programme.

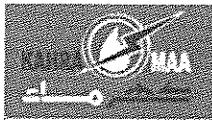
7.1.4.2 GENERAL REQUIREMENT OF MATERIALS AND METHODS

Excavation and Backfill

- A. All trenches for buried pipes shall be excavated to a minimum of 300 mm below the invert of the pipe. The trench shall be refilled with fine granular material to the invert of the pipe. This material shall be levelled and compacted to 95% SPDD.
- B. After pipe is laid, backfill pipe trenches with granular fill to a depth 300mm above the pipe. The fill shall be thoroughly tamped around and over the pipes in 150mm layers.
- C. Refer to, and comply with, the Excavation and Grading Section 02200 in addition to the requirements in this section.
- D. Compaction shall be to at least 95% Modified Proctor Density.
- E. Contractor shall excavate the entire trench length before installing any piping or services.
- F. The Contractor shall then verify any interference with existing services and inform the Engineer before any new piping or services installation can proceed. The Contractor shall be responsible for any modifications required as a result of not complying with these requirements.
- G. Unless indicated otherwise, all piping with less than 1 meter cover shall be encased in concrete with 150mm cover on all sides, as described above.
- H. Install piping in accordance with the manufacturers printed instructions and recommendations.
- I. Minimum cover above outer jacket shall be 1500 mm.
- J. Allow for expansion, contraction and movement of all piping as required. Provide expansion joints in concrete encasement of pipes at all flexible pipe joints. Wrap all piping to be encased in concrete with polyethylene sheets.

Materials

- A. All materials and their workmanship shall be of the best quality of their respective kinds.
- B. All materials referred to in the Specification shall be subject to the Employers Agents approval and samples where requested shall form the standard of quality for all such materials used in the Works.
- C. Where the quality of materials is not specified, they shall be the best of their respective kinds and shall be in accordance with any relevant British Standard Specification or local standard applicable and samples or full details shall be submitted to the Employers Agent for approval before use.
- D. Should the Contractor wish to deviate in any way from specified items, he must do so in writing to the Employers Agent and obtain approval prior to



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

submitting his priced Tender, otherwise he shall be held to have included for any one of the specified manufacturers.

- E. When such terms as 'equal' or 'equal and approved' are used alternative articles may be accepted, but shall only be submitted for consideration as an alternative to those specified and they shall then be scheduled with full details and price differences. The alternative articles may only be utilised after the Engineer has commented and agreed their use in writing.
- F. The Employer's Agent may require the Contractor to submit correctly identified and documented samples of any materials or workmanship to be used in the Contract Works for his appraisal. The Contractor shall allow for any charges necessary in complying with this condition. All materials and workmanship for which samples have been accepted must conform in every respect with such samples, and any items not conforming to the accepted standard shall be removed.
- G. The complete installation shall be carried out in a neat and proper manner, particular attention being paid to the continuity of the whole system and sound and secure fixing of all materials and equipment. Under no circumstances will any inferior work be accepted by the Employers Agent or his appointed representative.
- H. All plant materials shall be new and the Contractor shall ensure that no materials or equipment are fitted which show signs of corrosion or faults or are damaged in any way. Replacement of such plant or materials shall be at the expense of the Contractor.

Compatibility

- A. Similar items of apparatus and equipment shall be made by the same manufacturer. Corresponding parts of all apparatus and equipment shall be interchangeable.

Samples

- A. The Contractor is to obtain or execute samples of material and workmanship and deposit same with the Employer's Agent at no additional expense to the contract for approval, if required, before incorporating in any part of the work. The Employer's Agent retains the power to reject any materials or workmanship that are, in his opinion, unsatisfactory and not up to standard and the Contractor shall immediately remove or amend such rejected materials or workmanship at his own expense.
- B. The contractor shall submit to the Engineer for comment, such samples of workmanship, materials or equipment which the contractor proposes to use in the execution of the works.
- C. Where, in the opinion of the Engineer and the Employers Agent, the samples submitted are not of a suitable standard, he reserves the right to instruct the contractor to obtain alternative materials or equipment from such a source as the Employers Agent may direct or agree with the contractor.
- D. As an alternative to the provision of samples, the Engineer may at his sole discretion, accept to visit existing installations where the requisite item(s) is installed.
- E. All expenditure in connection with samples shall be borne by the contractor.
- F. The Employer's Agent shall determine whether approved samples are to be retained on site, incorporated into the works or disposed of free of charge.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- G. Materials used on this project shall not be purchased by the Contractor before receipt of approval from the Engineer.
- H. All similar materials used on this project shall be purchased from the same manufacturer.
- I. It is recognized that a relatively high proportion of the engineering services installations and components are not normally expected to have a service life of the design life duration stated above, due to moving components and normal wear and tear related to use, thermal movement, etc. It is also recognized that some plant and installations may require planned replacement or major refurbishment prior to the end of their service life to avoid unacceptable disruption to the development due to failure.
- J. Having recognized limitations in respect of the ability of some engineering services installation to accord with the development design life, the Employer requires that all engineering installations have standards of durability and quality which reflect the intent of the development design life.
 - i. Table 2: Category 1: Replaceable
 - ii. Table 3: Required Service Life Table 2 : Category 1
 - iii. Predicted Service

In accordance with the typical economic life given by The Chartered Life Institute of Building Services Engineers' Guide, Volume B, Section B18, Table B18.2.

Design Life

As a minimum, the middle of the range of typical economic life given in CIBSE, Table B18.2 For consumable component parts, e.g. lamps, filters, bearings, etc., the manufacturer's normal durability will be expected. When requested, such manufacturer's data shall be submitted without undue delay. The premature failure of components due to manufacturer's quality control procedure, e.g. accepted percentage failure based on volume of production, will not be considered an acceptable criteria in the design life or predicted service life of the products installed in the project.

- i. Table 4: The normal level of maintenance for the engineering services installations will be level 2 'Scheduled Maintenance Plus repair'. The installations will be operated and maintained in accordance with Operating and Maintenance Instructions prepared by the Contractor. If any manufacturer or supplier of plant, equipment or components requires a maintenance level more stringent than level 2, this must be clearly identified and detailed within the contractor's written instructions, reliance on the maintenance personnel eliciting such requirements from manufacturer's published data/literature alone will not be accepted.
- ii. Table 5: Within the Operating and Maintenance Instructions for the development, the 'A' schedule of the type contained in Appendix A of the British Standard should be included. Within this schedule, the categories of Effects of Failure shall be listed and manufacturers/supplier's data on the life of their products. The contractor shall liaise and co-operate with others in the production of the schedule(s).

MOCK UPS



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. The contractor shall be instructed by the Employer's Agent to take part in construction of mock ups of the works to resolve quality standards, typical arrangements of the works or to resolve pinch point areas.
- B. Where such mock ups are undertaken within the frame of the building in the site of the works pertaining to the mock up, the mock up may form part of the permanent installation only in the event of an issue of an instruction advising the Employer's Agent acceptance for this purpose.
- C. Where such mock ups are constructed away from the works, or materials utilized in a non permanent mock up, they shall be considered to be samples, i.e. fan coil and associated ductwork and fittings.

VARIATION FROM MATERIALS SPECIFIED

- A. Materials and products specified by the name of the manufacturer, the brand or trade name, or catalogue reference, shall be the basis of the tender price. These shall be provided under the Contract unless substitutions are proposed and accepted, in writing by the Engineer, in accordance with the following procedure:
 - i. Substitution may be proposed only when the clause 'or other approved manufacturer is used in the specification. Any substitute shall comply with the base bid specifications.'
 - ii. The proposed substitution shall be listed under 'Variation from Materials Specified' on the tender proposal form.
 - iii. The proposed substitution shall show product name and complete description and also what difference, if any, will be made in the amount of the tender price for each substitution, should it be accepted.
 - iv. All additional costs resulting from the use of substituted items shall be paid by the Contractor.
- B. Manufacturer and quality standard of materials used in the construction of this Project shall be subject to the review of the Engineer.
- C. Materials and equipment supplied by this Division shall be new and free from defects and shall be equivalent in physical characteristics and performance in all respect to that specified by the manufacturer's name and catalogue reference.
- D. Where two or more manufacturers are named for a specific item, the choice of manufacturer shall rest with the bidder, unless indicated otherwise.
- E. Where a certain manufacturer's equipment has been specified by name or model number, the Contractor shall be responsible for ensuring that the same access or maintenance space is available for an alternate manufacturer's equipment that is used and that piping, duct and electrical connections can be made at no extra cost.
- F. The products of the specified manufacturers, even when model numbers are indicated, are acceptable only when the products comply with or are modified as necessary to comply with the requirements of the contract documents.
- G. Where manufacturer's model numbers are indicated, these are only intended to be a guide for equipment selection. The choice of manufacturer shall rest with the bidder based on the named manufacturers and the performance specification.
- H. All materials to be used shall be suitable for installation in a corrosive environment. All screws, bolts, washers, etc., in non-conditioned areas shall be stainless steel.

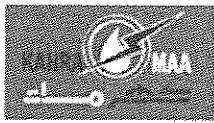


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- I. Local manufacturers will be acceptable provided that they comply fully with the specifications, and satisfy the engineer.

CUTTING, PATCHING, SLEEVES AND ESCUTCHEONS

- A. The Contractor shall leave chases and openings in walls and floors as required by the Mechanical Division for piping and accessories. These chases and openings shall not be cut larger than necessary to accommodate the equipment passing through.
- B. The cost, location and sizing of all cutting and patching required for the work of Mechanical Division shall be the responsibility of the Mechanical Division. Cutting and patching shall be performed by trades specializing in the materials to be cut and patched.
- C. The Contractor shall be advised in regard to this work before the concrete is poured and the walls are built, and when required, shall be given location for all holes and pipes, convectors and accessories. All necessary sleeves and inserts shall be supplied by the Mechanical Division. Holes not located in accordance with the above provisions shall be made at the expense of the Mechanical Division. Cutting of structural members shall not be permitted without specific written acceptance from the Engineer.
- D. All drilling for hangers, rod inserts and work of similar nature shall be done by the Mechanical Division.
- E. Escutcheons shall be provided at all penetrations of piping into finished areas. For insulated pipes the escutcheons shall be large enough to fit around the insulation. Escutcheons shall be chrome plated polished cast brass with set screw and of size sufficient to conceal openings in building construction.
- F. It shall be the responsibility of the Mechanical Division to supply the Contractor with anchor bolts and base diagrams of equipment showing exact location of anchor bolts.
- G. Pipes, ducts and conduits shall have galvanized steel sleeves where they pass through walls, floors, ceilings and partitions. Clearance shall be 12mm minimum. Sleeves shall be sized to clear insulated pipes and ducts which have a vapor barrier.
- H. Where pipes pass through exterior foundation walls, allowance shall be made for differential settlement between the pipe and the wall. A 6mm thick non corrosive material (ABS, GRP, or PVC) sleeve of inside diameter not less than 75mm greater than the outside diameter of the pipe shall be used. Water proofing shall be done through the use of Dogma seals or equal approved.
- I. In kitchens, and similar rooms, and in mechanical rooms and pipe spaces above basement floor, sleeves shall extend 100 mm above the floor. In floors with a damp proof/waterproof membrane, sleeves shall have a 50mm wide collar welded all around, at membrane level. Sleeves passing through stud partitions shall be No. 22 U.S. ga. steel. Where pipes are to be insulated, sleeves shall be sized to accommodate the outside diameter of the insulation.
- J. Where duct work passes through an opening other than where a fire damper is required, pack the opening around the duct with glass fibre and seal with Mastic.
- K. Where pipes or ducts pass through fire separations, pack space between duct or pipe and sleeve with UL listed, non corrosive, fire barrier penetration sealant. For PVC and plastic piping use "DONUT" Type INTUMEX #RS-10



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

plastic pipe fire stop closure system. Provide UL listed fire dampers within the ducts passing through fire walls. All pipe and duct penetrations shall have UL listed fire barrier assemblies.

PIPE SLEEVES

- A. The contractor shall be responsible for supplying all sleeves as necessary for incorporation into the building works, and ensuring the correct location, level and line are achieved.
- B. Sleeves shall be:
 - i. Clean, square, free from internal burrs and distortion.
 - ii. Complete with lugs to locate in floors and ceilings.
 - iii. Treated against corrosion.
 - iv. Finished flush with the finished face(s) of walls, floors, ceilings and partitions but project above the level of the bund in wet working areas or ablutions.
 - v. Caulked with an approved material to provide an effective seal for the required application (e.g., fire, waterproof, vapour barrier, etc.).
 - vi. In the form of puddle flanges on below ground services entries.
- C. Pipework passing through the structure and fitted with sleeves in areas occupied or in regular use shall have cover plates fitted around the pipes (or sleeves in wet areas) to suitably conceal the gap and sleeve end. The plates shall cover the sleeve end, including, oversize sleeves, and the piping to produce a neat and tidy appearance. Where pipes are adjacent to each other, space shall be allowed to neatly trim each sleeve cover plates.
- D. Where pipework passes through a fire rated structure the pipe, and insulation, if applicable, shall be combined with a metal sleeve and a proprietary stopping system capable of achieving fire separation compatible with the structure through which it passes.
- E. Pipework passing through roofs shall have sleeves projecting above the overflow level of the roof and fitted with sheet metal weathering aprons and skirts for application by others.

CONCEALMENT OF PIPING

- A. All pipes shall be concealed inside walls, and/or furred spaces unless specifically indicated otherwise.
- B. Carry out, without cost, all alterations necessary in the arrangement of work which has been installed without proper study and approval in order to make such work come within finished lines of walls, ceilings and floors or to allow the installation of the work of others.

PIPING INSTALLATION

- A. Before installing piping, check mechanical drawings with architectural, structural and electrical drawings; make an accurate layout of piping. Where interference may appear and departures from indicated arrangements are required due to changed locations and elevations of piping, obtain written permission for proposed changes from the Engineer.
- B. Verify all invert elevations required for drain connections prior to commencing installation and connections to ensure that these connections can be made with sufficient slope for drainage.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- C. Arrange and install piping to obtain maximum head room, avoiding structural interference. Where piping is to be furred in, or concealed, this contractor shall coordinate the work to maintain his lines and levels.
- D. Arrange and install piping approximately as indicated. Install piping parallel to building walls. Cut all pipes accurately to measurements taken at the site and install without springing or forcing. Make all changes in direction with fittings. Locate groups of pipes parallel to each other, spacing them at such a distance so as to permit the application of insulation. Pipes transporting hot fluids shall be installed at least 6" (150mm) away from pipes transporting cold fluids.
- E. The inside of all pipe, fittings, traps, valves and other equipment shall be smooth, clean and free from blisters, loose mill scale, sand and dirt when erected. Whenever work is suspended during construction, or whenever there is danger of depositing foreign matters in the pipes, protect the open ends by using temporary plugs or caps.
- F. The slope of the line shall be uniform between established elevations without pockets.
- G. All reductions in pipe size shall be made by using reducing fittings, installed to permit easy drainage of pipe system and to avoid air pockets.
- H. Where piping of dissimilar metals, including copper piping and ferrous materials, are joined provide dielectric couplings.
- I. Install piping serving all equipment in such a manner that only small sections need be removed to permit removal, cleaning or inspection (as applicable) of the unit itself, or coils, tube bundles or heat exchangers contained therein.
- J. Provide flanged or union connections for ready disconnection of piping at equipment. Victaulic couplings may be used in lieu of unions or flanges where permitted by the Engineer. Do not place any union or flanged connection in a location which will be inaccessible after completion of the building. For piping up to and including 2 inch (50mm), and where indicated on the drawings, install a union on each side of each control valve, regulator, etc. on one side of each check valve, and at all pieces of equipment without flanged connections such as pumps, air coils, tanks, etc., in order that such equipment may be readily disconnected. Use flanged connections on piping over 2 inches (50mm) and where indicated on the drawings. Where flanged valves, regulators, etc., do not permit the removal of flange bolts, separate two such devices by a spool. Always use a spool to separate equipment to be isolated by a butterfly valve.
- K. Where raised face flanges are to be mated with flat face equipment or valve flanges, the raised face of line flanges shall be removed. Bolt holes shall straddle centre lines. Steel flanges to be bolted to cast iron valves or equipment nozzles shall be flat faced, with full gaskets.
- L. In piping material classes permitting use of both welding neck and slip-on flanges, use of welding neck flanges shall be restricted to locations adjacent to welding fittings and butterfly valves.
- M. Locate all valves for easy access.
- N. Piping and pipe sizes not indicated on the drawings shall be of size as specified or as recommended by equipment manufacturers and in accordance with the requirements of the authorities having jurisdiction. Pipe runs shall be subject to the review of the Engineer.
- O. Use long radius type elbows where space permits.



Qatar General Electricity & Water Corporation

Tender NO. GTC 626/2014

Construction of Mega Reservoir PRPSs

(Packages A, B, C, D & E)

- P. Pipe all relief valves, backflow preventers and drain valves to nearest floor drain.
- Q. Steel piping installed in inaccessible locations shall have welded joints.
- R. Apply two coats of asphalt paint to all pipe laid in concrete or passing through concrete.
- S. Provide drip pans below all new water, or drain piping located in electrical rooms and transformer rooms. Pans shall be constructed of 18 gauge galvanized or stainless steel, cross-broken to prevent "oil-canning". Each pan shall have a 1" high lip and all corners shall be welded, brazed or soldered to be water tight. A pipe nipple of material matching the pan itself, shall be provided at the pan low point and piping shall direct the drainage to the nearest floor drain.
- T. Carry out, without cost, all alterations necessary in the arrangement of work which has been installed without proper study and approval in order to make such work come within finished lines of walls, ceilings and floors or to allow the installation of the work of others.

COORDINATION

- A. Allow for setting round piers and minor obstructions that may not be readily identified on the drawings due to scale or drawing convention.
- B. Take site measurements for all in situ or prefabricated pipework and prepare detailed working drawings prior to installation.
- C. Ensure clearance between adjacent services in accordance with item 1.17.
- D. Ensure access is maintained for the inspection, repair or replacement of adjacent services.

WORKMANSHIP

- A. An installation shall be unacceptable where there is evidence of materials, incorrect for the purpose, in anyway damaged, due to lack of protection or poor installation method and shall be replaced at the Contractor's expense. Any pipework or fittings with damage or deterioration to the manufacturer's finish shall be replaced or made good to the Engineer's satisfaction.

PIPEWORK PROTECTION

- A. Ensure foreign matter is not allowed to enter installed pipework.
- B. Fit purpose-made plastic or metal covers to all ends left open at any time. (A closed valve shall not be adequate for this purpose.)
- C. If the contractor fails to comply with this clause, the engineer shall have the right to request the pipework to be dismantled for inspection and cleaning for such length, as he deems necessary at the contractors' expense.

INSTALLATION METHODS

- A. Connection of copper pipework to galvanised components shall be by means of nonmetallic couplers. Flanged connections shall have rubber or vulcanite ferrules and washers for the bolt holes and non-conductive rubber rings for the full diameter of the flange faces.
- B. Connections to equipment shall be made using flanges or union connections and any necessary reducing fittings. Where the equipment flange is of a higher table pressure than the specified pipeline then matching flanges and bolts shall be fitted to the pipe.
- C. Where the equipment connection is less than line size the reduction shall be made close to the equipment on the equipment side of the isolating valves, which shall be line size.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- D. Pipe runs shall avoid running over any electrical panel or equipment. Should this be unavoidable then the contractor shall provide protection underneath the pipework to fully protect the equipment.
- E. Eccentric type reductions and enlargements shall be used on horizontal pipe runs to allow draining and venting, concentric fittings shall be used on vertical pipes with easy transition and an included angle not exceeding 30 degrees. Use square tees at venting and draining points. Bushes shall not be used for reducing purposes other than for thermometers or other control items. Long screw fitting connections shall not be used. For changes in direction centreline/radius/nominal bore ratio of 1.5 shall be used.
- F. Sets and bends shall be formed without a joint of any kind within its length and without evidence of ripping, thinning or other damage or distortion.
- G. Pulled bends shall be used wherever practicable in preference to round elbows unless appearance dictates otherwise. Sweep tees or twin elbow parallel tees shall be used on water circulation pipework with square tees or round elbows only on final draw-off dead legs of less than 13m, to facilitate draining or venting.
- H. Puddle flanges shall be fitted where pipes pass through waterproof or oil-proof structures or enter a pipe duct below ground level. The fabricated unit shall allow access for flange connection, be treated against corrosion, and built-in to the structure by others.
- I. The pipework installation shall be carried out in accordance with the following:-
- J. Pipework shall be:
 - i. Suitable for the purpose intended.
 - ii. New, free from burrs, corrosion, scale, cracks, laminations and other defects
 - iii. Marked with appropriate colour bands for the grade of pipe.
 - iv. Pipework shall be supplied in the manufacturer's straight random lengths.
 - v. Stored under cover in purpose-made racks in accordance with the manufacturer's recommendations and with ends sealed with purpose-made plastic or metal covers.

PIPEWORK CLEARANCES

- A. Pipework shall be so fixed as to give the following minimum clearances between the pipe or external surface of the insulation, where specified, and adjacent surfaces, as follows:

Adjacent Element	Clearance
Walls	25mm
Ceilings	50mm
Finished Floors	165mm
Adjacent pipes, both insulated including flange, valves, valve boxes, filters	25mm
Adjacent pipes, both uninsulated	50mm



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Adjacent pipes, one only insulated	50mm
Insulated pipes adjacent to conduit or trunking	25mm
Uninsulated pipes adjacent to conduit or trunking	100mm
Uninsulated pipes adjacent to electrical cables not in conduit or trunking	150mm
Insulated pipes adjacent to electrical cables not in conduit or trunking	100mm

- i. Pipes passing through walls, floors, ceilings and similar structural elements shall:
- ii. Be continuous with no joints within the thickness of the structure.
- iii. Be inserted through sleeves of similar material to the pipe which shall be built into the structure.
- iv. Be installed clear of the sleeve at all points.
- v. Be fitted with telescopic polished aluminium sleeve type or split chromium plate copper cover plates where normally visible in occupied and circulations area.

PIPEWORK BREAK CONNECTIONS

- A. Flanged or union break connections shall be provided in pipework systems:
 - i. To permit easy removal of equipment and pipework for maintenance, repair and replacement.
 - ii. At bends and branches as necessary to allow easy disconnection of sections of pipework.
 - iii. At a maximum of 12m centres in straight runs except within computer rooms where flanges and unions shall not be installed within main pipe runs.
 - iv. At all plant connections in locations such as to allow inspection, maintenance and replacement to be carried out with minimum disturbance to pipework and insulation. 1.12.27.2 Break connections shall not be provided on buried pipework or pipework in not normally accessible concealed locations.

CONNECTIONS FOR FUTURE USE

- A. Connections for future use shall be:
 - i. Fitted with an isolating valve in accordance with the valve schedule.
 - ii. Finished with a blank flange to the same specification as the mating flange or cap for non-flanged pipework.

VALVES

- A. All valves and cocks in water supply services shall comply with the requirements of the Water Supply Regulations for the services in which they are installed and the Contractor shall include for any testing and stamping which the Regulations may require.
- B. Valves are to be provided as indicated on the drawings and at all places necessary for the correct working, regulation, control and maintenance of



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

the installation. Valves shall be either screwed or flanged as appropriate for the pipework into which they are installed.

- C. All valves and cocks shall be located and installed to allow ease of operation and servicing. Where valve cocks are concealed behind access panels or similar, they shall, wherever practical, be grouped for ease of access and reduce the number of access panels required.
- D. All seats, discs and packing shall be suitable for the operating conditions, temperatures and pressures, and provide efficient service with the minimum of necessary maintenance.
- E. Valves and cocks in areas where unauthorized interference with settings is possible or where such interference could be a source of danger, shall be fitted with key operated spindles and dust covers. Alternatively, on large valves they shall be securely locked by means of a padlock, in the set position. Wheeled valves on hot services shall be fitted with "cool" pattern wheels.
- F. All screwed valves and cocks shall be fitted with a union on the "dead" side of the valve or cock.
- G. Valves shall be:
- H. Fitted with an engraved identification label.
 - i. Of the lock shield type where liable to interference from unauthorized persons.
 - ii. Lockable where items of plant may be maintained 'on line'.

VALVE KEYS

- A. A minimum of 3No of each type of valve key shall be supplied for the operation of lock shield valves, air cocks, drain cocks, etc.
- B. Safety/pressure relief valves
- C. Safety/pressure relief valves shall be:
 - i. Supplied with a suitable padlock and key.
 - ii. Fitted with a discharge pipe run to a point where the discharge shall be immediately noticeable, but shall not cause hazard to personnel or damage to property and finished.

EMERGENCY SHUT OFF SOLENOID VALVES

- A. Emergency gas shut off valves shall be provided at the building entry point and at the entry to boiler rooms and kitchens.
- B. The gas emergency shut off valves shall be of the two port solenoid type operated by a gas sniffer detection system, heat detectors or the building fire alarm system.
- C. The valves shall be normally open and motor shut on gas detection.

VALVE LUBRICATION

- A. Where lubricated plug valves are installed they shall be fitted with high pressure nipples and a minimum of two sealing compound injection guns complete with three pre-packed cartridges of each type of sealing compound used shall be provided.

INSULATION CLEARANCE

- A. All valve operating spindles, test points, vents, drain cocks, etc, shall be extended to clear any insulation.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

THERMOSTATIC EXPANSION VALVES

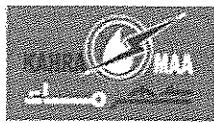
- A. Thermostatic Expansion Valve remote, bulbs shall be clamped to the horizontal suction line immediately after the evaporator and shall ensure good thermal contact. The T.E.V. bulb is not to be installed close to possible liquid pockets, pipe joints or solid metal components.
- B. The bulb must not be subjected to any temperature effects other than the suction line, in accordance with the manufacturer's recommendations of liquid from the remote bulb to the power head of the T.E.V. is not permitted.
- C. The selection of the T.E.V. must be such that its maximum operating pressure complies with that of the system's maximum operating and test pressure.
- D. Suction lines must be trapped immediately after the expansion bulb in order to prevent liquid refrigeration draining to the compressor during the off cycle period.

INTERFACE WITH STRUCTURE

- A. The contractor shall note the structural loading design allowances incorporated into the Structural Engineers calculations and ensure that his installation does not exceed these values.
- B. The contractor shall be responsible for the design, detailing, fabricating, supply, installation and statutory approvals of all secondary steelwork (as detailed below) or any other secondary structural work necessary to support, secure or otherwise connect the works within the contract to the primary structure.
- C. The contractor shall be responsible for any site surveys necessary to check the accuracy of the drawings with respect to the 'As Built' primary structure prior to carrying out any fabrication or installation of any secondary structural works.
- D. Detail drawings and calculations for all secondary structural works shall be submitted for review prior to the fabrication or the installation of any secondary structural works.
- E. All points of connections to the primary structure and the loads applied at these points shall be to the approval of the Employer's Agent via the Structural Engineer.
- F. Secondary steelwork and fixings shall be designed in accordance with the requirements of the Building Regulations and all relevant Codes of Practice and British Standards including the following:
 - i. BS.5950 : Structural Use of Steelwork in Buildings
 - ii. CP3 : Chapter V, Part 2 Wind Loads
 - iii. BS.648 : Schedule of Weights of Building Materials
 - iv. BS.6399 : Design Loadings for Buildings
- G. At all building expansion and construction joints, the contractor shall install flexible couplings and movement provisions within his installations. The details of the couplings and provisions to be used shall be agreed with the Employer's Agent during the working drawing production stage.

ACCESS AND MAINTENANCE

- A. In the preparation of installation drawings and in the erection of the mechanical and electrical contract work, the contractor shall ensure that adequate provision is made for access to, operation and maintenance of the various valves, damper components, plant and equipment.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- B. Provision shall be made so that apparatus which needs regular removal for maintenance may be removed with the minimum of disconnection and without interference to other adjacent installations.
- C. Provision of access shall be deemed to provide for installation, testing/commissioning, identification and future maintenance/ replacements.

WORKING IN CONFINED SPACES

- A. The Contractor shall be governed by a 'Safe System of Work' and all such works shall be undertaken in accordance with an appropriate 'Permit to Work' procedure where such procedures are in operation on the site.
- B. Where no 'Permit to Work' system is in operation, the works shall be undertaken only after full investigation and resolution of the following matters has been completed and the Employer's Agent informed in writing of the proposals :-
 - i. Assessment of the task to be undertaken
 - ii. Identification of the hazards of the task
 - iii. Decision on Methods of Working to avoid hazards
 - iv. Implementation of the system of work incorporating these methods
 - v. Monitoring of a system of work
- C. Before commencing work and before Personnel enter the space concerned, it shall be demonstrated to be safe by testing that no toxic or asphyxiant gases are present and that adequate oxygen levels are present.
- D. Before commencing work, include an assessment of the likelihood of the conditions remaining as found. The impact of any materials or equipment to be taken into the confined space or found there (deposits, sludge, residues, etc.) and the possibility of any hazardous gases or vapours being able to enter the space.)
- E. Only trained Personnel shall progress the works which shall be undertaken after consideration of the following :-
 - i. The provision of safe means of access and egress
 - ii. The presence of personnel to keep watch outside
 - iii. The provision of effective communications between personnel inside and outside
 - iv. The provision of suitable protective equipment including harnesses, if possible, and self rescuing breathing apparatus, if appropriate
 - v. The availability of gas detection equipment and staff trained in its use.
 - vi. A means of affecting a rescue in the event of an emergency

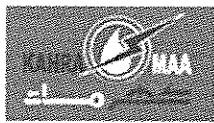
7.1.4.3 SERVICE DUCTS AND VOIDS

Services in ducts and in other voids shall be so arranged and secured that as far as is practicable, they will not prevent convenient access for the maintenance and renewal of any other service.

7.1.4.4 BUILDERSWORK

General

- A. Cutting of ways is excluded from this section of the works unless specifically included but the Contractor must include for marking off all holes for cutting. The Contractor must also include for marking off, cutting and making good on site all holes required for brackets and supports and fixing same.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- B. The Contractor must also include for preparation of complete and dimensioned builders work drawings, base detail drawings, etc. The Contractor must refer also to the Clause dealing with Drawings and Dimensions. All brackets shall be supported by Rawl bolts, Philips Redheads or Lindaptors, dependent on site conditions and the Contractor must include for cutting all holes for same, supplying and fixing whichever is requested by the Employers Agent.
- C. Where holes of a significant nature have already been agreed with the Architect, the Contractor shall check such builders work provisions and satisfy himself that the allowances are sufficient. The Contractor must report to the Employers Agent within seven days of the Contract award, his confirmation of such openings, otherwise they will be deemed to be acceptable.
- D. The Contractor will bear the full costs of any rectifications carried out due to incorrect work carried out by him.

Services Through Fire Stopping Walls, Floors etc.

- A. Where services pass through fire stop walls or floors, any resulting gaps left around the service and hole in the building structure shall be effectively infilled and sealed with fire resistant material to provide an air tight seal to prevent the passage of any smoke and thus maintain the fire-break. In addition on pipework systems, proprietary metal decorative pipe covers will be required to be fitted on both side of walls or floors. These shall be attached to the pipe and included in the Tender price.

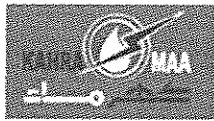
7.1.4.5 OPERATING LIMITS

No plant, equipment, valves, piping fittings etc. shall be installed under this contract if they will be operating outside the manufacturer's stated pressure and temperature operating limits.

7.1.4.6 TEMPORARY USE OF EQUIPMENT

Where the Contractor has been granted permission to use mechanical systems for his benefit during construction, he shall maintain the systems and equipment in proper operating condition.

Before any area of the building is turned over to the Owner for acceptance and for beginning of maintenance/guarantee period, the systems and equipment shall be returned to the initial new condition by replacing used air filters with new air filters, cleaning the air side of all coils in the air handling systems, replacing used belts in belt drives with new belts, lubricating all bearings according to manufacturer's factory standards and adjusting the thermostatic control system according to specifications and/or to suit the Engineer.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

7.1.4.7 EXISTING SERVICES AND EQUIPMENT

Changes and connections to existing services shall be made only in a manner and at a time accepted by the Engineer, so as to avoid any interruption of such services during normal working hours. If necessary, changes and connections to existing services shall be made outside of normal working hours, at no extra cost to this Contract.

Whenever existing services or equipment are to be removed, all piping for such services or equipment shall be removed from any area where it is exposed, if no longer required and securely capped or plugged in an acceptable manner. If necessary to facilitate installation of new work, any existing services and equipment shall be removed and then replaced by the Contractor, at no extra cost to this Contract.

Whenever it becomes necessary to relocate existing piping equipment to make possible installation of the work under this contract, such relocation shall be done by the Contractor at no extra cost to this Contract.

Where connections are made to existing services, existing services within 1m (3 ft.) of the connection shall be made good under this Contract.

7.1.4.8 SUBMITTALS:

Prior to any orders being placed the Commissioning Authority (CA) shall review all drawings and manufacturer's details.

Submittals shall be in a clear, definable and easily read format with the specified technical details, notes, performance data and calculations where applicable all in the English language.

Where drawings are to be examined the manufacturer's details shown on the drawings must have been previously approved.

Include all costs for attending meetings associated with the submittal review procedure. Meetings will be held at client's required location

Agree with the CA where samples of materials offered for review are to be sent.

Issue progressively drawings, calculations and submittals as agreed in advance with the CA for review.

All correspondence related to the examination and review procedure shall be directed through the office of the CA.

The timescale for review or comment or otherwise on all submittals shall be 20 working days from the date of receipt

7.1.4.9 SCHEDULE OF DRAWINGS AND SUBMITTALS

Provide a schedule of all proposed drawings and submittals required for comment. The schedule shall be provided 2 weeks from contract appointment

Indicate as a minimum the following information on the schedule:

Drawing number and revision number

Drawing title and service

Scale



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Latest date required on site and/or for manufacturing purposes
Date required for final comment
Date for submission for comment
Date of commencement of drawing production
The schedule shall be updated as necessary on a regular basis at intervals agreed with the consultant during the contract period.
The programme for production of drawings and other submittals should include the necessary time for:
Submission
Examination
Alterations and re-submission in the event of the initial submission not being accepted
Final issue
Allow adequate time in the programme in order not to cause delays.
The full extent of all submittals shall be indicated in the schedule.
Group submittals for a particular part of the building or building engineering service as agreed with the consultant.

7.1.4.10 EQUIPMENT PERFORMANCE DETAILS

Details of the equipment selected for inclusion into the Works shall include the following information:

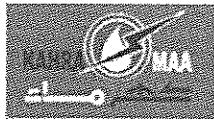
- Plant item description, reference identification and serial number.
- A. Electrical input rating - KVA, Volts, Phase.
 - B. Operating mode - duty, standby, generator etc.
 - C. Starting characteristics - starter type, current, starts/hour and starting time.
 - D. Performance characteristics - (full load current and power factor).
 - E. Noise level.
 - F. Weight.

The format of the information shall be as agreed with the consultant.

7.1.4.11 DRAWINGS

PREPARATION OF DRAWINGS:

- A. Agree with the CA a document numbering system prior to preparing any documents.
- B. All drawings shall be prepared using a computer aided draughting system and the software used to produce drawings shall be approved prior to commencement of drawing production.
- C. Each service shall be represented by a separate layer/overlay, for subsequent easy modification.
- D. Prior to commencement of drawing production agree the sequence of layers, pen colours and sizes.
- E. The medium for transfer of information shall be Auto Cad 2006 AutoCAD drawing files shall be DWG

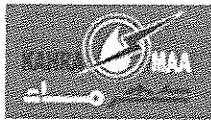


**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- F. Drawing plots shall be "A" size to British Standard, with an agreed logo/title block.
- G. The standard drawing size is to be A0 Scales used on drawings shall be selected to convey clearly the proposals

REVIEW OF SUBMITTALS:

- A. Submittals will be examined for compliance in principle with the design intent
- B. Such examination shall not relieve any responsibilities and obligations under the contract.
- C. Examination of any submittal by the consultant shall not mean that the consultant is responsible for the correctness of the drawing or submittal or its suitability for purpose. These responsibilities shall remain as defined elsewhere and as the contract.
- D. Allow adequate time in the programme for submittals with due allowance for incorporation of comments and resubmission in order not to cause delays.
- E. Each package shall contain all drawings, design calculations, support information, manufacturer's literature, etc necessary to facilitate examination by the CA.
- F. Revised items on drawings shall be clearly indicated and annotated with a revision number/letter.
- G. Submittals will be returned indicating "A", "B" or "C" action.
- H. "A" action
 - i. Examined no comments
 - ii. "B" action
 - iii. Examined subject to minor amendments
 - iv. "C" action
 - v. Rejected with or without comments
- I. In this case the drawings shall be re-submitted after correction or with further information added.
- J. Drawings and submittals with "B" or "C" action, shall be adjusted/revised for comments immediately and re-submitted to the CA within 5 days or earlier if site progress dictates.
- K. Where drawings are revised and updated during the construction stage these shall be issued to the CA for examination of the revision only, the revision being clearly marked.
- L. Builder's work information and installation drawings shall not be examined in detail but shall be examined by the CA for general suitability.
- M. Record drawings are to be prepared as the contract works progress and shall be examined in the same manner as for other submittals.
- N. The timescale for review or comment or otherwise of record drawings shall be 30 working days from the date of receipt by the consultant



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.4.12 MISTAKES

MISTAKES IN SUBMITTALS:

- A. Examination and/or issue on a CA instruction of submittals shall not be deemed to remove any duties, obligations and responsibilities under the contract.
- B. Be responsible for any error, discrepancy or omission in any submittal, presentation or drawing prepared or where others have prepared these for submittal.
- C. The said indemnity shall be subject to the proviso that such error, discrepancy or omission is not due to any inaccurate data, drawing or information provided by the employer or by the CA on his behalf.

FORM AND NUMBER OF SUBMITTALS TO BE PROVIDED:

- A. All submittals shall be issued to the consultant
- B. Provide drawn information in the following forms but not limited to the following
 - C. Initial copies for comment
 - D. print form
 - E. Final copies for distribution
 - F. print form and
 - G. CAD format
- H. Provide copies of drawn information as follows:
 - I. Sketch drawings
 - J. Final copies for design team (10no)
 - K. Schematic drawings
 - L. Initial copies for comment (10no)
 - M. Co-ordination drawings
 - N. Initial copies for comment (10no)
 - O. Workshop drawings
 - P. Initial copies for comment (10no)
 - Q. Workshop wiring drawings
 - R. Initial copies for comment (10no)
 - S. Builder's work information
 - T. Initial copies for comment (10no)
 - U. Controls logic diagrams
 - V. Initial copies for comment (10no)
 - W. Final copies for design team (10no)
 - X. As-installed drawings
 - Y. Site record copy in print form (10no)

REVISIONS TO DRAWINGS:

- A. Where revisions take place either under the authority of a CA instruction, or by written agreement with the CA or when revised architectural, structural or services information is issued, all drawings shall be modified accordingly and shall be re-issued for construction purposes subject to examination by the CA.
- B. The issue of revised drawings shall be in accordance with and with regard to the agreed programme for construction and where time is available re-issues shall be grouped together, as agreed with the CA.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

DRAWING DEFINITIONS

A. GENERAL:

- i. This section defines each of the main drawing types and outlines the extent and content of drawn information.
- ii. The contractor is to provide Shop drawings, workshop
- iii. Drawings, Record drawings and as built drawings in accordance with the following

B. THE TENDER DRAWINGS:

- i. Drawings produced to enable those tendering to interpret the design and to submit a tender for executing all or any part of the Works as defined elsewhere.

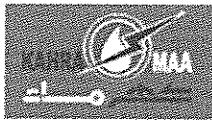
C. SKETCH DRAWINGS:

- ii. Line diagrams and layouts indicating basic proposals, location of main items of plant, routes of main pipes, air ducts and cable runs in such detail as to illustrate the incorporation of the engineering services within the project as a whole.
- iii. Schematic drawing: A line diagram describing the interconnection of components in a system. The main features of a schematic drawing are as follows.
 - 1) A two dimensional layout drawing with divisions to show the distribution of the system between building levels. Or an isometric style layout indicating the distribution of systems across individual floor levels. The drawing is not necessarily constructed to scale.
 - 2) Includes all functional components which make up the system, i.e. plant items, pumps, fans, valves, strainers, terminals, electrical components, distribution and components.
 - 3) Symbols and line conventions in accordance with BS EN ISO 3766, BS EN ISO 7518 and BS EN ISO 11091 Recommendations for symbols and other graphic conventions.
 - 4) Symbols and line conventions in accordance with QCS
 - 5) Label the drawing with appropriate pipe, duct and cable sizes where these are not shown elsewhere.
 - 6) Indicate components which have a sensing and control function and show the links between them, eg. building management systems, fire alarms and HV controls.
 - 7) Identify the major components indicated on the schematic drawing so that their whereabouts in specification and on other drawings can be easily determined.
 - 8) Commissioning data - include all data essential to testing and commissioning including:
 - 9) design total pressure losses at equipment
 - 10) location of valves and flow measuring stations

7.1.4.13 CO-ORDINATION

COORDINATION DRAWING:

- A. A drawing showing the inter-relationship of two or more engineering services and their relation to the structure and building fabric. The main features of a co-ordination drawing are as follows:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- B. Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas.
- C. A spatially co-ordinated drawing, i.e. no physical clashes between the system components when installed at the scaled-off positions shown on the drawing. Provide dimensions in areas where tolerances are minimal.
- D. Make allowance for the service at its widest point for spaces between pipe and duct runs. Allow for insulation, standard fitting dimensions and joint widths on the drawing.
- E. Make allowance for those plant items specified by the designer and identified in the design specification.
- F. Make allowance for installation working space and space to facilitate commissioning and maintenance.
- G. Indicate positions of main fixing points and supports where they have significance to the structural design.
- H. Arrange the services so that it is possible to demonstrate a feasible sequence of installation.
- I. Support the drawing with individual services drawings for clarity.
- J. Plantroom layouts to a scale of at least 1:20, accompanied by cross-sections and elevations to a scale of at least 1:20.

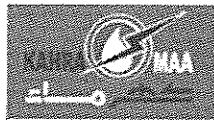
WORKSHOP DRAWING:

- A. A drawing based on the detailed drawing or co-ordination drawing with the primary purpose of defining that information needed by the tradesmen on site to install the works. The main features of installation drawings should be as follows:
 - i. Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas.
 - ii. A spatially co-ordinated drawing, i.e. no physical clashes between the system components when installed at the scaled-off positions shown on the drawing.
 - iii. Make allowance for inclusion of all supports and fixings necessary to install the works.
 - iv. Make allowance for the service at its widest point for spaces between pipe and duct runs. Allow for insulation, standard fitting dimensions and joint widths on the drawing.
 - v. Make allowance for installation details provided from shop drawings.
 - vi. Make allowance for installation working space; space to facilitate commissioning and space to allow on-going operation and maintenance in accordance with the relevant health and safety requirements.
 - vii. Make allowance for plant and equipment including those which are chosen as alternatives to the designers specified option.
 - viii. Provide dimensions where the positioning of services is considered to be important enough not to leave to the tradesmen on site.
 - ix. Plantroom layouts to a scale of at least 1:20, accompanied by cross-sections and elevations to a scale of at least 1:20

INSTALLATION WIRING DIAGRAM:

- A. Drawing showing the interconnection of electric components, panels etc in accordance with the design intent indicated in the schematic drawings and incorporating the details provided on manufacturer's certified drawings.

SHOP DRAWINGS:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Drawing prepared by a fabricator or supplier unique to the project. Including supplier's drawings for ductwork, pre-fabricated pipework, sprinkler systems, control and switchgear panels and associated internal wiring.

MANUFACTURER'S DRAWING:

- A. Drawing provided by a manufacturer or supplier to indicate a typical representation of the product, components or plant items to be supplied for a particular project.

MANUFACTURER'S CERTIFIED DRAWING:

- A. Drawing provided by a manufacturer or supplier to indicate details of the product, components or plant items and which the manufacturer or supplier guarantees the supplied equipment will comply with.

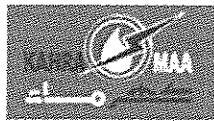
AS BUILT DRAWING:

- A. Drawing showing the building and services installations as installed at the date of practical completion. The main features of the record drawings should be as follows.
- Provide a record of the locations of all the systems and components installed including pumps, fans, valves, strainers, terminals, electrical components, distribution and components.
 - Use a scale not less than that of the installation drawings.
 - Have marked on the drawings the positions of access points for operating and maintenance purposes.
 - The drawings should not be dimensioned unless the inclusion of a dimension is considered necessary for location.

BUILDER'S WORK DRAWING:

- A. It is the contractors' responsibility to supply builders work drawings as set out below these are to be supplied in line with the building programme to enable the main contractor to carry out these work.
- B. Installation stage
- C. Drawing to show requirements for building works necessary to facilitate the installation of the engineering services (other than where it is appropriate to mark out on site).
- D. Builder's work drawn information to be provided shall include:
- Details of all bases for plant formed in concrete, brickwork or blockwork to a scale of not less than 1:20
 - Details of all attendant builders work, holes, chases, etc for conduits, cables and trunking etc and any item where access for a function of the installation is required to a scale of not less than 1:100
 - Details of all purpose made brackets for supporting service or plant/equipment to a scale of not less than 1:50
 - Details of all accesses into ceilings, ducts, etc at a scale of not less than 1:50
 - Details of all special fixings, inserts, brackets, anchors, suspensions, supports etc at a scale of not less than 1:20
 - Details of all sleeves, puddle flanges, access chambers at a scale not less than 1:20

CONTROLS LOGIC DIAGRAMS:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Diagrams, drawings and/or schematic details of all control components and instruments showing the layout with each item uniquely identified together with a description of the controls operation and details of the associated interlocking.

SWITCHGEAR, STARTER AND CONTROL INSTRUMENTATIONAL PANEL DRAWINGS:

- A. Drawings showing the construction and internal wiring diagrams of the starters, panels and/or other devices.

AS-INSTALLED DRAWINGS:

- A. Drawings/records retained on site to record the progress of and any site modifications to the Works including any changes to software.

7.1.4.14 SCHEDULES

PLANTROOM SCHEDULES AND SCHEMATICS:

- A. Provide good quality plant and switch room drawings, schedules, schematics and instructions and hang in the respective plant room or any other appropriate location or where directed by the CA.
B. Protect surfaces of such information by pressure lamination
C. Hang using suitable fixings and provide backboards AS necessary
D. A sample shall be submitted for approval to the CA prior to commencing production.

- i. Schematic drawings of circuit layouts showing:
- ii. Location, identification and duties of equipment
- iii. Location of controls devices
- iv. Circuit layout
- v. Control schematics.
- vi. Location of mechanical and electrical plant and equipment items.
- vii. First aid instructions for treatment of persons after electric shock.
- viii. Location of isolating switch for electricity supply.
- ix. Location of main incoming gas valve serving gas meter and isolation point.
- x. Location of main incoming water main and isolation point.
- xi. Emergency operating procedures and telephone numbers for emergency call out service applicable to any system or item of plant and equipment.
- xii. All other items required under Statutory or other regulations.

RECORD DOCUMENTS

- A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.

7.1.4.15 QUALITY CONTROL

CONTRACTORS QUALITY CONTROL

- A. The Contractor shall have designated a single Quality Control (QC) Representative, not the Job Superintendent or Job Project Manager, responsible for the overall quality of workmanship and compliance with specifications. The Contractor shall submit for approval a resume for the Quality Control Representative.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- xiii. The QC Representative shall be responsible to observe and certify the performance of contractor tests and pre-inspections identified on the Contractor's Quality Control, Required Certification Log.
 - xiv. The QC Representative may elect to use an alternate expert to observe/certify performance.
 - xv. The QC Representative shall be qualified to monitor construction quality by experience and training.
- B. The Contractor shall submit for approval a Quality Assurance Plan at the Pre-construction Meeting. The plan shall include identification and resumes of the Quality Control Representative and any subordinate experts to the QC Representative. The plan shall also address the QC Representative's on site presence and participation in pre-installation, and sub-contractor meetings. The plan shall include a proposed bi-weekly Contractor's Quality Control report. This report shall include results of contractor certifications, client's test results, post installation inspection results, and updated Contractor's Quality Control, Required Certification Log. This plan has to be fully coordinated with other trades and activities and comply with Division 01 01400
- C. The contractor shall use the Contractor's Quality Control, Required Certification log as a guide to track and plan for required certified pre- or post application inspections.
- D. The QC Representative shall have the authority to stop work at any time quality problems necessitate. This authority shall be delineated in a letter of appointment from a company officer. The letter shall be included in the Quality Assurance Plan.

CONTRACTOR RESPONSIBILITY

- A. The Contractor shall employ and pay an independent agency, to perform inspections, tests, and similar quality control services which are designated in the technical
- B. The contractor is to engage a specialist to produce the operation and maintenance manuals.
- C. Changes in Drawings and, or Specifications
- D. Should any change in Drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify Consultant prior to execution of the Work. The work shall be carried out according to the requirements of such code in accordance with the instruction of the Consultant and at no additional cost to the contract.

CO-ORDINATION OF ENGINEERING SERVICES:

- A. Co-ordination of the Engineering Services Installations will be carried out as part of this contract. The contractor is to Agree principles of co-ordination with all parties concerned. And incorporate details provided by others into the Co-ordination Drawings. Ensure the installation drawings make due allowance for all building elements, structure and other services.
- B. Prior to submission check and approve all drawings, schedules and any other information provided by manufacturers, nominated suppliers or specialist sub-subcontractors to ensure that all the requirements of the contract documentation have been incorporated. Accompany all documents submitted with a certificate indicating that they have been checked by the Subcontractor.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- C. Regardless of the original assignment of responsibility for inspection, testing or similar services, the Contractor shall coordinate, with each agency engaged to perform inspections, tests and similar services, the sequence of activities to accommodate required services within the contract requirements in Division one.
- i. In addition the Contractor shall coordinate with each agency activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
 - ii. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities, notifying the consultant and testing agency at least 48 hours in advance of operations requiring testing services. Providing incidental labor and facilities to facilitate inspections, tests, sample taking and appropriate sample storage
 - iii. The contractor is responsible for the coordination of all his works and other trades and provide shop drawings and record drawings and as built drawings showing the inter-relationship of two or more engineering services and their relation to the structure and building fabric. The main features of a co-ordination drawing are as per guidelines outlined in part 1.4a above of this section.

STATUTORY AND REGULATORY REQUIREMENTS

- A. The provisions of Standards, Codes, Laws, Ordinances, etc., shall be considered minimum requirements. In case of conflict between their published requirements, the consultant shall determine which is to be followed and his decision shall be binding. Specific requirements of this specification or the drawings, which exceed the published requirements, shall take precedence over them.

FEES

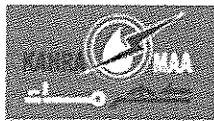
- A. All local fees, permits, and services of inspection authorities shall be obtained and paid for by the Contractor. The Contractor shall cooperate fully with local companies with respect to their services. Contractor shall include in his bid any costs to be incurred relative to power service (primary and/or secondary) and telephone service.

FAILURE & RE-TESTING

- A. Regardless of the original assignment of responsibility for inspection, testing or similar services, the Contractor shall be responsible for re-testing where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements. Removal and replacement Work necessitated by such noncompliance shall be at the Contractor's expense.
- B. When inspections or tests cannot be performed after proper notification and at the fault of the Contractor, rescheduling costs will be the Contractor's responsibility.

PROTECTION AND REPAIR

- A. Regardless of the original assignment of responsibility for inspection, testing or similar services, repair and protection are the Contractor's responsibility. Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Protect construction exposed by or for quality control service activities, and protect repaired construction.

- B. All plant, equipment, materials and prefabricated elements of the Works shall be properly packaged and protected against damage during delivery, storage and until fully, finally and properly installed and set to work.
- C. Submit to the Consultant a method statement on protection proposals for both stored and installed plant, equipment and materials.
- D. Protection shall also include adverse effects of environmental conditions prevalent in the stored and installed location.
- E. Any plant or equipment subject to incorrect storage or inadequate protection will be deemed unacceptable for incorporation into the works and new plant or equipment will be required as a replacement.
- F. Damaged plant, equipment and materials or that suffering from deterioration shall be replaced prior to handover.
- G. All plant, equipment and materials shall be protected against ingress of water and dust, formation of condensation, extremes and rapid changes of temperature, building works and operations of others.
- H. All open ends of pipes, ducts, conduit, and trunking etc shall be capped except when being worked upon.
- I. After removal of any temporary protection paint
- J. Parts liable to corrosion.
- K. Filter media shall only be installed when the plant items concerned are commissioned and tested.
- L. Install items such as grilles, diffusers, light fittings, switches, electrical accessories etc as near to completion as not to affect handover.

7.1.4.16 UTILITY EQUIPMENT

No utility equipment shall be energized until all tests and adjustments have been made to the satisfaction of the electric power company DEWA

7.1.4.17 TESTING SAFETY

Safety practices while testing shall comply with applicable state and local safety orders including IEC, BS, NICEIC, OSHA, NESC, NFPA 70E and the Accident Prevention Manual for Industrial Operations of the National Safety Council shall be observed.

7.1.5 21 0500 – Common Works Results for Fire Suppression

GENERAL

7.1.5.1 SECTION INCLUDES

Pipe, fittings, valves, and connections for sprinkler, standpipe and fire hose, and combination sprinkler and standpipe systems.

7.1.5.2 RELATED SECTIONS

Section 09 - Painting and Coating: Preparation and painting of fire protection piping systems.

Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Piping identification.



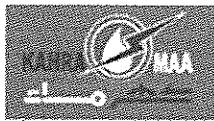
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

Section 21 1200 - Fire-Suppression Standpipes: Standpipe design.

7.1.5.3 REFERENCES

- ASME B16.5 - Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers; 2003 (ANSI/ASME B16.5).
- ASME B16.9 - Factory-made Wrought Steel Butt welding Fittings; The American Society of Mechanical Engineers; 2003.
- ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded; The American Society of Mechanical Engineers; 2005.
- ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005) (ANSI B16.18).
- ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).
- ASME B16.25 - Butt welding Ends; The American Society of Mechanical Engineers; 2003.
- ASME B36.10M - Welded and Seamless Wrought Steel Pipe; The American Society of Mechanical Engineers; 2004.
- ASTM A 47/A 47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reap proved 2004).
- ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2006a.
- ASTM A 234/A 234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2006a.
- ASTM A 795/A 795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2004. ASTM B 32 - Standard Specification for Solder Metal; 2004.
- ASTM B 75 - Standard Specification for Seamless Copper Tube; 2002.
- ASTM B 75M - Standard Specification for Seamless Copper Tube (Metric); 1999 (Re-approved 2005).
- NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2007.
- NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; National Fire Protection Association; 2007.
- UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.
- UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; 2004.
- UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; 2004.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.5.4 SUBMITTALS

See Section 01 - Administrative Requirements, for submittal procedures.

Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.

Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. These shall give hydraulic reference points to be designated by letter or number and to correspond to the comparable reference points shown on the hydraulic calculation sheets.

Project Record Documents: Record actual locations of components and tag numbering.

Operation and Maintenance Data: Include installation Instructions and spare parts lists.

7.1.5.5 QUALITY ASSURANCE

Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience. Approved by manufacturer.

All components should be UL listed, FM approved.

Valves: Bear UL label or marking. Provide manufacturer's name and pressure rating marked on valve body.

Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

All components of the automatic sprinkler system shall be from one manufacturer unless specifically stated otherwise.

7.1.5.6 DELIVERY, STORAGE, AND PROTECTION

Deliver and store valves in shipping containers, with labelling in place.

Provide temporary protective coating on cast iron and steel valves.

Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

7.1.5.7 EXTRA MATERIALS

See Section 01 - Product Requirements, for additional provisions.

Provide two valve stem packing for each size and type of valve installed.

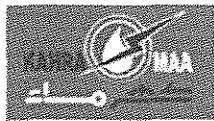
7.1.5.8 GENERAL SYSTEM AND PRODUCT REQUIREMENTS

Sprinkler Systems: work to conform to NFPA 13.

Standpipe and Hose Systems: Conform to NFPA 14.

Welding Materials and Procedures: Conform to ASME Code.

7.1.5.9 ABOVE GROUND PIPING



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Galvanized Steel pipe

Manufacturers: Refer to Appendix A

For working pressures below 20 bar

- A. Pipes shall be seamless factory galvanized (inside and outside) steel to ASTM A 53 grade B, schedule 40.
- B. Fittings for piping 50mm and smaller shall be UL listed and FM approved threaded factory galvanized cast iron fitting, class 250 to ANSI B16.4.
- C. Fittings for piping larger than 50mm shall be joined using factory galvanized mechanical roll grooved fittings and mechanical joints.

For Working pressures of 2000 kPa and above

- A. Pipes shall be seamless factory galvanized (inside and outside) steel to ASTM A53, grade B, schedule 80.
- B. Fittings for 50mm and smaller shall be UL listed and FM approved threaded factory galvanized malleable iron fittings, class 300 to ANSI B 16.3.
- C. Fittings for piping larger than 50mm shall be extra heavy UL listed and FM approved flanged and weld galvanized wrought steel fittings class 300 to ANSI B 16.9.

Ductile Iron Pipe

For pipes and fittings using on main riser in the core, pipe shall be new cement lined ductile iron to AWWA C104, C110 and C151.

Manufacturers: Refer to Appendix A

7.1.5.10 MECHANICAL GROOVED COUPLINGS:

Manufacturers: Refer to Appendix A

Material

Malleable iron housing clamps to engage and lock, "C" shaped electrometric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

Drain Above Ground: UPVC class 16 pressure pipe for sprinkler test drain connections.

7.1.5.11 PIPE HANGERS AND SUPPORTS

Manufacturers: Refer to Appendix A

All hangers, supports and accessories shall be UL listed and FM approved

- A. Hangers for Pipe 15 to 40 mm: Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support for Pipe Sizes to 80 mm: Cast iron hook.
- E. Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support..

7.1.5.12 GATE VALVE

All valves shall be UL listed and FM approved



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Manufacturers: Refer to Appendix A

Up To and Including 50 mm:

- A. Bronze body, bronze trim, screwed bonnet, non-rising stem, lockshield stem, inside screw with back seating stem, solid wedge disc, alloy seat rings, solder ends. ANSI B16.5, Class 150

Over 50 mm:

- A. Iron body, bronze trim, bolted bonnet, rising stem, hand wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. ANSI B16.5, Class 125

Over 100 mm:

- A. Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.

7.1.5.13 OS&Y VALVE (MONITORED)

All valves shall be UL listed and FM approved

Valve body and bonnet shall be electrostatically applied fusion bonded epoxy, coated both inside and out by the valve Manufacturer. The coating shall meet the requirements of AWWA C550. Coating to be applied only at the valve manufacturer's facilities.

The wedge shall be fully encapsulated in the elastomer, including the guides. The brass stem nut must be rigidly enclosed in the wedge to maintain alignment. The wedge elastomer shall be bonded to the wedge.

The waterway shall be full size to allow for tapping use; no cavities or depressions are permitted in the seat area.

Monitored OS&Y valves shall be used for all valve controls in the mainline fire distribution system. Additional valves are to be provided to each tenancy unit for isolation during refurbishment. All valves to be monitored by the fire alarm control panel.

7.1.5.14 GLOBE OR ANGLE VALVES

All valves shall be UL listed and FM approved

Manufacturers: Refer to Appendix A

Up To and Including 50 mm:

- A. Bronze body, bronze trim, screwed bonnet, rising stem and hand wheel, inside screw with back seating stem, renewable composition disc and bronze seat, solder ends. ANSI B16.5, Class 125

Over 50 mm:

- A. Ductile Iron body, bronze trim, bolted bonnet, rising stem, hand wheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends. ANSI B16.5, Class 150

7.1.5.15 BALL VALVES

All valves shall be UL listed and FM approved

Manufacturers: Refer to Appendix A

Up To and Including 50 mm:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

Over 50 mm:

- A. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

7.1.5.16 BUTTERFLY VALVES

All valves shall be UL listed and FM approved

Manufacturers: Refer to Appendix A

Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.

Disc: Aluminium bronze.

Operator: 10 position lever handle.

Bubble-tight shut-off to 1 MPa pressure in either direction when the piping and connecting flange is removed from one side of the valve.

Valves 150mm and larger shall be with worm gear manual operator with indication of valve opening.

Butterfly valves may be provided in lieu of gate valves in sizes 150mm or larger, subject to review by the Engineer.

7.1.5.17 CHECK VALVES

All valves shall be UL listed and FM approved

Manufacturers: Refer to Appendix A

Up To and Including 50 mm:

- A. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

Over 50 mm:

- A. Cast Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

100 mm and Over:

- A. Cast Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

7.1.5.18 AUTOMATIC AIR VALVE

All valves shall be UL listed and FM approved

Manufacturers: Refer to Appendix A

The cover shall be bolted to the valve body and sealed with a flat gasket. Resilient seats shall be replaceable and provide drop tight shut off to the full valve pressure rating.

The valve body and cover shall be constructed of cast iron for working pressures up to 300 psig. Higher pressure rated valves shall be constructed of ductile iron. The orifice, float and linkage mechanism shall be constructed of Type 304 stainless steel.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

EXECUTION

7.1.5.19 PREPARATION

Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

Remove scale and foreign material, from inside and outside, before assembly.

Prepare piping connections to equipment with flanges or unions.

7.1.5.20 INSTALLATION

Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

Install standpipe piping, hangers, and supports in accordance with NFPA 14.

For above ground pipes, screwed and socketed joints shall be used on pipes up to and including 40mm diameter. Pipes larger than 50mm diameter shall be joined by welded flanged joints or roll grooved couplings

Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

Install piping to conserve building space, to not interfere with use of space and other work.

Group piping whenever practical at common elevations.

Sleeve pipes passing through partitions, walls, and floors.

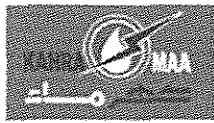
Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

Inserts:

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 100 m.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

Pipe Hangers and Supports:

- A. Install hangers to provide minimum 15 mm space between finished covering and adjacent work.
- B. Place hangers within 300 mm of each horizontal elbow.
- C. Use hangers with 40 mm minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- D. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- E. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- F. Provide copper plated hangers and supports for copper piping.
- G. Prime coat exposed steel hangers and supports. Refer to Section 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09.

Do not penetrate building structural members unless indicated.

Provide sleeves when penetrating footings, floors, and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.

When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.

Provide gate valves for shut-off or isolating service.

Provide drain valves at main shut-off valves, low points of piping and apparatus.

7.1.5.21 INSPECTOR TEST CONNECTIONS AND DRAINS

Provide inspector's test connections, riser drains and low point drains as required in NFPA 13 and NFPA 14. Drains and test connections shall be piped to drain risers in locations acceptable to the Engineer. Provide sprinkler zone valve cabinets, where shown on drawings, to house all valves and accessories.

7.1.6 21 0513 – Common Motor requirements for Fire Suppression

GENERAL

7.1.6.1 SECTION INCLUDES

Single phase electric motors.

Three phase electric motors.

7.1.6.2 RELATED SECTIONS

Section 26 2717 - Equipment Wiring

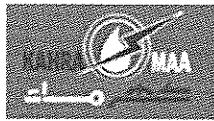
Section 26 2913 - Enclosed Controllers.

7.1.6.3 REFERENCES

ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc.; 1990 (R2000).

IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; Institute of Electrical and Electronic Engineers; 2004.

NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2006.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.

BS 2048 – Dimensions for fractional horse-power motors

BS 4999 – Winding Terminations

BS 5000 - Rotating electrical machines of particular types or for particular applications

7.1.6.4 SUBMITTALS

See Section 01 - Administrative Requirements, for submittal procedures.

Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.

Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

Operation Data: Include instructions for safe operating procedures.

Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

7.1.6.5 QUALITY ASSURANCE

Conform to NFPA 70.

Provide certificate of compliance from authority having jurisdiction indicating approval of high efficiency motors.

Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

7.1.6.6 DELIVERY, STORAGE, AND HANDLING

Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

WARRANTY

See Section 01 - Closeout Submittals, for additional warranty requirements.

Provide five year manufacturer warranty for motors larger than 15kW.

PRODUCTS

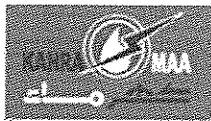
7.1.6.7 GENERAL CONSTRUCTION AND REQUIREMENTS

Electrical Service: Refer to Section 26 2717 for required electrical characteristics.

Construction:

- A. Open drip-proof type except where specifically noted otherwise.
- B. Design for continuous operation in 50 degrees C environment.
- C. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

Wiring Terminations:

- A. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
- B. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

The motor shall be sized to operate continuously without exceeding the horsepower rating regardless of the flow and head throughout the entire range of operation.

It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel paint prior to shipment.

Factory test certificates shall be provided.

7.1.6.8 APPLICATIONS

Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications.

Single phase motors for shaft mounted fans and centrifugal pumps: Split phase type.

Motors located in exterior locations, explosion proof environments, and dust collection systems: Totally enclosed type.

Motors located in outdoors: Totally enclosed weatherproof epoxy-treated type.

7.1.6.9 THREE PHASE POWER - SQUIRREL CAGE MOTORS

Starting Torque: Between 1 and 1-1/2 times full load torque.

Starting Current: Six times full load current.

Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

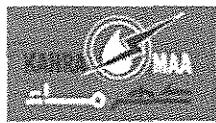
Insulation System: NEMA Class B or better.

Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 2913.

Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

Sound Power Levels: To NEMA MG 1.

Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

EXECUTION

7.1.6.10 INSTALLATION

Install in accordance with manufacturer's instructions.

Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

Check line voltage and phase and ensure agreement with nameplate.

Pump and motor shall be factory aligned and shall be realigned by the Contractor after installation.

7.1.7 21 0516 – Expansion fitting and Loops for Fire Piping

GENERAL

7.1.7.1 SECTION INCLUDES

Flexible pipe connectors.

Expansion joints and compensators.

Pipe loops, offsets, and swing joints.

7.1.7.2 RELATED SECTIONS

Section 21 1200 – Fire Suppression Stand Pipes.

Section 21 1300 – Fire Suppression Sprinkler Systems.

7.1.7.3 REFERENCES

ASTM A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2004.

EJMA (STDS) - EJMA Standards; Expansion Joint Manufacturers Association; 2003.

7.1.7.4 SUBMITTALS

See Section 01 - Administrative Requirements, for submittal procedures.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Contractor to employ an expert in this field to assess the requirements for expansion and contraction in the horizontal and vertical plane for all pipework.

Product Data:

- A. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions meter and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- B. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

Design Data: Indicate selection calculations.

Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

Maintenance Data: Include adjustment instructions.

7.1.7.5 REGULATORY REQUIREMENTS

Conform to UL requirements.

7.1.7.6 EXTRA MATERIALS

See Section 01 - Product Requirements, for additional provisions.

Supply two sets of packing for each packed expansion joint.

PRODUCTS

7.1.7.7 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

Manufacturers: Refer to Appendix A

Inner Hose: Carbon Steel.

Exterior Sleeve: Single braided stainless steel.

Pressure Rating: 23 bar and 232 Deg C.

Joint: Flanged.

Size: Use pipe sized units.

7.1.7.8 EXPANSION JOINTS

Manufacturers: Refer to Appendix A

Pressure Rating: 23 bar and 204 Deg C

Joint: Flanged.

Size: Use pipe sized units.

Application: All main core risers should be assessed and provided with steel packed sliding sleeve expansion joint where required.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Expansion joints outside of core for 200mm diameter pipe and larger shall be packless bellow type with equalizing rings, stainless steel bellows, limit stops, internal telescoping sleeves and carbon steel bevelled welding ends.

Expansion joints outside of core for 150mm diameter and smaller shall be packless bellows type with stainless steel bellows, anti-torque device, limit stops, guides and threaded pipe ends, or Victualic mover expansion couplings complete rigid couplings with EPDM gaskets.

7.1.7.9 ACCESSORIES

Stainless Steel Pipe: ASTM A269.

Pipe Alignment Guides:

Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 25 mm thick insulation, minimum 75 mm travel.

EXECUTION

7.1.7.10 INSTALLATION

The contractor shall carry out a review of expansion and contraction associated with the piping system by the employment of a specialist in this field of work.

The contractor shall coordinate and ensure that all associated elements of the analysis conducted is reviewed and agreed on by a structural engineer of record to verify the design intent and any impact on the structure to be considered. All associated works and agreements to be carried out between the structural engineering and contractor.

The contract shall be responsible for all aspect of this work. Refer to item 1.3 for submittal and processes. Additionally this application should also be analyzed in association with expected pipe stress from seismic and wind driven structural movement.

Install in accordance with manufacturer's instructions.

Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

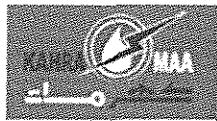
Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

Pipework passing across building expansion joints shall be provided with flexible connections that shall allow an axial displacement in the horizontal plane to match the building movement tolerance and an associated displacement in the vertical plane.

Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

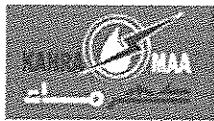
Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Pipe loops shall be:-

- A. Fabricated from similar material to the pipe in which they are installed.
- B. Fabricated from a single length of pipe with pulled bends. No joints or fittings shall be permitted.
- C. Finished with a straight length of pipe no less than 15 x the diameter of the pipe.
- D. Rated to the same pressure as the main pipework.
- E. Unless particularly specified otherwise bellows shall be:
- F. Fabricated from stainless steel.
- G. Installed strictly in accordance with the manufacturers recommendations.
- H. Installed with 50% cold pull which shall be witnessed by the Engineer.
- I. Pipelines shall not be pulled up for cold draw until the anchor points are rigid and firm.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.8 21 0517 – Sleeves and Sleeve Seals for Fire Suppression Piping and Equipment

GENERAL

7.1.8.1 SUMMARY

Section Includes:

- A. Sleeves.
- B. Grout.

SUBMITTALS

Product Data: For each type of product indicated.

PRODUCTS

7.1.8.2 SLEEVES

Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends

7.1.8.3 GROUT

Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

Characteristics: Nonshrink; recommended for interior and exterior applications.

Design Mix: 34.5-MPa, 28-day compressive strength.

EXECUTION

7.1.8.4 SLEEVE INSTALLATION

Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 25-mm annular clear space between piping and concrete slabs and walls.

Sleeves are not required for core-drilled holes.

Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

- A. Cut sleeves to length for mounting flush with both surfaces.
 - i. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 50 mm above finished floor level.
- B. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

Install sleeves for pipes passing through interior partitions.

- A. Cut sleeves to length for mounting flush with both surfaces.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- B. Install sleeves that are large enough to provide 25mm annular clear space between sleeve and pipe or pipe insulation.
- C. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint."

Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

7.1.8.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

Use sleeves and sleeve seals for the following piping-penetration applications:

- A. Exterior Concrete Walls above Grade:
 - i. Piping Smaller Than 65mm Galvanized-steel-pipe sleeves.
 - ii. Piping 65mm and Larger: Galvanized-steel-pipe sleeves.
- B. Exterior Concrete Walls below Grade:
 - i. Piping Smaller Than 65mm Galvanized-steel-pipe sleeves with sleeve-seal system
 - ii. Piping 65mm and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
- C. Concrete Slabs-on-Grade:
 - i. Piping Smaller Than 65mm: Galvanized-steel-pipe sleeves with sleeve-seal system
 - ii. Piping 65mm and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
- D. Concrete Slabs above Grade:
 - i. Piping Smaller Than 65mm Galvanized-steel-pipe sleeves.
 - ii. Piping 65mm and Larger: Galvanized-steel-pipe sleeves.
- E. Interior Partitions:
 - i. Piping Smaller 65mm Galvanized-steel-pipe sleeves.
 - ii. Piping 65mm and Larger: Galvanized-steel-sheet sleeves.

7.1.9 21 0548 – Vibration and Seismic Control for Fire Suppression Systems

GENERAL

7.1.9.1 SECTION INCLUDES

Inertia bases.

Vibration isolators

7.1.9.2 RELATED SECTIONS

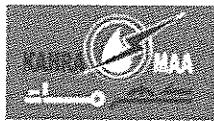
Section 03 - Cast-in-Place Concrete

7.1.9.3 SUBMITTALS

See Section 01 - Administrative Requirements, for submittal procedures.

Product Data: Provide schedule of vibration isolator type with location and load on each.

Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate seismic control measures.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

PRODUCTS

7.1.9.4 MANUFACTURERS

Refer to Appendix A

7.1.9.5 INERTIA BASES

Structural Bases:

- A. Construction: Welded structural steel with gusseted brackets, to support equipment and motor, with motor slide rails.
- B. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.

Concrete Inertia Bases:

- A. Construction: Structural steel channel perimeter frame, with gusseted brackets and anchor bolts, reinforcing; concrete filled.
- B. Mass: Minimum of 1.5 times weight of isolated equipment.
- C. Connecting Point: Reinforced to connect isolators and snubbers to base.
- D. Concrete: Minimum 20 MPa concrete.

7.1.9.6 VIBRATION ISOLATORS

Open Spring Isolators:

- A. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
- B. Spring Mounts: Provide with leveling devices, minimum 6 mm thick neoprene sound pads, and zinc chromate plated hardware.
- C. Sound Pads: Size for minimum deflection of 1.2 mm; meet requirements for neoprene pad isolators.
- D. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.

Closed Spring Isolators:

- A. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
- B. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
- C. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 7 mm clearance.
- D. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.

Spring Hanger:

- A. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
- B. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- C. Misalignment: Capable of 20 degree hanger rod misalignment.
- D. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.

Neoprene Pad Isolators:

- A. Rubber or neoprene waffle pads.
 - i. Thickness: Minimum 13 mm.
 - ii. Maximum Loading: 345 kPa.
 - iii. Rib Height: Maximum 0.7 times width.
- B. Configuration: Single layer.
- C. Configuration: 13 mm thick waffle pads bonded each side of 6 mm thick steel plate.

Roof Mounting Curb: 350 mm high with rigid steel lower section containing adjustable spring pockets with restrained spring isolators, steel upper section to support rooftop equipment, and continuous elastomeric membrane extending from upper section for counterflashing over roofing. Provide acoustical package consisting of interior perimeter angles and cross members to support up to two layers of gypsum board.

EXECUTION

7.1.9.7 INSTALLATION

Install in accordance with manufacturer's instructions.

Bases:

- A. Set steel bases for 25 mm clearance between housekeeping pad and base.
- B. Set concrete inertia bases for 50 mm clearance between housekeeping pad and base.
- C. Adjust equipment level.

On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.

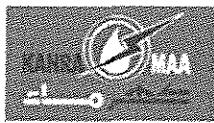
7.1.9.8 FIELD QUALITY CONTROL

Inspect isolated equipment after installation and submit report. Include static deflections.

7.1.9.9 SCHEDULES

Pipe Isolation Schedule.

- A. 25 mm Pipe Size: Isolate 120 diameters from equipment.
- B. 50 mm Pipe Size: Isolate 90 diameters from equipment.
- C. 80 mm Pipe Size: Isolate 80 diameters from equipment.
- D. 100 mm Pipe Size: Isolate 75 diameters from equipment.
- E. 150 mm Pipe Size: Isolate 60 diameters from equipment.
- F. 200 mm Pipe Size: Isolate 60 diameters from equipment.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

7.1.10 21 0553 – Identification for Fire Suppression Piping and Equipment

GENERAL

- 7.1.10.1 SECTION INCLUDES
- Nameplates.
 - Tags.
 - Stencils.
 - Pipe Markers

7.1.10.2 RELATED SECTIONS

Section 09 - Painting and Coating: Identification painting.

7.1.10.3 REFERENCES

- ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 1996 (Reaffirmed 2002).
- NFPA 13 Standard for the Installation of Sprinkler Systems
- ASTM E 84 Surface burning characteristics of building materials (also NFPA 255 and UL 723)

7.1.10.4 SUBMITTALS

Section 01 - Administrative Requirements, for submittal procedures.

List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

Product Data: Provide manufacturers catalog literature for each product required.

Samples: Submit two labels

Manufacturer's Installation Instructions: Indicate special procedures, and installation.

Project Record Documents: Record actual locations of tagged valves.

PRODUCTS

7.1.10.5 NAMEPLATES

Description: Stainless steel metal plate with engraved letters or stamped.

Letter Color: Black.

Letter Height 6 mm.

7.1.10.6 TAGS

Metal Tags: Stainless steel metal plate with engraved black letters on light contrasting background color. Tag size minimum 40 mm diameter with smooth edges.

Chart: Typewritten letter size list in anodized aluminum frame.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.10.7 STENCILS

Stencils: With clean cut symbols and letters of following size:

1. 20-30 mm Outside Diameter of Insulation or Pipe 200 mm long color field, 15 mm high letters.
2. 40-50 mm Outside Diameter of Insulation or Pipe: 8 inch 200 mm long color field, 20 mm high letters.
3. 65-150 mm Outside Diameter of Insulation or Pipe: 12 inch 300 mm long color field, 30 mm high letters.
4. 200-250 mm Outside Diameter of Insulation or Pipe: 600 mm long color field, 65 mm high letters.
5. Over 250 mm Outside Diameter of Insulation or Pipe: 800 mm long color field, 90 mm high letters.
6. Equipment: 65 mm high letters.

Stencil Paint: As specified in Section 09, semi-gloss enamel, colors conforming to ASME A13.1.

7.1.10.8 PIPE MARKERS

Color: Conform to ASME A13.1.

Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 150 mm wide by 0.10 mm thick, manufactured for direct burial service.

7.1.10.9 CEILING TACKS

Description: Steel with 20 mm diameter color coded head.

EXECUTION

7.1.10.10 PREPARATION

Degrease and clean surfaces to receive adhesive for identification materials.

Prepare surfaces in accordance with Section 09 for stencil painting.

7.1.10.11 INSTALLATION

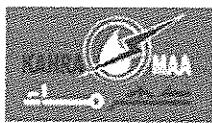
Install stainless steel nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

Install tags with corrosion resistant chain.

Apply stencil painting in accordance with Section 09

Install plastic pipe markers in accordance with manufacturer's instructions.

Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Identify pumps and valves with stainless steel nameplates. Small devices, such as in-line pumps, may be identified with tags.
- Identify control panels and major control components outside panels with stainless nameplates.
- Identify thermostats relating to terminal boxes or valves with nameplates.
- Identify valves in main and branch piping with tags.
- Tag automatic controls, instruments, and relays. Key to control schematic.
- Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 20 mm diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 6 m on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction. Vertical piping to be identified at least once for each storey interval of the building.
- Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

7.1.11 21 0900 – Instrumentation and Control for Fire Suppression Systems

GENERAL

7.1.11.1 SECTION INCLUDES

- Pressure Gauges and pressure Gauge taps.
- Alarm Valve, Control Valve, Alarm Switch.
- Static pressure Gauges.
- Flow meters.
- Vortex inhibitor

7.1.11.2 RELATED SECTIONS

- Section 23 2113 - Hydronic Piping.
- Section 23 0943 - Pneumatic Control System for HVAC.
- Section 23 0923 - Direct-Digital Control System for HVAC.
- Section 23 0993 – BMS Sequence of Operations
- Section 13 - Intrusion Detection System.

7.1.11.3 REFERENCES

- BS 5235 - BS 5235 Specification for dial-type expansion thermometers; 1975
- BS EN 837-1:1998 Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
- ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers; 2005.
- ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi; The American Society of Mechanical Engineers; 2004.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold Water Meters; American Water Works Association; 1996 (R 2005) ANSI/AWWA C706).

AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance; American Water Works Association; 1999.

UL 393 - Indicating Pressure Gauges for Fire-Service; Underwriters Laboratories Inc.; 2005.

NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2007.

UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.

7.1.11.4 PERFORMANCE REQUIREMENTS

Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

7.1.11.5 SUBMITTALS

See Section 01 - Administrative Requirements, for submittal procedures.

Product Data: Provide rated capacities, specialties and accessories, electrical requirements and wiring diagrams.

Shop Drawings: Indicate components, assembly, dimensions, required clearances, location, indicate equipment piping and connections, valves, strainers, and thermostatic valves and motor required for complete system.

Manufacturer's Certificate: Certify that components of package not furnished by manufacturer have been selected in accordance with manufacturer's requirements.

Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer See Section 01300 - Administrative Requirements, for submittal procedures.

7.1.11.6 ENVIRONMENTAL REQUIREMENTS

Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs

PRODUCTS

7.1.11.7 PRESSURE GAUGES

Manufacturers: Refer to Appendix A

- A. Pressure gauges shall be UL ULC/ FM/EN listed spring pressure gauges with 100 mm dial.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- B. Each gauge shall be controlled by a valve having arrangement for draining.
- C. Install gauges above and below the alarm valve on the sprinkler riser, on the suction and discharge side of all pumps, on incoming water services and at the highest point of all sprinkler risers

7.1.11.8 PRESSURE GAUGE TAPPINGS

Gauge Cock: Tee or lever handle, brass for maximum 1034 kPa.

Needle Valve: Brass, 6mm NPT for minimum 1034 kPa.

Pulsation Damper: Pressure snubber, brass with 6 mm connections.

Syphon: Steel, Schedule 40, 6 mm angle or straight pattern.

7.1.11.9 ALARM VALVES

Manufacturers: Refer to Appendix A

All valves shall be UL listed and FM approved

Materials:

Iron body, bronze trim, for 1206 kPa working pressure complete with electric pressure switches, test and alarm bell connections, pressure gauges, low pressure switch and all other appurtenances for a complete wet pipe system. Use Class 300 valves where required.

Alarm valves shall be complete with electric alarm gong, all required auxiliary valves and drains and with pressure switch for wiring into building electric alarm system.

Locate alarm gong on exterior of building above fire department inlet breeching connection (two locations) 2500 mm above grade.

7.1.11.10 CONTROL VALVES

Manufacturers: Refer to Appendix A

All control valves shall be UL listed and FM approved gate or butterfly valves with supervisory switches built into the valve assembly.

Except where special features are required or unless otherwise reviewed or specified, all valves shall be of one manufacturer with the manufacturer's name and the pressure rating clearly marked on the outside of the valve body.

7.1.11.11 ALARM SWITCH

Manufacturers: Refer to Appendix A

Flow alarm switch shall be UL listed and FM approved for the size of pipe in which it is installed as a paddle type water flow indicator.

Each flow switch shall be complete with supervised shut-off valve, drain valve and test valve with sight glass.

7.1.11.12 FLOW METERS

Manufacturers: Refer to Appendix A

Flow meter shall be a single turbine type insertion flow meter.

A. The wetted material shall be constructed of 316L stainless steel.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- B. Flow meter accuracy shall not exceed +/- 1% with velocities from 3 to 30 fps.
- C. Provide output to BMS.
- D. Install flow meters according to manufacturers' instructions paying particular attention to the upstream and downstream piping requirements.

7.1.11.13 STATIC PRESSURE GAUGES

Manufacturers: Refer to Appendix A

Static pressure gauge shall be UL/FM/EN/PLC approved.

90 mm diameter dial in metal case, diaphragm actuated black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

7.1.11.14 VORTEX INHIBITORS

Manufacturers: Refer to Appendix A

Vortex Inhibitor shall be supplied by fire water tank manufacturer.

Internal suction elbow fitted with a vortex inhibitor plate. Sized to ensure the maximum effective capacity of the tank can be pumped without any problems incurred by the inflow of air to the hydraulic system.

EXECUTION

7.1.11.15 INSTALLATION

Install in accordance with manufacturer's instructions.

Contractor to submit calibration certificate of gauges from testing lab prior to do any installation or using for pressure testing checks.

Install pressure gauges in piping tee with gauge cock at the most readable position. Select gauges with bottom side or rear inlet as appropriate.

Install snubbers on all pressure gauges installed in close proximity of pump discharge.

Provide red set hands to indicate normal or critical pressure in gauges subjected to variable pressures.

Use remote reading type pressure gauges with armoured capillary tubes, when installed above 2 Ms from FFL.

Install positive displacement meters with isolating valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.

Provide one pressure Gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to Gauge.

Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 60 mm for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

Install meter in accordance with Kahramma Regulations

Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 0943.

Coil and conceal excess capillary on remote element instruments.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Provide instruments with scale ranges selected according to service with largest appropriate scale.

Install Gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

Adjust Gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

1. Locate test plugs adjacent thermometers and thermometer sockets.

7.1.11.16 INSTALLATION: FIRE PUMP SYSTEM

Refer to section 21 3000 on pump specification.

Install level switches in the fire tank for:

- A. low level – control to switch off pumps
- B. high level - signal to control panel and BMS
- C. Level indicator – signal to BMS

Provide flow meter on the supply and discharge of the pumps and monitor at both the local control panel and BMS

Provide pressure gauges as indicated on the drawings

All monitoring devices are to be wired to a control panel and be monitored by FACP and BMS.

7.1.12 21 1200 – Fire Suppression Standpipes

GENERAL

7.1.12.1 SECTION INCLUDES

Standpipe system.

Fire department connection.

Fire extinguishers located in hose cabinets

7.1.12.2 RELATED SECTIONS

Section 10 4400 - Fire Protection Specialties.

Section 21 0500 - Common Work Results for Fire Suppression: Fire protection piping.

Section 21 0553 - Identification for Fire Suppression Piping and Equipment.

Section 21 3000 - Fire Pumps.

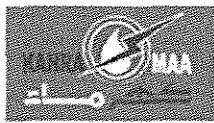
Section 21 1300 - Fire-Suppression Sprinkler Systems.

Section 22 0553 - Identification for Plumbing Piping and Equipment.

Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

7.1.12.3 REFERENCES

FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

NFPA 10 - Standard for Portable Fire Extinguishers; National Fire Protection Association; 2007.

NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; National Fire Protection Association; 2007.

UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

BS EN 671 - Fixed Fire Fighting Systems – Hose Systems

BS 750 – Underground Fire Hydrants and Surface Box Frames and Covers

BS 1452 – Specifications for Grey Iron Castings

BS 2789 – Iron Castings with Spheroidal or Nodular Graphite

BS 5163 – Double Flanged Cast Iron Wedge Gate Valves for Waterworks Purposes

BS 5423 - Portable Fire Extinguishers.

7.1.12.4 SUBMITTALS

Product Data: Provide manufacturer's catalog sheet for equipment indicating rough-in size, finish, and accessories.

Shop Drawings: Indicate supports, components, accessories, and sizes.

Submit proof of approval to Civil Defence.

Project Record Documents: Record actual locations of components.

Operation Data: Include manufacturer's data.

Maintenance Data: Include servicing requirements and test schedule.

Certificates: Provide certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests.

7.1.12.5 QUALITY ASSURANCE

Perform Work in accordance with NFPA 14. Maintain one copy on site.

Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience approved by manufacturer.

7.1.12.6 PRE-INSTALLATION MEETING

Convene one week before starting work of this section.

7.1.12.7 DELIVERY, STORAGE, AND PROTECTION

Deliver and store products in shipping packaging until installation.

7.1.12.8 EXTRA MATERIALS

Provide two extra hose nozzles and hoses.

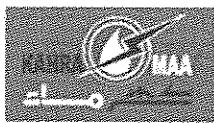
PRODUCTS

7.1.12.9 STANDPIPE

The fire standpipe and fire protection systems shall be in accordance with the requirements of the civil defense department and NFPA 14.

Galvanized Steel pipe

Manufacturers: Refer to Appendix A



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Mechanical Grooved Couplings:

- A. Manufacturers: Refer to Appendix A
- B. Approvals: UL/FM Approved
- C. Material

Malleable iron housing clamps to engage and lock, "C" shaped electrometric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

7.1.12.10 FIRE HOSE CABINETS

Manufacturer: Refer to Appendix A

Hose Cabinets:

- A. Door: 2.7 mm thick stainless steel, flush, glazed with 6 mm thick wired glass full panel; hinged, positive latch device.
- B. Finish: Enamelled, color as selected.
- C. Hose Reel Rack
- D. Cabinets shall have suitable ventilation openings

HOSES WITH SEMI-RIGID HOSE

- A. Hose: The nominal bore of the hose shall be 25mm that shall not exceed a length of 30m. Hose reels with semi-rigid hose shall generally comply with BS EN 671-1.
- B. Nozzle: Chrome plated brass; combination fog, straight stream, and adjustable shut-off.
 - i. Rotary operated nozzles shall be marked to show the direction of closing and opening.
 - ii. Lever operated shall be marked to show the setting for:
 - 1) Shut-off
 - 2) Spray (sheet or conical) and/or straight stream

- C. Working, test and minimum burst pressure for hose reels shall be as given by Qatar Civil Defence.

HOSE SYSTEMS WITH LAY-FLAT HOSE

- A. Provide hose reels with swivel hose guides in accordance with the Qatar Civil Defence regulations.
- B. Installation to BS EN 671-2 and Qatar Civil Defence regulations.

7.1.12.11 HYDRANT

The hydrant shall comply with ANSI /AWWA C 502 and shall be UL listed and FM approved or as accepted and inline to Qatar Civil Defence requirements.

Materials for the hydrants shall be as follows:

- A. Nozzle section, barrels, stand pipe flanges, breakable flange, base, main valve flange, weather-shield operating nut and bonnet all shall be ductile iron
- B. Main valve disc shall be ductile iron core and fully encapsulated in EPDM rubber
- C. Caps shall be cast iron
- D. Coating above ground shall be fusion bonded epoxy inside and out
- E. Coating below ground shall be bitumen or fusion bonded epoxy



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- F. Nozzles, valve seat ring, drain ring, drain bushings and plugs, stem nut, stem bushing and thrust nut shall be bronze
- G. Stop nut, cap chain, bolts and nuts shall be zinc plated steel
- H. Stem rod coupling, standpipe lock rings, nozzle lock screw, lock plate, lock plate screw and spider bolt shall be stainless steel
- I. Barrel gaskets and cap gaskets shall be nitrile rubber.

Hydrants shall be wet or dry barrel type with a minimum 4" (100 mm) nominal diameter barrel and two 2½" (65 mm) instantaneous fire hose connections.

A certificate shall be obtained from the manufacturer stating that the fire hydrants to be supplied are suitable for use in Qatar.

Fire hydrants shall be installed in accordance with the manufacturer's instructions.

Breeching inlet fire brigade connection size shall be 65mm diameter and comply with all Qatar Civil Defence requirements.

7.1.12.12 FIRE DEPARTMENT CONNECTION

Approvals: UL/FM/EN/BS and QCDD.

Type: Flush mounted wall type with chrome plate finish.

Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.

Drain: 20 mm automatic drip, connected to drain.

Label: "Standpipe - Fire Department Connection".

7.1.12.13 VALVES

Approvals: UL/FM/EN/BS and QCDD.

Hose Station Valve: Angle type, brass finish, 40 mm nominal size with automatic ball drip; refer to Section 21 0500. The valve may be either a manual or automatic type.

Hose Connection Valve: Angle type; chrome plated finish; 65 mm size, thread to match fire department hardware, 2070 kPa working pressure, with threaded cap and chain of same material and finish; refer to Section 21 0500.

Pressure Reducing Valve: Angle type; chrome plated finish with inner hydraulic controls; 40 mm size, thread to match fire department hardware, 2760 kPa inlet pressure, with threaded cap and chain of same material and finish; refer to Section 21 0500.

7.1.12.14 FIRE EXTINGUISHERS

Manufacturers: Refer to Appendix

General: Comply with NFPA 10; BS5423; UL and FM listed. Fire extinguishers shall be environmental friendly type in accordance with Civil Defense approval.

Water Type: Copper container with positive displacement pump and discharge hose.

A. 22 Litres capacity with 4A rating.

Multi-Purpose Dry Chemical Type: Cartridge operated with hose and shut-off nozzle or integral shut-off nozzle.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

J. 4.5 kg capacity type ABC.

Fire extinguishers shall be colour coded according to their type. And as per Qatar Civil Defence requirements.

EXECUTION

7.1.12.15 INSTALLATION

Install in accordance with manufacturer's instructions and Qatar Civil Defense requirements.

Install in accordance with NFPA 14.

Fire hose reel assemblies shall be provided with full operational instructions for display on or adjacent to the hose reel.

The supplier shall make available an installation and maintenance manual for hose reels.

All hose systems shall be such that they can be operated efficiently by one person and that such systems shall have a long service life and will not need excessive maintenance.

A Certificate for the Fire Hydrants shall be obtained by the manufacturer stating that the fire hydrants to be supplied are suitable for use in Qatar

Locate and secure cabinets plumb and level. Establish top of cabinet (inside horizontal) surface 1675 mm above finished floor.

Locate hose station valve in cabinet at 150 mm above finished floor.

Connect standpipe system to water source ahead of domestic water connection.

Flush entire system of foreign matter.

7.1.12.16 FIELD QUALITY CONTROL

Perform field inspection and testing in accordance with Section 01

Test entire system in accordance with NFPA 14.

Test shall be witnessed by Qatar Civil Defense personnel .

7.1.13 21 1300 – Fire Suppression Sprinkler Systems

GENERAL

7.1.13.1 SECTION INCLUDES

Wet-pipe sprinkler system.

Fire department connections.

7.1.13.2 RELATED SECTIONS

Section 21 0500 - Common Work Results for Fire Suppression: Pipe, fittings, and valves.

Section 21 0553 - Identification for Fire Suppression Piping and Equipment.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Section 21 0900 – Instrumentation & Control for Fire Supression System.
- Section 21 3000 - Fire Pumps.
- Section 21 1200 - Fire-Suppression Standpipes.
- Section 22 0553 - Identification for Plumbing Piping and Equipment.
- Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

7.1.13.3 REFERENCES

- NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2007.
- NFPA 13R - Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height; National Fire Protection Association; 2007.
- ASTM A47/A47M Standard Specification for Ferritic Malleable Iron Castings
- ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2006a.
- UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.13.4 SUBMITTALS

See Section 01 - Administrative Requirements, for submittal procedures.

Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections

Shop Drawings:

- A. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
- B. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
- C. Submit shop drawings to authority having jurisdiction for approval. Submit proof of approval to.

Samples: Submit two of each style of sprinkler specified.

All components of the automatic sprinkler system shall be from one manufacturer unless specifically stated otherwise. The fire protection Contractor shall maintain a Consultant on site from the manufacturer for the duration of the project who shall supervise the complete installation. The manufacturer shall issue a certificate upon completion of the project stating that the complete system has been installed, tested and commissioned as per the specifications, drawings, NFPA and Civil Defence requirements. The Fire Protection Contractor shall then maintain the complete installation in accordance with NFPA requirements for a period of one year after the Taking-over Certificate is issued.

Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

7.1.13.5 QUALITY ASSURANCE

Maintain one copy of referenced design and installation standard on site.

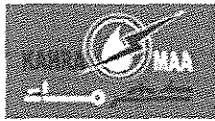
Conform to UL requirements.

Design system under direct supervision of a Professional Fire Protection Consultant experienced in design of this type of work and licensed in Doha Qatar.

Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience approved by manufacturer.

It is the responsibility of this Contractor to make a detailed review of all drawings during the tender period, in order to fully comprehend the extent of the work to be completed. These drawings are schematic in nature and show the intent for the minimum requirements of the fire protection systems. Obstructions



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

to pipe routing and obstructions to the location of sprinkler heads are not shown on these drawings. It is this Contractor's responsibility to locate and detail these obstructions as part of the scope of work. In addition it is this Contractor's responsibility to acquaint himself of all the drawings from the other disciplines – structural, electrical, and mechanical, during the tender phase, so that all of the interferences can be appreciated at the time of tender. No extras will be given for conditions that were known at the time of tender.

Equipment and Components: Provide products that bear UL label or marking.

Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

The Fire protection System shall be in accordance with the requirements, regulations and By-Laws of authorities having jurisdiction, NFPA and the requirements of Associated Factory Mutual Fire Insurance Companies.

The fire protection Contractor shall be experienced in the design and installation of fire protection systems to NFPA standards, and shall be approved company by Qatar Civil Defence.

The contractor shall be responsible for all design work in all aspect to be carried. The contractor shall be responsible for integrating such designs within the construction requirements of the works. The system shall to be fully design as per the requirements of the Qatar Civil Defence regulations.

7.1.13.6 MOCK-UP

Provide components for installation in mock-up.

Mock-up may not remain as part of the Work.

7.1.13.7 PRE-INSTALLATION MEETING

Convene one week before starting work of this section.

7.1.13.8 DELIVERY, STORAGE, AND PROTECTION

Store products in shipping containers and maintain in place until installation.

Provide temporary inlet and outlet caps. Maintain caps in place until installation.

Provide temporary inlet and outlet caps. Maintain caps in place until installation.

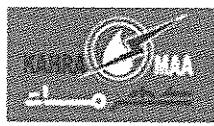
7.1.13.9 EXTRA MATERIALS

See Section 01 6000 – Product Requirements for additional provisions.

Provide extra sprinklers of type and size matching those installed in quantity required by referenced NFPA design and installation Standard.

Provide suitable wrenches for each sprinkler type.

Provide metal storage cabinet in location designated.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

PRODUCTS

7.1.13.10 MANUFACTURERS

Refer to Appendix for approved manufacturers

7.1.13.11 SPRINKLER SYSTEM REQUIREMENTS

Sprinkler System: Provide coverage for entire building.

Occupancy: Ordinary Hazard Group 2; comply with NFPA 13.

Water Supply: Determine volume and pressure from water flow test data.

Interface system with building control system.

Provide fire department connections where indicated.

7.1.13.12 SPRINKLERS

Suspended Ceiling Type: Recessed pendant type with matching push on escutcheon plate.

A. Finish: Chrome plated.

B. Escutcheon Plate Finish: Chrome plated.

C. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

Exposed Area Type: Standard upright type with guard.

Sidewall Type: Standard horizontal sidewall type with matching push on escutcheon plate and guard.

A. Finish: Chrome plated.

B. Escutcheon Plate Finish: Chrome plated.

C. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

Fast Response Type Recessed pendant type with matching push on escutcheon plate.

A. Finish: Chrome plated.

B. Escutcheon Plate Finish: Chrome plated.

C. As per the fire engineer report, fast response sprinkler coverage is required for Level 98 to 100.

Guards: Finish to match sprinkler finish.

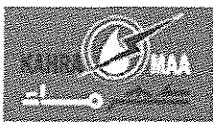
Spray Nozzles: Brass with solid cone discharge, 30 degrees of arc with blow-off dust cap.

7.1.13.13 PIPING SPECIALTIES

Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.

Flooding Deluge Valve: Gate type valve with rubber faced disc actuated manually with water motor alarm and electric alarm, with alarm testing trim.

Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.

Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 240 volt AC and 2.5 amp at 24 volt DC.

Fire Department Connections:

- A. Type: Flush mounted wall type with chrome plated finish.
- B. Outlets: Two ways with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
- C. Drain: 19 mm automatic drip, outside.
- D. Label: "Sprinkler - Fire Department Connection".

E. Fire Department Connection

- i. A system fire department connection shall be provided on the system riser in accordance with N.F.P.A. 13, Standard for Installation of Sprinkler Systems. The fire department connection shall be of a brass body with an integral clapper assembly to separate flow between inlets. The fire department connection shall be installed in an area accessible for the first response unit. The fire department connection shall be UL Listed and Factory Mutual Approved for fire protection use.

F. Water Motor Alarm

- ii. Water flow will activate a hydraulic powered water motor alarm by way of integral valve alarm line trim piping. The water motor alarm shall be connected to a water pressure retarding chamber to limit the propensity of unnecessary alarms. The water motor alarm shall be equipped with a rear closure plate to limit the access of foreign materials or accumulation of debris. The water motor alarm shall be UL Listed and Factory Mutual Approved for the application in which it is used.

EXECUTION

7.1.13.14 INSTALLATION

Install in accordance with referenced NFPA design and installation standard.

Install equipment in accordance with manufacturer's instructions.

Provide approved double check valve assembly at sprinkler system water source connection.

Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.

Locate outside alarm gong on building wall as indicated.

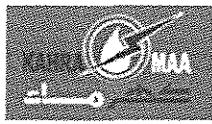
Place pipe runs to minimize obstruction to other work.

Place piping in concealed spaces above finished ceilings.

Apply masking tape or paper cover to ensure concealed sprinkler, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

Install and connect to fire pump system in accordance with Section 21 3000.

Flushentire piping system of foreign matter.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Install guards on sprinklers in plant rooms where indicated otherwise.

Hydrostatically test entire system.

Require test be witnessed by Fire Marshall.

Protect installed sprinklers with protective cap during construction.

7.1.13.15 INTERFACE WITH OTHER PRODUCTS

Ensure required devices are installed and connected as required to fire alarm system.

7.1.13.16 SCHEDULES

The sprinkler design density and areas are identified for the different occupancy areas within the building shall be to NFPA 13 and Fire Engineered report.

Friction losses in pipe shall be calculated in accordance with the Hazen and Williams formula with 'C' value of 120 for above ground steel pipe and 100 for underground pipe.

Hydraulic calculation requirements: The velocity in overhead piping and fittings shall not exceed 3 metres per Second. This includes riser nipples. Velocity in cross mains shall not exceed 3.8 metres per second. The velocity in the immediate area of the sprinkler system alarm check valve shall not exceed 4 meter³ per second* Velocities shall be shown on calculations.

Hydraulic calculation shall include and identify the pressure drop from the water tank to the pump and through the loop main to the risers, in addition to the overhead piping

7.1.14 21 1313 – Wet Pipe Sprinkler Systems

GENERAL

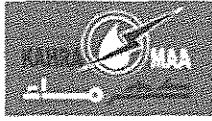
7.1.14.1 SUMMARY

Section Includes:

- A. Pipes, fittings, and specialties.
- B. Fire-protection valves.
- C. Fire-department connections.
- D. Sprinklers.
- E. Excess-pressure pumps.
- F. Alarm devices.
- G. Manual control stations.
- H. Control panels.
- I. Pressure gages.

Related Sections:

- A. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.
- B. Division 21 Section "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
- C. Division 21 Section "Foam-Water Systems" for AFFF piping.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- D. Division 21 Section Electric-Drive, Centrifugal Fire Pumps Diesel-Drive, Centrifugal Fire Pumps" for fire pumps, pressure-maintenance pumps, and fire-pump controllers.

7.1.14.2 DEFINITIONS

High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure 300 psig or 20 bar.

Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

7.1.14.3 SYSTEM DESCRIPTIONS

Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

7.1.14.4 PERFORMANCE REQUIREMENTS

Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

High-Pressure Piping System Component: Listed for 300-psig working pressure.

Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

A. Available fire-hydrant flow test records indicate the following conditions:

- i. Date
- ii. Time
- iii. Performed by
- iv. Location of Residual Fire Hydrant R
- v. Location of Flow Fire Hydrant F
- vi. Static Pressure at Residual Fire Hydrant R
- vii. Measured Flow at Flow Fire Hydrant F
- viii. Residual Pressure at Residual Fire Hydrant R

Sprinkler system design shall be approved by authorities having jurisdiction.

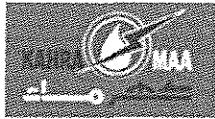
A. Margin of Safety for Available Water Flow and Pressure: 5% percent, including losses through water-service piping, valves, and backflow preventers.

B. Sprinkler Occupancy Hazard Classifications as per NFPA 13:

- i. Fire Pump Room: Extra Hazard Group 1
- ii. Chlorination: Extra Hazard Group 1

C. Minimum Density for Automatic-Sprinkler Piping Design as per NFPA 13:

- i. Light-Hazard Occupancy 4.1mm/min. over 139-sq. m.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- ii. Ordinary-Hazard, Group 1 Occupancy: 6.1 l/m over 139-sq. m area.
- iii. Ordinary-Hazard, Group 2 Occupancy: 8.1 l/min. over 139-sq. m area.
- iv. Extra-Hazard, Group 1 Occupancy: 12.2 lpm. over 232-sq. m area.

D. Maximum Protection Area per Sprinkler:

- i. Office Spaces: 20.9sq. m.
- ii. Storage Areas: 12.1sq. m
- iii. Mechanical Equipment Rooms 12.1sq. m.
- iv. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

E. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

- i. Light-Hazard Occupancies: 6.3 L/s for 30 minutes.
- ii. Ordinary-Hazard Occupancies: 15.75 L/s for 60.

Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13.

7.1.14.5 SUBMITTALS

Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

Wiring Diagrams: For power, signal, and control wiring.

Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

- i. Domestic water piping.
- ii. HVAC ducting and piping.
- iii. Items penetrating finished ceiling include the following:
- iv. Lighting fixtures.
- v. Air outlets and inlets.

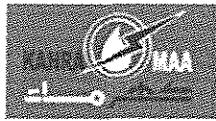
Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

Welding certificates.

Fire-hydrant flow test report.

Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

Field quality-control reports.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

7.1.14.6 QUALITY ASSURANCE

Installer Qualifications:

- A. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - i. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

- A. NFPA13, "Installation of Sprinkler Systems."
- B. NFPA13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
- C. NFPA24, "Installation of Private Fire Service Mains and Their Appurtenances."

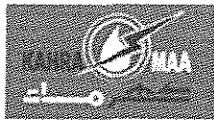
7.1.14.7 PROJECT CONDITIONS

Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

- A. Notify operations team and local Civil Defence Authority no fewer than three days in advance of proposed interruption of sprinkler service and do not proceed with any interruption of sprinkler system prior to written permission from local authority.

7.1.14.8 COORDINATION

Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.14.9 EXTRA MATERIALS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- A. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PRODUCTS

7.1.14.10 PIPING MATERIALS

Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

7.1.14.11 STEEL PIPE AND FITTINGS

Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Grade C Pipe ends may be factory or field formed to match joining method.

Galvanized and coated, Steel Couplings: ASTM A 865, threaded.

Malleable- or Ductile-Iron Unions: UL 860.

Cast-Iron Flanges: ASME 16.1, Class 125.

Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

- B. Manufacturers: Refer to Appendix A.
- C. Pressure Rating: in range of 175 psig to 300 psig.
- D. Galvanized and coated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
- E. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

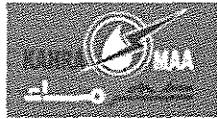
Steel Pressure-Seal Fittings: UL 213, FM-approved, required pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

7.1.14.12 CPVC PIPE AND FITTINGS

CPVC Pipe: ASTM F 442/F 442M and UL 1821, SDR 13.5, for 175-psig rated pressure at 62 deg C with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.

CPVC Fittings: UL listed or FM approved, for 175-psig rated pressure at 150 deg F 62 deg C, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.

- A. 22mm to 40mm: ASTM F 438 and UL 1821, Schedule 40, socket type.
- B. 50mm to 80mm: ASTM F 439 and UL 1821, Schedule 80, socket type.
- C. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- D. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
- E. Flanges: CPVC, one or two pieces.

7.1.14.13 PIPING JOINING MATERIALS

Pipe-Flange Gasket Materials: flat face, 3.2 mm thick, nonmetallic and asbestos free

- A. Class125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
- B. Class250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493, solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.

- A. Use solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Use adhesive primer that has a VOC content of 650 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

Valves and Check Valves of 2½" size and above shall be flanged type and 2" size below shall be threaded type.

7.1.14.14 PROTECTION VALVES

General Requirements:

- A. Valves shall be UL listed or FM approved.
- B. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig
- C. Minimum Pressure Rating for High-Pressure Piping: 300 psig.

Ball Valves:

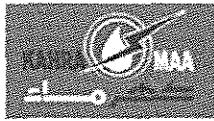
- A. Manufacturers: Refer to Appendix A:
- B. Standard: UL 1091 except with ball instead of disc.
- C. Valves 40mm and Smaller: Bronze body with threaded ends.
- D. Valves 40mm TO 50mm Bronze body with threaded ends or ductile-iron body with grooved ends.
- E. Valves 80MM and above Ductile-iron body with grooved ends.

Bronze Butterfly Valves:

- A. Standard: UL 1091.
- B. Pressure Rating: 175 psig to 300 psig
- C. Body Material: Bronze.
- D. End Connections: Threaded.

Iron Butterfly Valves:

- A. Standard: UL 1091.
- B. Pressure Rating: 175 psig to 300 psig



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- C. Body Material: Cast or ductile iron.
- D. End Connections: Grooved.

Check Valves:

- A. Manufacturers: Refer to appendix A
- B. Standard: UL 312.
- C. Pressure Rating: 250 psig minimum and 300 psig.
- D. Type: Swing check.
- E. Body Material: Cast iron.
- F. End Connections: Flanged or grooved.

Iron OS&Y Gate Valves:

- A. Standard: UL 262.
- B. Pressure Rating: 250 psig minimum 300 psig.
- C. Body Material: Cast or ductile iron.
- D. End Connections: Flanged or grooved.

7.1.14.15 TRIM AND DRAIN VALVES

General Requirements:

- A. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- B. Pressure Rating: 175 psig (12bar) minimum.

Alarm Valves:

- A. Standard: UL 193.
- B. Design: For horizontal or vertical installation.
- C. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages and fill-line attachment with strainer.
- D. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
- E. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

Deluge Valves:

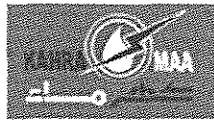
- A. Standard: UL 260.
- B. Design: Hydraulically operated, differential-pressure type.
- C. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
- D. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.

Automatic (Ball Drip) Drain Valves:

- A. Standard: UL 1726.
- B. Pressure Rating: 175 psig minimum.
- C. Type: Automatic draining, ball check.
- D. Size: DN 20
- E. End Connections: Threaded.

7.1.14.16 FIRE-DEPARTMENT CONNECTIONS

Exposed-Type, Fire-Department Connection:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Standard: UL 405.
- B. Type: Exposed, projecting, for wall mounting.
- C. Pressure Rating: 175 psig minimum.
- D. Body Material: Corrosion-resistant metal.
- E. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- F. Caps: Brass, lugged type, with gasket and chain.
- G. Escutcheon Plate: Round, brass, wall type.
- H. Outlet: Back, with pipe threads.
- I. Number of Inlets: four.
- J. Escutcheon Plate Marking: Similar to "AUTO SPRINKLER & STANDPIPE."
- K. Finish: Polished chrome plated.
- L. Outlet Size: DN 150.

Flush-Type, Fire-Department Connection:

- A. Standard: UL 405.
- B. Type: Flush, for wall mounting.
- C. Pressure Rating: 175 psig minimum.
- D. Body Material: Corrosion-resistant metal.
- E. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- F. Caps: Brass, lugged type, with gasket and chain.
- G. Escutcheon Plate: Rectangular, brass, wall type.
- H. Outlet: With pipe threads.
- I. Body Style: Horizontal
- J. Number of Inlets: Four
- K. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
- L. Finish: Polished chrome plated

7.1.14.17 SPRINKLER SPECIALTY PIPE FITTINGS

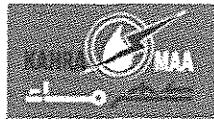
Branch Outlet Fittings:

- A. Standard: UL 213.
- B. Pressure Rating: 175 psig minimum300 psig maximum
- C. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
- D. Type: Mechanical-T and -cross fittings.
- E. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
- F. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
- G. Branch Outlets: Grooved, plain-end pipe, or threaded.

Flow Detection and Test Assemblies:

- A. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- B. Pressure Rating: 175 psig minimum and 300 psig
- C. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
- D. Size: Same as connected piping.
- E. Inlet and Outlet: Threaded.

Branch Line Testers:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Standard: UL 199.
- B. Pressure Rating: 175 psig
- C. Body Material: Brass.
- D. Size: Same as connected piping.
- E. Inlet: Threaded.
- F. Drain Outlet: Threaded and capped.
- G. Branch Outlet: Threaded, for sprinkler.

Sprinkler Inspector's Test Fittings:

- A. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- B. Pressure Rating: 175 psig minimum and 300 psig .
- C. Body Material: Cast- or ductile-iron housing with sight glass.
- D. Size: Same as connected piping.
- E. Inlet and Outlet: Threaded.

Adjustable Drop Nipples:

- A. Standard: UL 1474.
- B. Body Material: Steel pipe with EPDM-rubber O-ring seals.
- C. Size: Same as connected piping.
- D. Length: Adjustable.
- E. Inlet and Outlet: Threaded.

Flexible, Sprinkler Hose Fittings:

- A. Standard: UL 1474.
- B. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
- C. Size: Same as connected piping, for sprinkler.

7.1.14.18 SPRINKLERS

General Requirements:

- A. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- B. Pressure Rating for Residential Sprinklers: 175 psig maximum.
- C. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

Automatic Sprinklers with Heat-Responsive Element:

- A. Early-Suppression, Fast-Response Applications: UL 1767
- B. Non-residential Applications: UL 199
- C. Residential Applications: UL 1626
- D. Characteristics: Nominal 12.7-mm orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

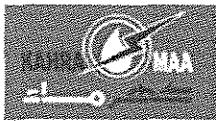
Open Sprinklers with Heat-Responsive Element Removed: UL 199.

A. Characteristics:

- i. Nominal 12.7mm Orifice:

Sprinkler Finishes:

- A. Chrome plated.
- F. Bronze.
- G. Painted.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Sprinkler Temperature Rating

- A. 1. 79°C, Standard Response for Ordinary Hazard Occupancies.
- B. 2. 68°C, Standard Response for Light Hazard Occupancies.

Special Coatings:

- A. Wax.
- B. Lead.
- C. Corrosion-resistant paint.

Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

- A. Ceiling Mounting: Chrome-plated steel, one piece, flat with 25-mm vertical adjustment or Plastic, white finish, one piece, flat.
- B. Sidewall Mounting: [Chrome-plated steel] [Plastic, white finish], one piece, flat.

Sprinkler Guards:

- A. Standard: UL 199.
- B. Type: Wire cage with fastening device for attaching to sprinkler.

7.1.14.19 ALARM DEVICES

Alarm-device types shall match piping and equipment connections.

Water-Motor-Operated Alarm:

- A. Standard: UL/FM/LBC/EN and QCDD approved.
- B. Type: Mechanically operated, with Pelton wheel.
- C. Alarm Gong: Cast aluminum with red-enamel factory finish.
- D. Size: 250-mm diameter.
- E. Components: Shaft length, bearings, and sleeve to suit wall construction.

Electrically Operated Alarm Bell:

- A. Standard: UL/FM/LBC/EN and QCDD approved.
- B. Type: Vibrating, metal alarm bell.
- C. Size: 150-mm minimum 200-mm diameter.
- D. Finish: Red-enamel factory finish, suitable for outdoor use.

Water-Flow Indicators:

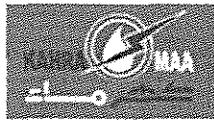
- A. Standard: UL/FM/LBC/EN and QCDD approved.
- B. Water-Flow Detector: Electrically supervised.
- C. Type: Paddle operated.
- D. Pressure Rating: 250 psig
- E. Design Installation: Horizontal or vertical.

Pressure Switches:

- A. Standard: UL/FM/LBC/EN and QCDD approved.
- B. Type: Electrically supervised water-flow switch with retard feature.
- C. Components: Single-pole, double-throw switch with normally closed contacts.
- D. Design Operation: Rising pressure signals water flow.

Valve Supervisory Switches:

- A. Standard: UL 346.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- B. Type: Electrically supervised.
- C. Components: Single-pole, double-throw switch with normally closed contacts.
- D. Design: Signals that controlled valve is in other than fully open position.

7.1.14.20 CONTROL PANELS

Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.

- A. Panels: UL listed and FM approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.

EXECUTION

7.1.14.21 PREPARATION

Perform fire-hydrant flow test according to NFPA 13. Use results for system design calculations required in "Quality Assurance" Article.

Report test results promptly and in writing.

7.1.14.22 SERVICE-ENTRANCE PIPING

Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."

Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

7.1.14.23 PIPING INSTALLATION

Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

- A. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

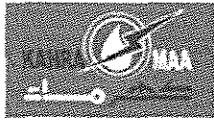
Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.

Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

Install unions adjacent to each valve in pipes DN 50 and smaller.

Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having DN 65 and larger end connections.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

Install sprinkler piping with drains for complete system drainage.

Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

Install alarm devices in piping systems.

Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than 12mm and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

Fill sprinkler system piping with water.

Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "Escutcheons for Fire-Suppression Piping."

7.1.14.24 JOINT CONSTRUCTION

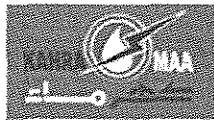
Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

Install unions adjacent to each valve in pipes 50mm and smaller.

Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having 65mm and larger end connections.

Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

Apply appropriate tape or thread compound to external pipe threads.

Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

Steel-Piping, Pressure-Sealed Joints: Join light wall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

Shop welds pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer..

Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

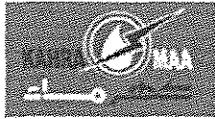
Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

- A. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
- B. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

7.1.14.25 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

7.1.14.26 VALVE AND SPECIALTIES INSTALLATION



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

Specialty Valves:

- A. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
- B. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
- C. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

7.1.14.27 SPRINKLER INSTALLATION

Install sprinklers in suspended ceilings in center off acoustical ceiling panels.

Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

7.1.14.28 FIRE-DEPARTMENT CONNECTION INSTALLATION

Install wall-type, fire-department connections.

Install yard-type, fire-department connections in concrete slab support. Comply with requirements for concrete in Division 03 Section "Cast-in-Place Concrete".

Install automatic (ball drip) drain valve at each check valve for fire-department connection.

7.1.14.29 IDENTIFICATION

Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

7.1.14.30 FIELD QUALITY CONTROL

Perform tests and inspections.

Tests and Inspections:

- A. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- D. Energize circuits to electrical equipment and devices.
- E. Start and run excess-pressure pumps.
- F. Coordinate with fire-alarm tests. Operate as required.
- G. Coordinate with fire-pump tests. Operate as required.
- H. Verify that equipment hose threads are same as local fire-department equipment.

Sprinkler piping system will be considered defective if it does not pass tests and inspections.

Prepare test and inspection reports.

7.1.14.31 CLEANING

Clean dirt and debris from sprinklers.

Remove and replace sprinklers with paint other than factory finish.

7.1.14.32 PIPING SCHEDULE

Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed..

CPVC pipe; Schedule 40CPVC fittings; and solvent-cemented joints may be used for light-hazard and residential occupancies.

7.1.14.33 SPRINKLER SCHEDULE

Refer to Drawings for sprinkler schedule,

7.1.15 21 1339 - Foam Water System

GENERAL

7.1.15.1 SUMMARY

Section includes Foam Water Sprinkler System, as shown on the drawings and specifications herein.

Meet local building and fire regulations, including the most recent issue of the following:

- A. NFPA 11 - Standard for the Low Expansion Foam Systems;
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems;
- C. NFPA 16 - Standard for Low, Medium, & High Expansion Foam;
- D. NFPA 30 Flammable and Combustible Liquids Code;
- E. NFPA 72 - Standards for the Application, Installation, Location, Performance and Maintenance of Fire Alarm Systems and their Components;

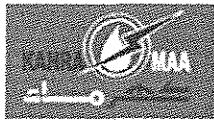
7.1.15.2 SUBMITTALS

Product Data: For each type of product indicated.

Shop Drawings: Include system layout drawings, specifications and hydraulic calculations.

Submit proof of approval to Civil Defence.

Operation Data: Include manufacturer's data.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Maintenance Data: Include servicing requirements and test schedule.

All components of the foam water sprinkler system shall be UL listed and labelled.

Material shall meet current ASTM and ANSI standard.

7.1.15.3 QUALITY ASSURANCE

Provide all labour, materials, products, equipment and services to supply and install Foam Water Sprinkler systems as indicated on the Drawings and specified in this Section of the Specification in accordance with NFPA 11, 13 & 16 and to the requirements of the Local Civil Defence Authority.

Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience approved by manufacturer.

PRODUCTS

7.1.15.4 PIPEWORK AND FITTINGS

All pipework, valves and fittings, unless otherwise specified, shall comply with relevant clauses in the NFPA 13 & 16 regulations.

Underground piping shall be in accordance with NFPA 13 & 16.

Contractor shall supply, deliver and install all pipework materials and fittings for the Foam Water systems.

Provide pipe hangers in accordance with NFPA 13 & 16.

All pipe work, fittings and valves shall be free from corrosion, scale and internal obstruction.

Manufacturer's standard fittings shall be used and fabricated fittings will not be acceptable without approval.

For working pressures below 20 bar the pipework shall be seamless factory galvanized steel in accordance with ASTM A53 grade B schedule 40.

Fittings on 50 mm and below shall be galvanized malleable iron fittings conforming to class 250, ANSI B16.4 and or B16.25 and shall be UL listed, FM approved.

Fittings 65 mm and above shall be factory galvanized mechanical roll grooved fittings and shall be UL listed, FM approved. These shall be class 300 to class 16.9.

All valves and fittings used in the pipework system shall not have a pressure rating less than that of the pipework.

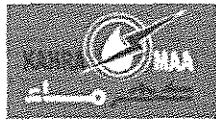
7.1.15.5 VALVES

All valves controlling connections to water supplies and foam water system shall be UL listed and indicating valves and shall be in accordance with NFPA 13 & 16.

All valves shall have the name of the manufacturer and working pressure cast or stamped on body.

All valves shall be selected for the working pressure and test pressure required.

7.1.15.6 DELUGE VALVES



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

The deluge valve shall be automatic in operation from a detection system (combination fixed temperature and rate of rise heat actuated detector, etc.) a local manual station or a remote manual station.

The valve shall have a water flow switch, alarm test connection, contact for starting fire pump system and de-energizing protected equipment.

The Contractor shall provide all relevant drains and gauges.

All trim required for the valve, such as pipe, nipples, valves, check valves, and strainers shall be included.

7.1.15.7 OS & Y VALVES

OS & Y gate valves shall be UL Listed and shall be fitted to the installation in order to shut the valve, the spindle must turn clockwise.

The hand wheels of all stop valves shall be clearly marked to indicate which direction the wheel is to be turned to close the valve.

An indication shall also be provided which shows whether the valve is open or shut.

Bolted bonnet, outside screw and yoke, wedge gate, iron body, bronze trim with flanged ends, threaded or grooved ends.

Valves 50 mm (2 in) and smaller, Underwriters Laboratories pattern, bronze to ASTM B61 solid wedge and screwed ends. OS & Y 1400 Pa (water, oil gas).

Valve 65 mm and larger, Underwriters Laboratories pattern, iron body bronze mounted, OS & Y solid wedge, flanged ends, 1200 kPa (water, oil, gas).

7.1.15.8 CHECK VALVES

Check valves shall be of materials similar to the gate valves for the appropriate systems in which they will be installed.

All check valves shall be of quick closing type to eliminate the sudden surge in the pipe line on closing.

Valves 50 mm and smaller, bronze to ASTM B61 designed of both horizontal and vertical mounting replaceable composition disc, screwed cap and ends, 1400 kPa (water, oil, gas).

Valves 65 mm and larger, iron body, Underwriters Laboratories pattern, bronze mounted, regrind renew bronze disc and seat ring, bolted cap, designed for either horizontal or vertical mounting, flanged ends, 1200 kPa (water, oil, gas).

Swing Type: Use for water and low pressure general services: 50 mm and smaller with screwed bonnet, screwed end; 65mm and larger with bolted bonnet, flanged end or grooved end.

Silent Type: Use for standpipe system pumps. Valves to have cast iron body and bronze or stainless steel trim and to be of the center guide type, with flanged end or grooved end.

7.1.15.9 AIR VENTS AND DRAIN VALVES

UL listed air vents and drain valves shall be provided at high points and low points respectively in all Foam –Water system piping in accordance with NFPA 11, 13, & 16.

Air vents shall have gunmetal or brass bodies, non-ferrous or stainless steel float and guides, and non-corrodible valves and seats.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Each automatic air vent shall be controlled by a lock-shield valve.

7.1.15.10 PRESSURE GAUGES

Provide UL listed pressure gauges, in accordance with NFPA 13 & 16, where indicated on the drawings and as mentioned below.

All gauges shall be provided with snubbers.

Gauges shall have 100 mm diameter dial, white coated with black figures and graduations.

Shutoff cock shall be provided between gauge and piping to permit gauge removal while system is under pressure.

Gauges shall have graduation such that at normal working pressure the needle is in the centre of the field.

All gauges shall be calibrated in kPa to a maximum of not less than 1-1/3 times and not more than 2 times the operating pressure.

7.1.15.11 FOAM PRESSURE PROPORTIONER

Provide UL listed Foam Pressure Proportioner in accordance with NFPA 16, where indicated on the drawings.

Foam Pressure Proportioner shall be used to produce constant preset foam solution in pressure proportioning system.

It should be designed to inject automatically the quantity of foam concentrate in to a water stream over a wide flow rate by balancing the pressure of the foam concentrate with that of water supply.

The flow rate has to be selected as per the calculations.

7.1.15.12 FOAM LINE PROPORTIONER

Provide UL listed Foam Line Proportioner, in accordance with NFPA 16, where indicated on the drawings.

All Foam Line Proportioner should be designed for a minimum pressure differential of approximately 35% of the inlet pressure between the inlet and outlet to operate correctly.

7.1.15.13 FOAM WATER SPRINKLER

Provide UL listed / FM Approved sprinkler heads as required and as shown on the drawings in accordance with NFPA 13 & 16.

The sprinkler heads shall be of the spray pattern installed in an upright position or pendant position as required.

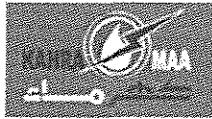
Finish of sprinklers shall be to the approval of the Architect.

The Contractor shall supply set of spare sprinkler heads in each type and located in a cabinet in the fire pump room together with sprinkler spanners for use in removing and installation of the heads in accordance with NFPA 13 & 16 and as per the requirements of the Local Civil Defence Authority.

7.1.15.14 FOAM SYSTEM BLADDER TANK

Provide UL listed, FM Approved Foam Bladder Tank as required and as shown on the drawings in accordance with NFPA 13 & 16.

Bladder Tank shall be welded pressure vessels constructed of carbon steel with a working pressure of 175 psi.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Bladder Tank shall be supplied either vertical or horizontal configuration and shall be mounted on full skirt, securely welded to tank shell, complete with four (4) mounting clips.

The tank shall have centre discharge piping, located within the bladder, to ensure that the foam concentrate flows to the bottom discharge.

Bottom discharge connection shall have provision to prevent the internal piping from entering the discharge piping.

Tank shall include all necessary drain and vent valves, concentrate fill piping and fill cup. In accordance with the NFPA requirement for valve supervision, all tank valves shall be locking type, brass or bronze ball valves with identification labels on the handles.

All piping for foam concentrate shall be schedule 40 brass pipe.

Water pressurization and foam concentrate supply connections shall be female NPT. External surfaces of tank and piping shall be coated with red high solids epoxy finish.

7.1.15.15 FOAM CONCENTRATE (3% FF)

The Contractor shall provide UL listed / FM Approved Foam Concentrate (3% AFFF) as required and based on the design calculations.

7.1.15.16 ELECTRIC PRESSURE ALARM SWITCH

The Contractor shall provide UL listed electric alarm pressure switch in accordance with NFPA 13 & 16 and they shall be mounted on a vertical branch pipe at least 300 mm long.

The pressure switch shall be of the diaphragm bellows operated type, and shall be sufficiently sensitive to operate when only one sprinkler is discharging

The pressure switch shall be provided with volt free contacts to facilitate monitoring by a Building Management System and wired to the main fire alarm panel.

7.1.15.17 ALARM AND DISCHARGE ACTION

Cross-zoned Detection System: The Foam Water sprinkler system shall be automatically actuated by either verified detection circuits or cross-zoned detection circuits.

Combination of Fixed Temperature & Rate-of-Rise Heat detectors shall be installed at no more than 23 square meters of coverage per detector (or as per manufacturers /applicable standards requirements)..

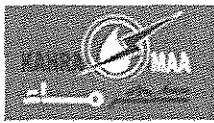
The detectors shall be alternated throughout the protected area and be compatible on either circuit

A. Phase I (General Alarm)

- i. Activation of any single detector in any detection zone shall:
 - a) Cause a first-stage alarm (slow pulse horn/strobe);
 - b) Energise a lamp on the activated detector and control panel

B. Phase II (Pre-Discharge)

- i. Activation of two adjoining (cross-zoned) or any second (verified) detector shall:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- a) Transmit an alarm signal to remote monitoring or building alarm panel;
- b) Cause a second-stage (pre-discharge) alarm (fast pulse horn/strobe) to operate;
- c) Operate auxiliary contacts for air conditioning shutdowns and automatic dampers;
- d) Initiate an adjustable time delay (Foam Water sprinkler system release).

C. Phase III (Discharge)

- i. Upon completion of the time delay the Foam Water sprinkler system shall:
 - a) Cause discharge (steady horn/strobe) alarm to be activated;
 - b) Operate auxiliary contacts for emergency power off all electrical equipment (excluding lighting and emergency circuits for life safety);
 - c) Activate visual alarms at protected area entrance (strobe);
 - d) Energise control solenoid for Deluge valve releasing Foam Water sprinkler system into the alarmed zone only.

7.1.15.18 AUXILIARY COMPONENTS

Manual Releasing Stations shall be provided at each exit of the protected area and shall when activated, immediately release the Foam Water and cause all audible/visual alarms to activate.

Abort Stations shall be provided at each exit of the protected area and shall, when operated, interrupt the discharge of Foam Water and emergency power off function.

The Abort Stations shall be momentary devices (dead-man) requiring constant pressure to maintain contact closure.

Graphic Annunciator shall be provided at the control panel location.

The Graphic Annunciator shall be provided by the equipment manufacturer in an approved NEMA enclosure with keyed face plate.

The Graphic Annunciator shall display the entire Foam Water sprinkler system protected area (silk screened) and shall indicate each heat detector and its proximity.

7.1.15.19 MATERIALS AND EQUIPMENT – ELECTRICAL

Materials and equipment shall be of a single manufacturer.

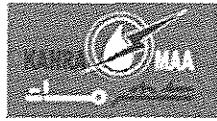
Provide materials and equipment from approved suppliers.

The name of the manufacturer and the serial numbers shall appear on all major components. Locks for all cabinets shall be keyed alike.

NEMA rating and/or electrically hazardous classifications shall be observed and any equipment or materials installed must meet or exceed the requirements of service.

Any wiring shall be of the proper size to conduct the circuit current but shall not be smaller than 18 AWG, unless otherwise specified for a given purpose.

The use of aluminium wire is strictly prohibited.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

All electrical circuits shall be numerically tagged with suitable devices at its terminating point.

Black coloured wire shall be used exclusively for the identification of the neutral conductor of an alternating current circuit.

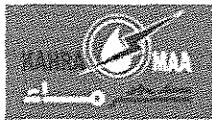
Green/Yellow coloured wire shall be used exclusively for the identification of the earth ground conductor of an AC or DC circuit.

Primary system voltage shall be 220 VAC, single phase, 50 Hz.

7.1.15.20 CONTROL SYSTEMS – GENERAL

All control systems shall be UL listed or FM approved and be utilised with listed or approved operating devices and shall be capable of the following features:

- A. Ground fault indication
- B. Supervised detection circuit(s)
- C. Supervised alarm circuit
- D. Supervised release circuit
- E. Supervised manual pull circuit
- F. Supervised line power circuit
- G. Alarm overrides trouble logic
- H. Battery standby
- I. Front panel indicating lamps (LEDs)
- J. Key lock steel enclosure
- K. Programmable time delay
- L. Programmable detection logic
- M. Prioritised trouble logic
- N. Solid state integrated circuitry
- O. Lamp test



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.15.21 CONTROL PANEL

Provide a control system, in addition to the general requirements for control panels the control system shall meet the requirements of this section.

The Internal power supply shall operate from 220 VAC, single phase, 50 Hz (1.0/0.5 amp rectified to 24 VDC (2 amp).

The control system shall provide provisions for housing its own set of "on-line" float charge emergency batteries within the enclosure.

The control system shall provide two supervised detection (input circuits) programmable for:

- A. Independent-zoning
- B. Priority-zoning
- C. Cross-zoning

A supervised dedicated manual pull circuit designated for immediate operation of the release circuit shall be provided.

Abort function (if used) shall be programmed for either immediate release or 10 second delay after abort and comply with IRI requirements.

A programmable time delay for 10, 15, 30 or 60 seconds shall be provided between verification of a fire situation and suppression system release.

Battery Supervision shall be provided for condition and placement of the batteries.

Four (4) plug-in relays with two (2) Form C (DPDT) contacts, one relay with Form C (SPDT) rated at 10 amps, 30 VDC and 7.5 amps at 240 VAC shall be provided for auxiliary functions.

Each of the following actions shall cause one for the five relays to transfer:

- A. General alarm
- B. Pre-discharge alarm
- C. System discharge
- D. Assignable general alarm or pre-discharge alarm
- E. System trouble

LED indicators shall be provided on the front door to annunciate the following conditions:

- A. Power On (green)
- B. System trouble - (yellow)
- C. Zone 1 alarm - (red) (yellow)
- D. Zone 2 alarm - (Red) (Yellow)
- E. Manual pull/Abort alarm - (Red) (Yellow)

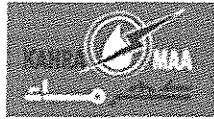
EXECUTION

7.1.15.22 INSPECTION

Do not recess, paint or conceal any work including piping and accessory equipment before it has been inspected and approved.

The Contractor shall prevent theft of sprinkler systems components.

The Contractor shall replace any missing items prior to final inspection and handover.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

The Contractor shall protect all finishes, replace or repair any damaged finishes to the satisfaction of the local consultant.

7.1.15.23 TESTING

Foam Water system test shall be carried out in presence of client representative, local fire official, engineer and the Contractor in order to verify the system performance.

The Contractor shall test all system components in accordance with NFPA 13 & 16.

The Contractor shall carry out any additional tests required by the authorities having jurisdiction.

The Contractor shall carry out any additional tests required by the authorities having jurisdiction.

The Contractor shall submit certification that systems have been designed and installed in accordance with NFPA 13, 16 and the requirements of the Local Civil Defence Authority.

The Contractor shall perform tests before piping is concealed.

The Contractor shall remove all components which will not withstand test pressure, and replace after tests.

Eliminate leaks or remove and refit defective parts.

Caulking of threaded or welded joints will not be permitted.

The Contractor shall repeat all tests as often as necessary to obtain certification.

7.1.15.24 IDENTIFICATION SIGNS

The Contractor shall provide signs, conforming to NFPA 13 & 16 requirements and in accordance with the requirements of local authorities, for each valve and alarm device

7.1.15.25 PAINTING

The Contractor shall paint all exposed sprinkler piping with a suitable primer and top coat(s) in bright red to the satisfaction of the lead consultant.

The Contractor shall obtain agreement from the Architect on top coat paint colour before application.

7.1.16 21 2000 – Fire Extinguishing System

GENERAL

7.1.16.1 SECTION INCLUDES

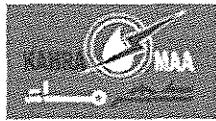
Automatic clean agent fire extinguishing system.

7.1.16.2 RELATED SECTIONS

Section 21 0500 - Common Work Results for Fire Suppression: Pipe, fittings, and valves.

Section 21 0553 - Identification for Fire Suppression Piping and Equipment.

Section 21 0900 – Instrumentation & Control for Fire Suppression System.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

7.1.16.3 SUBMITTALS

See Section 01 - Administrative Requirements, for submittal procedures.

Shop Drawings: Provide the following:

- A. Automatic Clean Agent Extinguishing System Cylinders.
- B. Extinguishing Panel, Pressure Switch, Control Head.
- C. Detectors.
- D. Automatic Clean Agent Extinguishing System Nozzles.
- E. Release Sounder.
- F. System piping diagram.
- G. Wiring diagrams.

Product Data on materials and components for use.

List of tests included.

Certified test data

A list of proposed suppliers and Subcontractors intended to be used.

7.1.16.4 QUALITY ASSURANCE

- A. The manufacturer of all equipment supplied under this section shall have at least 10 years experience in the manufacture of specific equipment being supplied.

Approved Subcontractors.

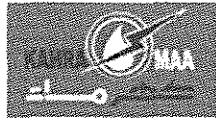
- A. Only Subcontractors approved by the Civil Defence Authority having jurisdiction shall be permitted to install fire protection equipment and systems. The Subcontractor shall submit written proof that he is authorized to install fire protection systems together with his approval classification. The Subcontractor shall also submit a separate prequalification for the fire protection Work issued by the Engineer.

Qualifications: Execute Work of this section only by skilled tradesmen employed by a qualified Fire Protection Subcontractor approved by the Civil Defence Authority having jurisdiction and regularly engaged in the installation of pressurized chemical fire protection systems.

The equipment shall be listed by UL or other accepted regulatory body, and the system shall meet the standards of NFPA or equivalent British Standard

Standards and other Codes of Practice: In addition to the requirements indicated on the Design Drawings or specified in the Specification, the Work shall be in accordance with provisions of the following standards and codes. The current editions of the publications listed below form a part of this Section.

- A. National Fire Protection Association, NFPA Standards.
 - i. NFPA 25: Standard for the Inspection, Testing and Maintenance of Water Based Fire Protection Systems.
 - ii. NFPA 27: Standard for the Application, Installation, Location, Performance and Maintenance of Fire Alarm Systems and their Components.
- B. National Electrical Manufacturers Association, NEMA Standards.
- C. American Society for Testing and Materials, ASTM International Standards.
- D. American National Standards Institute, ANSI Standards.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- E. American National Standards Institute, ANSI Standards.
 - F. Underwriters' Laboratories, UL Standards.
 - G. Factory Mutual System, FM Standards.
- Provide testing and inspections in accordance with Section 014000 Quality Requirements

Preconstruction Testing/ Reports

- A. Submit reports of independent tests demonstrating that the products and systems comply with the specified performance requirements.
- B. Where test results for a material or product are not available, undertake testing to show compliance with the Specification at an independent testing laboratory acceptable to the Engineer
- C. The provision of testing data or the carrying-out of tests does not relieve the Contractor of his responsibilities regarding the performance requirements, durability or service life requirements.

Testing and Inspection: Provide as indicated under Site Quality Control within Part 3 of this Section.

7.1.16.5 DELIVERY, STORAGE AND HANDLING

Deliver, store, protect and handle products to Site under provisions of Section 016000 Product Requirements.

Deliver, store, protect and handle products to Site with particular reference to Abu Dhabi, UAE climatic conditions.

7.1.16.6 PROJECT CONDITIONS

Project Climatic Conditions

- A. Refer to the Particular Specification for details of the project location and associated climatic conditions.
- B. Climate
 - i. Violent sand and dust storms of several hours duration occur and even on comparatively still days, fine dust is carried in suspension in the atmosphere.
 - ii. All apparatus and equipment shall therefore be so designed and constructed that they operate satisfactorily and without any deleterious effect for prolonged and continuous periods in the conditions stated in the Particular Specification.

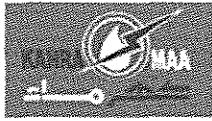
Civil Work Coordination

- A. Take into account of all the Civil/ Mechanical Work performed by other Subcontractors associated with installation of electrical, mechanical, plumbing and other facilities.

GENERAL

7.1.16.7 SCOPE OF WORK

- A. Supply all materials, labour, equipment to provide a pre-engineered automatic clean agent extinguishing system located in transformer rooms, high voltage rooms, main low voltage switchgear rooms, telecommunication rooms, security rooms in accordance with the requirements of NFPA 2001 and details indicated on the Design Drawings.
- B. Provide all labour, materials, products, equipment and services to supply and install all fire extinguishers and ancillaries as required and as indicated on drawings and as specified in this Section of the Specification in



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- accordance with NFPA 10 in addition to the requirements of the Civil Defence Authority having jurisdiction.
- C. Provide all labour, materials, products, equipment and services to supply and install fire blankets and all associated ancillaries as required and as indicated on the drawings and as specified in this Section of the Specification in accordance with NFPA 10 in addition to the requirements of the local civil defence and authority having jurisdiction.
 - D. Provision of Third Party appointment in accordance with the requirements of the Civil Defence Authority having jurisdiction to review Shop Drawings, inspection, audit report and any other requirements stipulated by the Civil Defence Authority having jurisdiction to obtain the completion certificate from the Civil Defence Authority having jurisdiction.

7.1.16.8 PRODUCT SELECTION

Manufacturers: Provide systems and products from one of the listed manufacturers within the approved manufacturer list.

7.1.16.9 DESIGN CRITERIA

Comply with requirements of Section 210100 Operation and Maintenance of Fire Suppression and Section 210500 Common Work Results for Fire Suppression for basic materials and methods for mechanical Work.

It shall be the Contractor's responsibility to be fully aware of and comply with all of the requirements of the above listed documents.

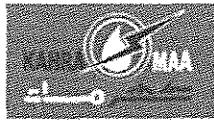
Pipes and Fittings

- A. Pipe and fittings shall be Carbon Steel Schedule 40, unless otherwise indicated.

7.1.16.10 AUTOMATIC CLEAN AGENT FIRE EXTINGUISHING SYSTEM, PERFORMANCE REQUIREMENTS

7.1.16.10.1. System Description.

- A. The Automatic Clean Agent Fire Extinguishing System shall comply with the environmental performance requirements of the sustainability framework of the Authority having jurisdiction, as detailed in the Particular Specification.
- B. The Automatic Clean Agent Fire Extinguishing System shall provide the required 7% concentration of agent in the space protected. A piping arrangement and nozzle shall convey the agent from the cylinders to the hazard and discharge the agent completely within 10 seconds. The piping and nozzles shall be engineered for the specific flow rates required and calculations shall be supplied with the system layout drawings for review and acceptance by the Engineer.
- C. The system design shall incorporate the capability of fully testing all electrical detection, discharge control, abort, power shutdown, air conditioning shutoff, fire damper and door closer circuits without discharge of the agent and without disconnecting the agent supply from the system.
- D. Installed systems shall be complete with all control wiring for detectors, alarms, door releases, fire damper releases, abort stations, manual pull stations air conditioning and computer equipment shutdown devices, voltage trips and circuit breakers. All wiring, including control circuitry, shall consist of insulation copper conductors installed in metal conduit.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.16.10.2. Equipment Instruction Plates

- A. Provide engraved instructions plates detailing emergency procedures at each system control panel and at each hazard area manual discharge station/abort switch location. Permanent name plates shall be used in the control panel to identify control logic unit contacts and major circuits.
- B. Etched aluminum warning signs shall be provided at all entrances and exits of the protected area. Entrance sign shall read: "WARNING - DO NOT ENTER ROOM WHEN ALARM SOUNDS, Automatic Clean Agent Extinguishing System BEING RELEASED." Exit sign shall read: "WHEN ALARM SOUNDS, VACATE AT ONCE, Automatic Clean Agent Extinguishing System BEING RELEASED."
- C. Basic Pipes and Pipe Fittings
- D. Automatic Clean Agent Fire Extinguishing System manifold and piping shall conform to the relevant requirements of the latest codes and standards.
- E. Pipes shall be black or galvanized steel, schedule 40 or 150mm diameter and smaller, complying with the relevant provisions of ASTM A106.
- F. Fittings shall be galvanized malleable iron 2070kPa class complying with the relevant provisions of ASTM A197, ductile iron 2070 class complying with the relevant provisions of ASTM A234. For 20mm diameter or smaller pipe sizes, 1035kPa class fittings are acceptable.

7.1.16.10.3. Control Panel

- A. The detection and extinguishing shall be 1 integrated panel. The power source for the system shall be 2 separately used standard voltage circuits which shall be connected to the control panel. The panel output shall be 24 Volts DC with a battery operated stand-by which shall automatically take over and operate the system for 24 hours in the event normal power is interrupted. When trouble of this kind or within the system occurs, an audible signal as well as the indicating lights shall warn operating personnel. The fire detection and control system shall be comprised of a solid state, low power information processor and associated supervisory and interface circuitry. The system shall provide adequate isolation from external wiring to assure against transient signals causing false alarms. The system shall be optimized for use with graphic annunciation displays.
- B. The unit shall include the following functions and logic sequence:
 - i. Operation of all smoke detection circuits.
 - ii. Operation of all agent discharge circuit.
 - iii. Operation of all audible (and visual) pre-alarm and alarm signals.
 - iv. Provide primary power (and control backup power) for entire system.
 - v. Provide interconnection to remote security.
 - vi. Provide supervision of the following described items.
 - vii. The unit shall include supervision of the following circuitry.
 - viii. Input power status.
 - ix. Manual pull station circuits.
 - x. Alarm circuits.
 - xi. Abort switch circuits.
 - xii. Detection circuits.
 - xiii. Agent discharge circuits.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- xiv. Time delay circuits.
- C. A set of contacts for connection to pre-action valve shall be provided.
- D. Activation of 1 detector shall activate the general alarm. The alarm shall be a combined horn and strobe, low pulse.
- E. Remote annunciations to the buildings security system and illuminate LED light on graphic annunciator.
- F. Activation of a cross-zoned detector in the same area shall:
 - i. Prompt activation and annunciation of pre-discharge alarms. The alarm shall be combined horn and strobe (fast pulse).
 - ii. Energize a time delay mechanism which shall release for 30 seconds. The agent shall be released at the end of this time interval unless a dead man - "Agent Hold" (abort switch) is depressed, restarting the time delay when released.
 - iii. Shut down the air-conditioning system and close its dampers.
- G. Discharge of the agent shall shut down power to equipment within the protected area.
- H. If a manual pull station is energized, the actions within this Section in the preceding clauses shall bypass the time delay and overriding abort switch.

7.1.16.10.4. Storage Cylinders

- A. The Automatic Clean Agent Fire Extinguishing System cylinders shall be constructed of high strength steel alloy conforming to applicable specifications of the Civil Defence Authority having jurisdiction. All containers shall be mounted securely in an upright position. Cylinders manifolded together shall be of the same size and weight/capacity. Each cylinder in a multiple cylinder group connected to a manifold shall be fitted with a flexible discharge hose and a manifold check valve. The check valve shall prevent agent loss during discharge should a cylinder be disconnected from the manifold. A mechanical method of actuation shall be provided at the cylinder location of local emergency operation.

7.1.16.10.5. Discharge Valve

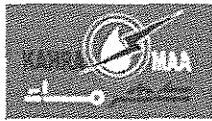
- A. Operation of the valve shall be by means of differential pressure using the container pressure at the source. The force differential and a metallic spring shall act to hold the valve closed prior to discharge and the force shall reverse upon actuation to open the valve. This reversal shall be accomplished by means of venting the agent through an opening on the container valve. The container valve shall be equipped with a pressure gauge for continuous monitoring of the container pressure safety outlet to automatically relieve pressure build-up.

7.1.16.10.6. Discharge Nozzles

- A. Discharge nozzles shall be 1 piece cast aluminium, have either a 180° or 360° flat fan-shaped discharge pattern and range in orifice sizes from 3mm to 50mm in 1mm increments.

7.1.16.10.7. Pressure Switch

- A. This pneumatically actuated switch shall be used to give positive identification of release of the agent in the piping system.
- B. The switch shall have 1 set of Normally Open (NO) and 1 set of Normally Closed (NC) contacts.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.16.10.8. Smoke Detectors

- A. Devices shall be UL listed and FM approved. The minimum contacts rating shall be 1amp for standard voltage, single phase, 50 Hz ±10% fluctuation.

7.1.16.10.9. Graphic Annunciators

- A. An engraved multi-layer acrylic graphic display showing walls, doors, windows, location of control panel and location of all smoke detectors shall be provided. The number and location of the displays shall be as stated in the Contract Documents. Silk screen graphics shall not be acceptable.
- B. Panel colour shall be white with black lettering. Indicators shall be Light Emitting Diodes (LED) in red, yellow or green. All points shall be wired to a labelled terminal strip which is plug compatible to the wiring harness for ease of installation. All graphics shall use a hide-away hinge system that eliminates the need for metal frames and visible screw heads. Back boxes shall be made of 1.5mm thick steel.

7.1.16.10.10. Battery Backup Power System

- A. A battery backup of the entire automatic clean agent fire extinguishing system, including detection, alarm, actuation and supervisory system shall be required. The back-up system shall be designed such that upon main power failure, backup power automatically services the system with no delay or interruption of any kind. The battery system shall be capable of powering the system for a period of not less than 24 hours in a normal standby condition, at the end of which time it shall be capable of operating the entire system in a full alarm condition for period of not less than 10 minutes. The trouble horn and light shall be activated to indicate that the system is operating on a battery power.

7.1.16.10.11. Alarm Horn/ Strobe Combination

- A. The alarm horn shall operate on 24Volts polarized DC power to allow supervision of the circuit wires.
- B. The alarm horn shall have a minimum sound level of 98 decibels at 3m.
- C. A horn and strobe light shall operate simultaneously from 1 power supply with flash rate of 1-3 flashes per second with peak light intensity of 800 candlepower.

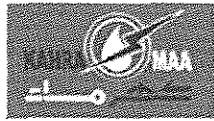
7.1.16.10.12. Manual Pull Stations

- A. The manual pull station shall be provided for the release of the Automatic Clean Agent Fire Extinguishing System in case of an emergency.
- B. The unit shall be contained within a metal body having a single pole switch. The unit shall require double action operation.

7.1.16.10.13. Abort Switch

- C. The abort switch shall be used where investigation delay is desired between detection and actuation of the system.

7.1.16.10.14. This switch shall be a momentary contact "dead-man" type switch requiring constant pressure to operate 1 set of NO (Normally Open) contacts and 1 set of NC (Normally Closed) contacts on each contact block. Clear operating instructions shall be provided at the abort switch.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.16.10.15. Automatic Fire Dampers

- A. Provide pressure trips for automatic fire dampers in air conditioning ductwork serving hazard areas separated by fire walls. Activation of fire dampers shall occur upon activation of Automatic Clean Agent Extinguishing System discharge. In case of motorized or electro-thermal link dampers, pressure trips are not required.

7.1.16.10.16. Basic Identification of Installation

- A. Piping System Identification: Bare and insulated piping shall be labelled in accordance with a piping colour code. Lines above ceilings shall have utility name and directional flow arrows stencilled in designated colour. Exposed piping in mechanical equipment room shall be painted with their designated colour, flow arrow shall be painted in contrasting colour. Spacing of description and arrow shall be 10m.
- B. Underground Piping Identification: Provide continuous underground type plastic marker, located directly over buried line at 150 to 200mm below finished grade.
- C. Valve Identification: Provide valve tag on every valve in each piping system. Tag shall be brass, 50mm in diameter with utility service and valve number embossed or stamped on it. List each tagged valve in valve schedule for each piping system. Mount valve schedule frames and schedules in machine rooms.
- D. Mechanical Equipment Identification: Provide engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, including main control and operating valves and primary balancing dampers.
- E. Install fire protection signs on piping in accordance with the requirements of the Civil Defence Authority having jurisdiction.
- F. Extinguishers shall be mounted at a height of 1530 mm from the top of the said extinguisher to the finished floor level.
- G. Fire extinguisher cabinets shall be set true and level at a height of 1500 mm from the top of the cabinet to the finish floor level.

EXECUTION

7.1.16.11 EXAMINATION

Verification of Conditions: Examine areas for compliance with requirements for installation and conditions affecting performance of the Work. Identify conditions detrimental to a proper and timely completion and notify the Engineer of the unsatisfactory conditions. Proceed with installation only after unsatisfactory conditions have been corrected.

7.1.16.12 INSTALLATION

7.1.16.12.1. Installation of Automatic Clean Agent Fire Extinguishing System

- A. The automatic clean agent system shall be installed in accordance with the requirements of NFPA 2001 and in accordance with instructions provided by the manufacturer.
- B. The manual activating device shall be located in a path of exit or egress.
- C. Provide interlock with automatic closing door releases.
- D. Integrate system with pre-action sprinkler system.
- E. Provide interlock with motorized smoke fire dampers.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- H. Provide signal to fire alarm system as indicated under Division 28 Electronic Safety and Security.

7.1.16.12.2. Installation of Pipes and Pipe Fittings

- A. Provide Work in accordance with the requirements of codes and standards for installation of fire protection piping materials. Install piping products where indicated in accordance with manufacturer's written instructions, and in accordance with recognized industry practices, to ensure that piping systems comply with requirements and serve intended purposes.
- B. Coordinate as necessary to interface components of fire protection piping properly with other work.
- C. Connect between tanks and nozzles/ sprinkler heads as indicated on the Design Drawings.
- D. Run pipes as high as possible.
- E. Pressure test piping 1034kPa.

7.1.16.13 SITE QUALITY CONTROL

7.1.16.13.1. Inspection

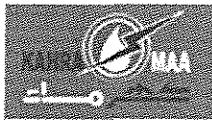
- A. All actuation components including but not limited to remote manual pull stations, mechanical or electrical devices, detectors, actuators, sprinkler heads and controllers shall be checked for proper operation during the inspection in accordance with the manufacturer's listed procedures. In addition to these requirements, specific inspection requirements listed in the applicable NFPA or British Standard shall also be followed.
- B. Verify that enclosing walls are continuous above ceilings and below raised floors to enable required concentration to be built up and maintained for required time to ensure fire extinguished.

7.1.16.13.2. Pressure Test

- A. After portions of the Automatic Clean Agent Fire Extinguishing System Systems work are completed, the work shall be hydrostatically tested in the presence of the Engineer. Give 5 days advance notice of the tests to the Employer. Furnish all pumps, gauges, instruments, test equipment and personnel required for these tests and make all provisions for removal of test equipment.
- B. Piping shall be tested individually by fire suppression zones, with plugs and/or caps in place of nozzles and agent storage containers as follows: A preliminary test of not more than 1500kPa shall be carried out to reveal possible major leaks. After this preliminary test, the pressure shall be raised to 2,000kPa. If leaks are found, they shall be eliminated by tightening, repair or replacement. On completion of any remedial work, hydrostatic tests shall be repeated until no leakage occurs.

7.1.16.13.3. Flow and Compliance Test

- A. Coordinate and schedule flow tests at a times agreed with the Engineer. Notify the Engineer as to the time of flow and compliance tests a minimum of 2 weeks in advance of any such tests.
- B. Provide all test equipment necessary to test and demonstrate that the automatic clean agent fire extinguishing system satisfactorily complies with the Contract Document requirements. The flow and compliance test report shall include recordings of the following data:



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

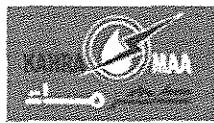
- i. Verification of status for each item of equipment, alarm signalling and zone barrier closure device prior to the test and at each stage of Automatic Clean Agent Fire Extinguishing System Alarm, including abort and reset to the manual mode.
- ii. Discharge time: Time period to complete discharge by means of digital timing devices.
- iii. Concentration: Use thermal conductivity recording gas analyzers with a minimum of three simultaneous recording points. Concentrations shall be recorded through entire holding time.
- C. Complete data shall be recorded for each fire suppression zone in accordance with the following scenario description:
 - i. Conditions Normal: Simulate an occupied facility and verify status of device and equipment using test lights on valves in lieu of pressurized agent storage containers.
 - ii. Stage-I Automatic Clean Agent Fire Extinguishing System Alarm: Activate a random smoke detector by canned smoke or similar agent and verify status of devices and equipment.
 - iii. Stage-II Automatic Clean Agent Fire Extinguishing System Alarm: Activate another random smoke detector by canned smoke or similar agent. After alarm, activate abort mode and verify status of devices and equipment.
 - iv. Manual Mode: Cancel the Automatic Clean Agent Fire Extinguishing System timed release period logic by activated the key operated reset and verify status of devices and equipment.
 - v. Stage-III Automatic Clean Agent Fire Extinguishing System Alarm: Activate a manual discharge station and verify status of devices and equipment.
 - vi. Conditions Normal: Simulate an occupied facility and verify status of devices and equipment with pressurized agent storage containers replacing the test lights on valves.
 - vii. Stage-IV Automatic Clean Agent Fire Extinguishing System Alarm: Activate random smoke detectors by canned smoke, or similar agent, and allow the Clean Agent timed release period logic to discharge the test gas. Record times and concentrations.
- D. If flow and compliance test indicates a fire suppression zone including related accessory devices and equipment failed to function, or concentrations during holding period were not satisfactory, reschedule another flow and compliance test to demonstrate satisfactory performance after making corrections.

7.1.16.14 DEMONSTRATION

General: Refer to Section 017900 Demonstration and Training for additional demonstration and training requirements.

Demonstration

- A. Demonstrate to the Engineer, the features and functions of the system and subsystems including labelling process.
- B. Furnish the necessary trained personnel to perform the demonstration and instructions and arrange to have the manufacturer's representatives present to assist with the demonstrations.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- C. Allow a minimum of 2 sessions for performing the prescribed demonstration lasting 4 hours.
- D. Arrange with the Engineer the date and times for performing the demonstrations.
- E. Training: The manufacturer of the extinguishing system shall demonstrate to the Employer's operating staff on the following topics:
 - i. Cleaning of system.
 - ii. Operation of system.
 - iii. Re-charging of system.
 - iv. Trouble-shooting and repair tips.

7.1.17 21 3113 – Electric-Drive, Centrifugal Fire Pumps

GENERAL

7.1.17.1 SUMMARY

Section Includes:

- A. Split-case UL/FM approved fire pumps
- B. Fire-pump accessories and specialties UL/FM approved.
- C. Flow meter systems.

7.1.17.2 PERFORMANCE REQUIREMENTS

Seismic Performance: Fire pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

Pump Equipment, Accessory, and Specialty Pressure Rating: 300 psig minimum unless higher pressure rating is indicated.

7.1.17.3 SUBMITTALS

Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.

- A. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- B. Wiring Diagrams: For power, signal, and control wiring.

Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.

- A. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

B. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Product Certificates: For each fire pump, from manufacturer.

Source quality-control reports.

Field quality-control reports.

Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.

7.1.17.4 QUALITY ASSURANCE

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

7.1.17.5 COORDINATION

Coordinate sizes and locations of concrete bases with actual equipment provided.

PRODUCTS

7.1.17.6 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

Description: Factory-assembled and -tested fire-pump and driver unit.

Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.

Finish: Red paint applied to factory-assembled and -tested unit before shipping.

7.1.17.7 HORIZONTALLY MOUNTED, MULTISTAGE, SPLIT-CASE FIRE PUMPS UL LISTED/FM APPROVED.

Manufacturers: Refer to Appendix A

Pump:

- A. Standard: UL 448 for split-case pumps for fire service.
- B. Number of Stages: Two.
- C. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
- D. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
- E. Wear Rings: Replaceable bronze.
- F. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - ii. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- iii. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
- G. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.
Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
Driver:
 - A. Standard: UL 1004A
 - B. Type: Electric motor; NEMA MG 1, poly phase Design B.Capacities and Characteristics:
 - A. Rated Capacity: 4,731.77 lpm (1,250 gpm)
 - B. Total Rated Head: 9 bars (130.53 psi)
 - C. Inlet Flange: Class 250.
 - D. Outlet Flange: Class 250
 - E. Motor Horsepower: 111.86 kw (150 hp)
 - F. Motor Speed: 2950 rpm
 - G. Electrical Characteristics:
 - i. Volts: 400 v
 - ii. Phase: Three.
 - iii. Hertz: 50

7.1.17.8 PRESSURE BOOSTER UL LISTED /FM APPROVED(JOCKEY) PUMP

Electrically operated, horizontal close coupled type with standard open drip-proof horizontal motor.

Control by automatic jockey pump controller with full voltage starter and minimum run timer to start pump on pressure drop in system and stay in operation for minimum period of time. Fire pump shall start automatically on further pressure drop or on jockey pump failure. Provide minimum run timer to operate the pump for a minimum of 3 minutes..

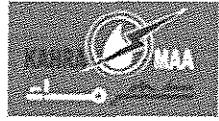
Pumps shall be UL Listed and FM approved.

Pumps shall be complete with a minimum of all accessories as specified in specification section 10.

Pump shall be zinc less bronze constructed.

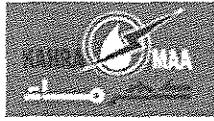
Bowl Assembly:

- A. The pump bowls shall be of zinc less bronze construction C92700, free from blow holes, sand holes and all other faults; accurately machined and fitted to close dimensions.
- B. The impeller shaft shall be of stainless steel of not less than 12% chrome content and shall be supported by bronze or neoprene bearings located on both sides of each impeller.
- C. The impeller shall be of the enclosed type and shall be of zinc less bronze construction C92700 of heavy construction, accurately fitted and balanced. For shaft sizes up through 56mm diameters, the impeller shall be locked securely to the impeller shaft with a tapered lock bushing. For shaft sizes above 56mm they shall be secured with a thrust washer, key and snap ring. The bowls and impeller shall be designed with smooth passages to assure



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

efficient operation. The impellers shall be adjustable by means of a top shaft adjusting nut.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

7.1.17.9 FIRE-PUMP ACCESSORIES AND SPECIALTIES

Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.

Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.

Relief Valves:

- A. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.
- B. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.
- C. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.
- D. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
- E. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
- F. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
- G. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
- H. Escutcheon Plate: Brass or bronze; rectangular.
- I. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
- J. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

Manifold:

- A. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
- B. Body: Exposed type, brass, with number of outlets required by NFPA 20.
- C. Escutcheon Plate: Brass or bronze; round.
- D. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
- E. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

7.1.17.10 FLOWMETER SYSTEMS

Description: UL-listed or FM-Approved, fire-pump flow meter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.

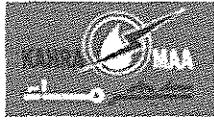
Pressure Rating: 300psig

Sensor: Annular probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flow meter, and fittings.

Permanently Mounted Flow meter: Compatible with flow sensor; with dial not less than 115 mm in diameter. Include bracket or device for wall mounting.

Portable Flowmeter: Compatible with flow sensor; with dial not less than 115 mm in diameter and with two 3.7-m long hoses in carrying case.

7.1.17.11 SOURCE QUALITY CONTROL



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."

Verification of Performance: Rate fire pumps according to UL 448.

Fire pumps will be considered defective if they do not pass tests and inspections.

Prepare test and inspection reports.

EXECUTION

7.1.17.12 EXAMINATION

Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.

Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.

Proceed with installation only after unsatisfactory conditions have been corrected.

7.1.17.13 INSTALLATION

Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.

Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete"

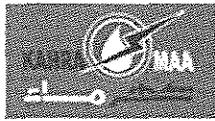
- A. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 450-mm centers around the full perimeter of concrete base.
- B. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
- C. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- D. Install anchor bolts to elevations required for proper attachment to supported equipment.

Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.

Support piping and pumps separately so weight of piping does not rest on pumps.

Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Division 21 Section "Fire-Suppression Standpipes." Division 21 Section "Wet-Pipe Sprinkler Systems."

Install pressure gages on fire-pump suction and discharge flange pressure-gage tapings. Comply with requirements for pressure gages specified in Division 21 Section "Fire-Suppression Standpipes." Division 21 Section "Wet-Pipe Sprinkler Systems."



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.

Install flow meters and sensors. Install flow meter-system components and make connections according to NFPA 20 and manufacturer's written instructions.

Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

7.1.17.14 ALIGNMENT

Align split-case pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.

After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.

Align piping connections.

Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

7.1.17.15 CONNECTIONS

Comply with requirements for piping and valves specified in Division 21 Section "Fire-Suppression Standpipes" Division 21 Section "Wet-Pipe Sprinkler Systems. Drawings indicate general arrangement of piping, fittings, and specialties.

Install piping adjacent to pumps and equipment to allow service and maintenance.

Connect relief-valve discharge to drainage piping or point of discharge.

Connect flow meter-system meters, sensors, and valves to tubing.

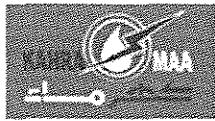
Connect fire pumps to their controllers.

7.1.17.16 IDENTIFICATION

Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

7.1.17.17 FIELD QUALITY CONTROL

Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Division 21 Section "Controllers for Fire-Pump Drivers."



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

Perform tests and inspections.

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

Tests and Inspections:

- A. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
- B. Test according to NFPA 20 for acceptance and performance testing.
- C. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- D. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.

Prepare test and inspection reports.

Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

7.1.18 21 5000 – Fire-fighters Override Control Panel

GENERAL

7.1.18.1 SUMMARY

This specification defines the basic construction and components for a Firefighter's Override Control Panel.

The control panel shall be a graphic display with switches and LED indicators.

The control panel shall be mounted on a flush or surface mounted enclosure.

7.1.18.2 RELATED SECTIONS:

Section 21 0100 Operation and Maintenance of Fire Systems

Section 21 0500 Common Work results for Fire Suppression

Section 21 0900 Instrumentation and Control for Fire Suppression Systems

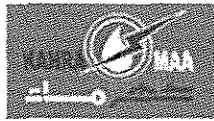
Section 23 3300 Air Duct Accessories

Section 23 0993 BMS Sequence of Operation

Section 26 0500 Basic Electrical Materials and Methods

Section 26 0513 Conductors and Cables

Section 26 0526 Grounding and Bonding for Electrical Systems



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Section 26 0529 Hanger & Supports for Electrical Systems
- Section 26 0533 Raceway and Boxes for Electrical Systems
- Section 26 0553 Identification for Electrical Systems
- Section 26 0710 Quality Requirements for Electrical Works
- Section 28 3163 Fire Alarm Integrated Audio Visual Evacuation system

7.1.18.3 REFERENCES

- NFPA 92A, Recommended Practice for Smoke-Control Systems;
- NFPA 92B, Guide for Smoke Management Systems in Malls, Atria, and Large Areas;
- NFPA 12, Carbon Dioxide Extinguishing Systems;
- NFPA 12A, Halon 1301 Fire Extinguishing Systems;
- NFPA 13, Installation of Sprinkler Systems;
- NFPA 15, Water Spray Fixed Systems for Fire Protection;
- NFPA 2001, Clean Agent Fire Extinguishing Systems
- NFPA 16, Installation of Foam-Water Sprinkler and Foam-Water Spray Systems;
- NFPA 17, Dry Chemical Extinguishing Systems;
- NFPA 17A, Wet Chemical Extinguishing Systems;
- NFPA 70, National Electrical Code;
- NFPA 72, National Fire Alarm Code;
- UL 864 Section 7 Control Units and Accessories for Fire Alarm Systems

7.1.18.4 GLOSSARY

- FFOCP Fire Fighters Override Control Panel
- LED Light Emitting Diode
- NFPA National Fire Protection Association
- UL Underwriters Laboratories

7.1.18.5 QUALITY ASSURANCE

The panels described within this specification shall be surface and shall be a 7-mil multi-polyester film, which is protected by a non-glare urethane textured coating.

The artwork can be black lines and legends with multi-coloured background or a black background with multi-ed lines and legends. The contractor is to provide a drawing indicating same for approval

Unless otherwise indicated elsewhere colour for the panel shall be red according the manufacturer's standard colour scheme.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

The film shall be bonded to a 0.125" clear irradiated aluminum back plate.

- A. Holes shall be drilled in the aluminium plate for the switches and the high intensity LEDs.
- B. LED's shall not protrude through the polyester film so the front surface is easily cleaned.
- C. An attractive aluminium frame finished in a clear or black anodizing enhances and protects the edge of the panel.

7.1.18.6 DESIGN REQUIREMENTS FOR FIRE FIGHTERS OVER-RIDE CONTROL PANEL

Provide a Fire Fans Control/Fire Damper Control Panel (FFCP/FDCP) and interface with the fire alarm control panel (FACP) for smoke control in the building, in accordance with NFPA and Civil Defence requirements.

The Contractor will provide relays in each mechanical switchboard and shall run and install fire rated cables wiring circuits from each switchboard to each override switch in the FFCP. The contractor is to fully integrate all the separate requirements of all of the functions to produce this multi section panel.

Provide the 'auto/off/on' switches in the FFCP for provision of the above signals and shall connect the Radox or equivalent wiring system cables to the FFCP. Provide and connect wiring circuits to, three (3) indicating lamps adjacent to each 'auto/off/on' switch on the FFCP for indication of:

- A. Fan running (Red Lamp)
- B. Fan Stopped (Green Lamp)
- C. Fan Fault (Amber Lamp)

Run extra low voltage circuits form each mechanical switchboard to the FFCP to activate the above indicating lamps. The Mechanical Services contractor will provide differential pressure switches in each air handling unit supply air duct to signal loss of air flow in the duct. The pressure switches will be integrated with the system control logic to provide the appropriate signals at the FFCP for run, stop and fault conditions.

The Fire contractor shall co-ordinate with the Mechanical Services contractor to ensure correct selection of relays, wiring circuits, voltages etc.

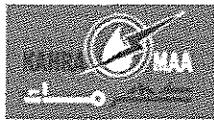
7.1.18.7 ALARM SIGNALING EQUIPMENT

Allow providing alarm signaling equipment and approved monitoring to a control centre for the first 12 months. Fire Services Sub-Contractor shall allow for all necessary application and monitoring costs.

It shall be the responsibility of the Fire Services Sub-Contractor to ensure that the transponder is fully operational to alert the Monitoring Centre and Fire Brigade to the operation of any alarm valve, flow switch, pressure switch and isolating valve anti tamper device.

The Fire Services Sub-Contractor shall provide new MIMS wiring from the transponder to the telephone connection demarcation point in the main distribution frame in accordance with the requirements of all authorities.

ON-AUTO-OFF fan control and OPEN-AUTO CLOSE damper control shall accomplish with three position rotary switches.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Four-position switches shall be used for dampers when PURGE AUTO-PRESSURIZE-OFF operation is required.

The switches shall be wired to terminals, Serial Interface, or customer supplied electronics which shall all be sub plate mounted in the enclosure.

A pushbutton shall be supplied for testing the LEDs.

High intensity LEDs shall be available in red, green, amber, yellow and blue.

T-1 3/4 LEDs shall be mounted on printed circuit boards.

The printed circuit boards shall be mounted to the aluminum backplate with machine screws.

Voltage dropping resistors for operation at 24VDC, 12VDC or 5VDC and diodes for LED test shall also be mounted on the printed circuit boards.

7.1.18.8 ESSENTIAL INSTRUCTIONS

Provide adjacent to the Fire Fan Control Panel/Fire Indicator Panel a set of Essential Instructions for the correct operation and procedures of the Air Handling equipment in the event of a fire.

7.1.18.9 FIRE SUPPRESSION SYSTEM (WET)

All pump sets shall also be provided with the following control facilities.

Manual Start electric pump sets

Manual stop electric pumps

Power available indicate in duplicate—electric pumps

Phase failure indication (each phase) in duplicate—electric pumps

Remote audible and visual alarm for phase failure, starter circuit isolator and power failure to battery point. Audible alarms for phase failure and starter circuit isolation to have 'mute' pushbutton but arranged to repeat continually at 2 minute intervals until system returned to normal.

Other alarms shall be arranged to illuminate and 'amber' identification light at FIP, identify each pump failure status. An alarm bell, similarly identified shall operate at the pump room entry. These alarms shall not be isolated by door isolation switches or other means.

Key switch control using fire rated cabling shall be provided for remote control of the fire services pump sets located at the FIP. The switch shall be labelled 'DUTY (OR STANDBY) FIRE PUMP' and for 3 positions 'Auto', 'Off' and 'On' the 'green' indication light shall be powered from the battery control system through auxiliary relays on the pump starter. The 'red' duty (or standby) pump pressure switches to record actual pump operation when the key switch is in the 'On' or 'Auto' position.

An 'amber' indication light shall also be provided to identify the local emergency start control function override.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

On operation of a sprinkler head, hydrant, hose reel or loss of pressure within the combined fire main system of sprinkler piping the following functions shall occur:

- A. Operation of electric jacking pump
- B. Operation of electric sprinkler/hydrant pump
- C. Water flow to the operating fire zone.
- D. Operation of system pressure switch in the operating fire zone with identification at the FIP transmission of signal via the transponder and FACP, to the Fire Brigades/monitoring station.
- E. Building fire mode system operation via the Mechanical Services Control Panels.
- F. Continued operation of pump(s) until manually stopped after system reset.
- G. Activation of the local electric Gong.
- H. Provide monitoring signal to the FIP input to confirm fire pumps set operation.

7.1.18.10 FIRE BOOSTER PUMP SYSTEM

The panel is able to override the building management system from the fire command centre manually. The fire booster pump will be manually activated by the fire fighters with status indicator lights shall be provided on the fire booster pump control panel and on the fire fan control panel (sub-panel—FFCP).

7.1.18.11 MECHANICAL VENTILATION SYSTEM INTERFACES

Smoke detectors with probes and all associated wiring and interface with FIP shall be provided as per drawings and schematic.

Provision for override controls at FIP/Fire Fan Control Panel/Damper Control Panel.

Indication of operation status of each fan shall be provided on the appropriate panel above.

7.1.18.12 FIRE CONTROL ROOM SUPPLY AIR SYSTEM

The Fire Control Centre ventilation shall be as required by Civil Defense.

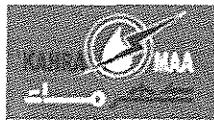
7.1.18.13 FIRE-TRIP WIRING

Supply and install all fire-trip wiring from the Fire Indicator Panels to each Mechanical Services Non- Essential and Essential Switchboards and to each relief motorised dampers as described above.

A fire-trip signal from the operation of the sprinkler system or smoke detection system shall place the switchboards in a fire-mode condition, and shall trip all associated fans and air handling units

7.1.18.14 CONTROLS

The Fire Contractor shall allow for the following items to be incorporated into the Fire Fan Control Panels and Damper Control Panels (FDCP) with override controls.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Indication of operation status of each fan and motorised dampers shall be provided on the appropriate panels above.

Refer to the mechanical services documentation for a complete description of the equipment and associated point schedule and actual equipment count per specification 23 0993. Requirements for motorized dampers are to be coordinated with the mechanical service contractor.

7.1.18.15 MANUAL OVERRIDE FAN CONTROLS

A system of comprehensive controls for the manual operation of the mechanical services plant by Fire Brigade Personnel shall be provided in accordance with local authority requirements to the FFCP and FFDP.

Provide at the Fire Fan Control Panel/Fire Indicator Panel an air conditioning re-set switch to re-set all Mechanical Services switchboards.

Supply and install all fire fan control and signal wiring between Fire Fan Control Panel/Fire Indicator Panel and the respective mechanical services switchboards.

PRODUCTS

7.1.18.16 MANUFACTURERS LIST

Refer to General Requirements and Scope of Works – Appendix A, Approved Manufacturers List

7.1.18.17 CONSTRUCTION

The control panel shall be constructed with a .125-inch aluminium substrate and a 7-mil polyester film overlay.

The polyester film overlay shall be protected by a non-glare textured coating, which is non-yellowing, durable, and scratch resistant.

LED's, resistors, diodes, etc. shall be mounted on printed circuit boards (PCBs).

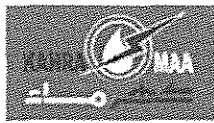
All wiring to the PCBs shall be made on solder type terminal turrets.

All switches shall be securely mounted to the panel.

7.1.18.18 GRAPHIC

Graphic Colours

- A. The film overlay shall be a graphic as shown in the drawing plan with black lines and legends, and coloured background areas.
- B. The graphic shall be made of 7-mil photographic film, having all accent colours applied to the backside of the film.
- C. Important areas such as elevator shafts, stairwells, and main air ducts shall be highlighted for easy identification.
- D. The panel manufacturer/supplier shall furnish a colour chart with a minimum of 22 accent colours for CONSULTANT's selection.
- E. It is the contractors responsibility to submit for approval to Civil Defense



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Graphic Surface

- A. The working surface (polyester film) shall be bonded to the aluminum substrate with an adhesive that has been proven not to delaminate in similar applications.
- B. The adhesive shall achieve 100 per cent bonding without any creases, bumps, or blemishes in the working surface (face) of the graphic.
- C. The working surface of the graphic shall be textured and non-glare.
- D. Translucent areas shall be made in the overlay for back-lighted indicators.
- E. LED's shall not protrude through the polyester film overlay.
- F. Backlit areas shall be subdued until the LED is illuminated.
- G. The illumination of any indicator shall be clearly visible from any viewing angle in front of the working surface of the graphic.

7.1.18.19 SUBSTRATE

The aluminium substrate shall have holes for LED's and switches.

The substrate shall have holes drilled and tapped for mounting the printed circuit boards.

The aluminium substrate shall have a clear irradiated finish to prevent oxidation.

7.1.18.20 INDICATORS

The indicators shall be high intensity LEDs, T-1 19 MM(3/4 in) size, and rated for normal operation at a current of 20mA.

The LEDs shall have an operating life of a minimum of 170,000 hours of continuous or pulsed operation.

The LED lens body shall be constructed of high impact plastic.

All LEDs shall be mounted on 1.57MM (.062 inch) printed circuit boards constructed of epoxy glass material, NEMA Type FR-4, Grade 10.

Resistors and diodes for current limiting and LED test shall also be mounted on the printed circuit boards.

Solder type, pressed in turrets shall be provided for electrical connections to the LEDs.

All field wiring shall terminate on modular screw clamp type terminals or connectors located in the rear of the enclosure.

7.1.18.21 SWITCHES

Rotary switches shall be used for specific panel operations unless other switch types are specified.

A key switch shall be used for panel enable operation when specified.

Switches shall be rated for the load served.

A momentary pushbutton shall be provided for simultaneous testing of all LEDs.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

All switch wiring shall be terminated on modular screw clamp type terminal strips or connectors mounted in the rear of the enclosure.

7.1.18.22 ENCLOSURE

The enclosure shall be made from cold rolled steel and be assembled using all welded and formed steel construction.

The enclosure shall be primed and painted with a baked enamel and have a textured finish.

A security door with viewing window may be supplied to prevent unauthorized operation of the control panel switches.

All enclosures shall be constructed according to UL 864 Section 7 specifications.

EXECUTION

7.1.18.23 EQUIPMENT INSTALLATION

FFOCP shall be mounted in accordance with the approved drawings and Section 26 0529, Hanger & Supports for Electrical Systems

Surface mount FFOCP with tops of cabinets not more than 1828-MM (72 inches) above finished floor.

Connect FFOCP with disconnect switch with lockable handle or cover; which shall be labeled in red "Fire Fighter's Override Control Panel".

7.1.18.24 WIRING INSTALLATION

Electrical Works shall comply with Section 26 0500, Basic Electrical Materials and Methods.

Wiring Method shall be in accordance with Section 26 0533 Raceway and Boxes for Electrical Systems.

Conceal raceway except in unfinished spaces and as indicated.

Wiring within Enclosures shall be separated for power-limited and non-power-limited conductors as recommended by manufacturer.

Install conductors parallel with or at right angles to sides and back of enclosure.

Bundle, lace, and train conductors to terminal points with no excess.

Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire alarm system to terminal blocks.

Mark each terminal according to system's wiring diagrams.

Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

Colour-Coding shall for FFOCP shall be different from normal building power wiring.

For Risers, install at least two vertical cable risers to serve the override system; separate risers in close proximity to each other, so loss of one riser does not prevent receipt or transmission of signal from other floors or zones.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.18.25 IDENTIFICATION

Identify system components, wiring, cabling, and terminals according to Section 26 0553, Identification for Electrical Systems

Install instructions frame in location visible from panel location.

Paint power-supply disconnect switch red and label FIRE FIGHTER'S OVERRIDE CONTROL PANEL.

7.1.18.26 GROUNDING

Ground cable shields and equipment according to system manufacturer's written instructions and Section 26 0526, Grounding and Bonding for Electrical Systems, to eliminate shock hazard and to minimize, to greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

Signal Ground Terminal shall be located at main equipment rack or cabinet and to be isolated from power system and equipment grounding.

7.1.18.27 FIELD QUALITY CONTROL

Manufacturer's Field Service:

- A. Engage factory-authorized service representative to inspect field-assembled components and connections and to supervise pretesting, testing, and adjustment of system.
- B. Report results in writing.

Pre-testing:

- A. After installation, align, adjust, and balance system and perform complete pre-testing.
- B. Determine, through pretesting, compliance of system with requirements of Drawings and Specifications.
- C. Correct deficiencies observed in pretesting.
- D. Replace malfunctioning or damaged items with new ones, and retest until satisfactory performance and conditions are achieved.
- E. Prepare forms for systematic recording of acceptance test results.

Report of Pre-testing:

- A. After pretesting is complete, provide letter certifying installation is complete and fully operable, including names and titles of witnesses to preliminary tests.

Final Test Notice:

- A. Provide minimum of 10 days' notice in writing when system is ready for final acceptance testing.

Minimum System Tests:

- A. Test system according to procedures outlined in NFPA 72.
- B. Minimum required tests are as follows:
 - i. Verify absence of unwanted voltages between circuit conductors and ground.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- ii. Test all conductors for short circuits using insulation-testing device.
- iii. With each circuit pair, short circuit at far end of circuit and measure circuit resistance with ohmmeter.
- iv. Record circuit resistance of each circuit on record drawings.
- v. Verify that control unit is in normal condition as detailed in manufacturer's operation and maintenance manual.
- vi. Test initiating and indicating circuits for proper signal transmission under open circuit conditions.
- vii. One connection each should be opened at not less than 10 percent of initiating and indicating devices.

7.1.18.28 CLEANING AND ADJUSTING

Remove paint splatters and other spots, dirt, and debris.

Touch up scratches and marred finish to match original finish.

Clean unit internally using methods and materials recommended by manufacturer.

7.1.18.29 DEMONSTRATION

Train client's maintenance personnel on procedures and schedules for troubleshooting, servicing, adjusting, and maintaining equipment and schedules.

Provide minimum of 8 hours' of on-site training.

Use approved final version of operation and maintenance manual as training aid.

Schedule training with client with at least seven (7) days' advance notice.

Review data in maintenance manuals.

Training shall not occur until all work is complete and has been approved.

7.1.18.30 ON-SITE ASSISTANCE

Occupancy Adjustments:

When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions.

Provide up to three requested visits to Project site for this purpose.

7.1.19 26 0509 - Fire Barriers and Cable Transitions

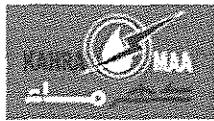
GENERAL

7.1.19.1 SUMMARY

Section includes fire rated barriers and fire stopping materials to be installed where wiring systems pass through fire rated building elements.

Related Sections:

- A. Section 26 0500 – Common Work Results for Electrical
- B. Section 26 0529 – Hangers & Supports for Electrical Systems
- C. Section 26 0533 – Raceways Boxes for Electrical Systems



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

D. Section 26 0536 – Cable Trays for Electrical Systems

7.1.19.2 REFERENCES

- ANSI/UL 1479 - Fire Tests of Through-Penetration Fire-stops Standard.
- ASTM E 136 - Standard Test Method for Behaviour of Materials in a Vertical Tube Furnace at 750 Degrees C.
- ASTM E119-08a - Standard Test Methods for Fire Tests of Building Construction and Materials
- ASTM E814-08a - Standard Test Method for Fire Tests of Penetration Fire-stop Systems.
- BS 476-20:1987. Fire tests on building materials and structures. Methods for determination of the fire resistance of elements of construction (general principles).
- BS 476-22:1987 - Fire tests on building materials and structures. Methods for determination of the fire resistance of non-loadbearing elements of construction.
- BS 7671:2008+A1:2011 - Requirements for electrical installations. IEE Wiring Regulations. Seventeenth edition.

7.1.19.3 SUBMITTALS

Product Data: For sleeve seals.

Point-wise compliance statement to the specifications duty signed by the manufacturer / manufacturer's authorized representative and by the Contractor.

The Contractor shall follow the submittal procedures outlined in the "General Requirements and Scope of Works".

7.1.19.4 QUALITY ASSURANCE

Employ a Specialist vendor to provide fire barriers and cable transits throughout the project.

Provide fire resistant cable transits and fire barriers as manufactured by recognized / approved supplier.

Provide all labour, materials, products, equipment and services to supply and install the fire barrier systems as indicated on the drawings and specified in these specifications.

All wiring systems passing through floors, walls, roofs, ceilings, partitions or cavity barriers shall be sealed to maintain the degree of fire resistance pertaining prior to the penetration.

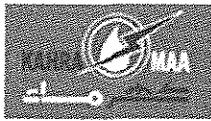
PRODUCTS

7.1.19.5 MANUFACTURERS

Materials and products proposed by the Contractor shall be compliant with the Specification. All material submittals shall be approved by the Engineer prior to procurement.

Refer the Approved Suppliers List in the "General Requirements and Scope of Works".

7.1.19.6 FIRE & WATER PROOF SEALANTS FOR DUCTS IN THE SUBSTATION BASEMENT WALLS



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

All cable sleeves in the basements shall be sealed with water proof material especially from outside. Fire & water proof sealant shall be provided from inside. This shall be done before NOSP. The same is required for spare sleeves with exception that end caps shall be provided for spare sleeve ends outside of the basement. This shall be verified by KM & the contractor shall provide a full pre-inspection report to KM with photos of all cable ducts from both directions (from inside & outside after the completion of sealing works) confirming that all works carried out as per the requirements of KM.

7.1.19.7 CABLE COATING

All Control and power cables (EHV, HV, MV & LV) cables laid on the floors, escape routes, vertical cable shafts, covered trenches, accessible trenches, cable trays, cable risers etc shall be coated with approved fire resistant/retardant coating to cover the combustible loads of cables and to prevent flame propagation.

Cable coating works shall be applied & provided for all the cables in the basement floor area and any other areas where single cable or a group of cables or cables on trays are available inside the substation buildings – for the entire length of the cable.

Application of fire proof cable coating material shall be of airless spray equipment only to ensure uniformly & evenly coating on all surface area of the cables and trays. Hand brush shall be used only on hard to reach areas on cable trays.

Minimum wet & dry film thickness of the applied cable coating shall not be less than recommended by the manufacturer and to comply with FM requirements.

7.1.19.8 FIRE PENETRATION SEALANT

All MEP, HVAC, Control and power cables sleeves and openings, floor/slab openings including spare and future openings / sleeves shall be sealed with approved fire resistant material, providing minimum of 4 hours fire resistance.

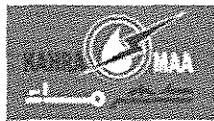
For all Fire cable penetrations, a uniform and international recognized sealing system shall be provided consisting of boards of compacted mineral wool, plasticized filling material, fire resistant/retardant coating etc as required and laid down in a test certificate issued from an independent approval institute.

Before applying the fire sealant materials, proper water sealant works (in Substations) shall be done as per the approved material & method statement for the cable sleeves which are available in the cable basement.

The sealing system shall be tight against fire, smoke, shall also be non-ageing, non-hygroscopic and non toxic, shall not contain any solvents or asbestos and shall not be harmful to the environment.

The Fire resistant/retardant coating shall be applied on both sides of the sealing boards as well as on both sides of the penetrating cables including cable trays & ladders. The coating of the cables and trays shall be on both sides as a minimum length of 500mm or in compliance with certified manufacturer's recommendation if required more than 500 mm.

Fire Sealant works for large openings of more than 1 meter shall be supported with angular steel bars / stiffeners to avoid any sagging. Fire Sealant located in floors or any other walking areas shall be protected against footsteps with suitable covers like chequered plates or gratings.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Business cards should be provided at suitable locations after completion of the passive fire protection works where contact details & company's name with the manufacturer details should be provided.

All works related to passive fire protection shall be done only by the approved manufacturer's applicators in line with approved method statement and KM requirements.

The proposed materials for passive fire protection (cable coating and fire penetration sealant) shall be listed and approved from International Testing Laboratories recognized by KM and Qatar Civil Defense.

EXECUTION

7.1.19.9 INSTALLATION

Install all fire barriers and cable transits in accordance with manufacturer's recommendations to maintain the fire integrity of the building.

During installation, the contractor is to provide temporary fire so the building fire integrity is always maintained.

Provide fire barriers within metal trunking systems at each floor. Include for support systems to prevent the barriers from falling within the trunking systems.

7.1.19.10 CERTIFICATION

Submit certification documents at the completion of the Works confirming the installation complies with the manufacturers' recommendations.

7.1.19.11 RECORD INFORMATION

Submit product details within the Operation and Maintenance Manuals.

Indicate all fire and smoke seal barriers on the record drawings.

7.1.20 28 3111 - Digital, Addressable Fire-Alarm System

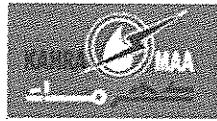
GENERAL

7.1.20.1 SUMMARY

- Section Includes:
 - A. Fire-alarm control unit.
 - B. Manual fire-alarm boxes.
 - C. Smoke detectors.
 - D. Heat detectors.
 - E. Notification appliances.
 - F. Firefighters' two-way telephone communication service.
 - G. Magnetic door holders.
 - H. Remote annunciator.
 - I. Addressable interface device.
 - J. Digital alarm communicator transmitter.
 - K. Radio alarm transmitter.
 - L. System printer.

7.1.20.2 SCOPE

This specification calls for the design, manufacture, supply, installation testing & commissioning and protection requirements of fire detection equipment to be provided.

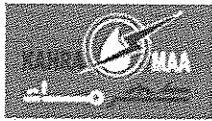


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Complete design, erection, testing and commissioning for the Fire Protection System shall be carried out directly by the specialist Loss Prevention appointed and KM approved sub-contractor for the project.

7.1.20.3 DEFINITIONS

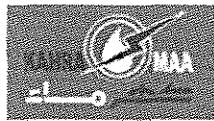
- LED: Light-emitting diode.
- NICET: National Institute for Certification in Engineering Technologies



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.20.4 REFERENCES

- Qatar Civil Defence Department requirements.
- Qatar Construction Specification 2010.
- NFPA-72 - National Fire Alarm and Signalling Code.
- NFPA 70 - National Electrical Code.
- All basic equipment proposed must be formally approved and listed by at least two international recognized testing laboratories from the following list:
 - A. LPCB Loss Prevention Council Board , United Kingdom.
 - B. FM Factory Mutual , USA.
 - C. UL Underwriters Laboratories Inc., USA.
 - D. ULC Underwriters Laboratories of Canada.
 - E. VdS Verein deutscher Sachversicherer , Germany.
 - F. AFNOR Association francaise de normalization, France.
- The supplier will be subject to the interpretations of the authority having jurisdiction as final arbitrator of any disputes relative to the applicable statutory requirements.
- In this specification, where KM HSE and QCDD Civil Defense requirement exceeds the requirement of the fire codes & Standards, KM HSE and QCDD Civil Defense requirements as the AHU (Authority Having Jurisdiction) shall be considered as final.
- All Fire Detection and Alarm system equipments shall have UL/FM/VDS and QCDD approvals.
- For all the proposed equipment/ Suppliers, a distributor must be available in the local market & must have technical support personal, workshop and an office located locally in the Qatar market.
- Also the proposed Fire Contractor must have a duly signed copy of the membership certificate from the Qatar Chamber of Commerce & Industry.
- All proposed fire fighting and fire alarm systems shall be proven in KAHRAMAA or installed in other power utilities in the GCC minimum for last three (3) years.
- Design parameters shall be as per relevant NFPA codes and standards.
- All electrical devices shall be type tested & proved to be free from mal-operation due to switching surges, voltage fluctuations, lighting and other electrical noises, which may be expected in electrical substation environment.
- Fire Protection System design, supply and Installation shall be carried by fully experienced and responsible contractor. Contractor shall submit their NFPA membership certification, Civil Defense approval, copy of Trade license, Project References (Local & International), Agency/ Distributorship agreement letters, End user's Performance certificate / Letter, Organization chart (for company and for project) separately, CVs of Design & Commissioning engineers along with their technical offer. Before a system is installed, complete working plans, Specifications and drawings shall be prepared and made available.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.20.5 SYSTEM DESCRIPTION

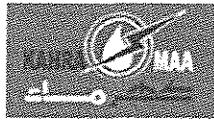
Non-coded, open source addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

Occupant Notification: integrated voice alarm system.

The PRPS Site shall have a networked system, linking all buildings to the Control Room in the Main Pumping Station, and both Guard Houses.

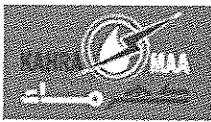
7.1.20.6 SUBMITTALS

- General Submittal Requirements:
 - A. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Engineer.
 - B. Shop Drawings shall be prepared by persons with the following qualifications:
 - i. Trained and certified by manufacturer in fire-alarm system design.
 - ii. NICET-certified fire-alarm technician, Level III minimum.
 - iii. Grade A registered engineer with MMUP and registered with QCDD.
- Product Data: For each type of product indicated.
- Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - A. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - B. Include voltage drop calculations for notification appliance circuits.
 - C. Include battery-sizing calculations.
 - D. Include performance parameters and installation details for each detector and installation location type, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - E. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - F. Include voice/alarm signalling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 - G. Include a coordinated ceiling and layout drawing indicating all MEPF equipment.
- Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
- B. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.
- C. Acoustic Calculations: Calculate requirements for selecting the spacing and rating of voice alarm speakers.
- Qualification Data: For qualified Installer.
- Field quality-control reports.
- Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. Include the following:
 - A. Detailed outline drawings with part numbers.
 - B. Detailed procedure for disconnecting and re-assembly of equipment.
 - C. Detailed procedure for operation and maintenance.
 - D. Detailed circuit diagram.
 - E. The complete test procedure with a faultfinding guide.
 - F. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - G. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 - H. Record copy of site-specific software.
 - I. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - i. Frequency of testing of installed components.
 - ii. Frequency of inspection of installed components.
 - iii. Requirements and recommendations related to results of maintenance.
 - iv. Manufacturer's user training manuals.
 - J. Manufacturer's required maintenance related to system warranty requirements.
 - K. Abbreviated operating instructions for mounting at fire-alarm control unit.
- Software and Firmware Operational Documentation:
 - A. Software operating and upgrade manuals.
 - B. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - C. Device address list.
 - D. Printout of software application and graphic screens.
- Point-wise compliance statement to the specifications duly signed by the manufacturer / manufacturer's authorized representative and by the Contractor.
- The Contractor shall follow the submittal procedures outlined in the "General Requirements and Scope of Works". Point-wise compliance statement to the specifications duly signed by the manufacturer / manufacturer's authorized representative and by the Contractor.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.20.7 QUALITY ASSURANCE

- **Installer Qualifications:** Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- **Installation Supervisor:** Shall be a Grade A registered engineer with MMUP and shall be registered with QCDD.
- **Source Limitations for Fire-Alarm System and Components:** Obtain fire-alarm system from a single source / manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- **NFPA Certification:** Obtain certification according to NFPA 72 by an NRTL or UL-listed alarm company.

7.1.20.8 PROJECT CONDITIONS

- **Interruption of Existing Fire-Alarm Service:** Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 - A. Notify the Construction Manager no fewer than seven days in advance of proposed interruption of fire-alarm service.
 - B. Do not proceed with interruption of fire-alarm service without the Construction Manager's written permission.
 - C. This clause also applies if there is a phased completion or occupation.

7.1.20.9 COORDINATION

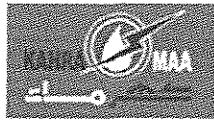
- Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

7.1.20.10 SEQUENCING AND SCHEDULING

- **Existing Fire-Alarm Equipment:** Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels and guards from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- **Equipment Removal:** After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.
- The requirements of this clause also apply where there is any phased completion or occupation.

7.1.20.11 SOFTWARE SERVICE AGREEMENT

- **Technical Support:** Beginning with Substantial Completion, provide software support for two years.
- **Upgrade Service:** Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.1.20.12 EXTRA MATERIALS

- Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - A. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - B. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - C. Smoke Detectors, Heat Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - D. Sounders, Speakers: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - E. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - F. Keys and Tools: One extra set for access to locked and tamper proofed components.
 - G. Audible and Visual Notification Appliances: One of each type installed.
 - H. Fuses: Two of each type installed in the system.
- Contractor shall provide all required spares as specified in the "General Requirements and Scope of Works".

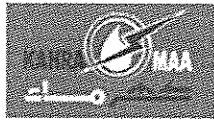
PRODUCTS

7.1.20.13 MANUFACTURERS

- Materials and products proposed by the Contractor shall be compliant with the Specification. All material submittals shall be approved by the Engineer prior to procurement.
- Refer the Approved Suppliers List in the "General Requirements and Scope of Works".
- All the devices which are going to be used inside Hazardous areas (Chlorine Building) should have ATEX approval.

7.1.20.14 SYSTEMS OPERATIONAL DESCRIPTION

- Fire-alarm signal initiation shall be by one or more of the following devices:
 - A. Manual stations.
 - B. Heat detectors.
 - C. Smoke detectors.
 - D. Duct smoke detectors.
 - E. Verified automatic alarm operation of smoke detectors.
 - F. Automatic sprinkler system water flow.
 - G. Smoke / heat detectors in elevator shaft and pit.
 - H. Fire-extinguishing system operation.
 - I. Fire standpipe system.
 - J. Activation of the Chlorine Scrubber System.
 - K. Activation of any systems connected to a fire alarm interface.
- Fire-alarm signal shall initiate the following actions:
 - A. Continuously operate alarm notification appliances.
 - B. Identify alarm at fire-alarm control unit
 - C. Transmit an alarm signal to the remote alarm receiving station.

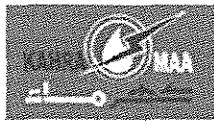


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- D. Unlock electric door locks in designated egress paths.
- E. Release fire and smoke doors held open by magnetic door holders.
- F. Activate voice/alarm communication system.
- G. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
- H. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
- I. Activate stairwell and elevator-shaft pressurization systems.
- J. Close smoke dampers in air ducts of designated air-conditioning duct systems.
- K. Recall elevators to primary or alternate recall floors.
- L. Activate emergency shutoffs for gas and fuel supplies.
- M. Record events in the system memory.
- N. Record events by the system printer.
- Supervisory signal initiation shall be by one or more of the following devices and actions:
 - A. Valve supervisory switch.
 - B. Low-air-pressure switch of a dry-pipe sprinkler system.
 - C. Elevator shunt-trip supervision.
- System trouble signal initiation shall be by one or more of the following devices and actions:
 - A. Open circuits, shorts, and grounds in designated circuits.
 - B. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - C. Loss of primary power at fire-alarm control unit.
 - D. Ground or a single break in fire-alarm control unit internal circuits.
 - E. Abnormal ac voltage at fire-alarm control unit.
 - F. Break in standby battery circuitry.
 - G. Failure of battery charging.
 - H. Abnormal position of any switch at fire-alarm control unit or annunciator.
 - I. Fire-pump power failure, including a dead-phase or phase-reversal condition.
 - J. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
- System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit. Record the event on system printer.

7.1.20.15 AUTOMATIC DETECTORS

- These shall be plug-in type separate base and sensing unit. An LED shall be provided in the base, which will operate when detector has been activated.
- The LED should remain "ON" until the system has been completely reset.
- The detection system shall sound alarm in the that the event detector operates.
- Adequate numbers of detectors to be provided in each room floor and ceiling voids, where provided.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- All floor and ceiling voids mounted detectors shall be provided with remote lamp indicators.
- For ceiling points this should be installed on the suspended ceiling and for floor void lamp on the wall near the detector at a height of 2m.
- Care should be taken to protect the detectors from close proximity of air flow from ducts.
- Detectors shall be installed not less than one meter from air diffuser.
- The detectors shall operate on 24 DC. Power loop wiring shall be monitored.
- The detectors shall be supervised and provide a trouble signal at the control panel if the detector head is removed and an alarm signal if the detector outer chamber is removed.
- The detector shall be of either the following applicable types mentioned in this specification.
- Detectors shall be provided for every beam pockets as per the requirements of NPFA 72.
- Intelligent Optical Smoke Detectors shall be considered and provided for the complete Fire Detection and Alarm System.
- Optical smoke detectors shall operate on a two-wire circuit and shall meet the requirements of NFPA, BSEN 5, or VDS wherever applicable.
- Optical smoke detectors shall operate on optical principle and shall consist of an asymmetrical sampling chamber, which shall allow Easy entry for slow moving fire particles whilst greatly reducing the possibility of unwanted alarms caused by dust contamination.
- The optical Smoke Sensor shall operate on a 'Fuzzy Logic Technology', by the use of a built in microprocessor, non-volatile memory, and fire scenarios, thereby reducing susceptibility to false alarms and improve the alarm response time. The smoke detector shall have the capability to work in standalone mode in case of loss of communication with MFACP and raise a standalone alarm. Also, the detector shall be intelligent to prevent indicating wrong location in case of alarm when relocating detector in different place after cleaning or service.
- The sensitivity of the device shall be variable. The addressable codes for the device shall be either electronically programmed or manually dip/dial switches.

7.1.20.16 PHOTO-OPTICAL SMOKE DETECTORS

- Photo optical smoke detectors operate on a photocell and light scattering principle. The detector shall respond to product of combustion or smoke with particle size from approximately 10 microns down to 0.2 microns and of the proper concentration. Proper concentration defines by UL as the ability to sense smoke in the 0.2 to 4 percent obscuration per foot range. The remote lamp indicator shall be installed on the ceiling tile.

7.1.20.17 AIR DUCT SMOKE DETECTORS

- Air Duct Smoke Detectors shall be Photo-Optical type and shall include built in sampling tubes. The sampling tubes shall extend a minimum of three-fourths the width of the duct and be located approximately at the centre of the Vertical dimension.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Remote Lamp Indicator shall install on the ceiling tiles.

7.1.20.18 FIXED TEMPERATURE HEAT DETECTORS

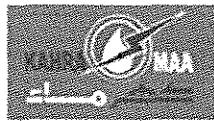
- Fixed temperature heat detectors shall be entirely electronic in operation and have a thermistor as ambient temperature sensor to be fully resettable. Detector temperature rating shall be approximately 120% of the maximum expected ambient temperature of the area to be protected.

7.1.20.19 COMBINATION FIXED-TEMPERATURE AND RATE OF RISE HEAT DETECTORS

- The fixed temperature element shall be independent of the rate of rise element. The rating for the combination fixed temperature and rate of rise type shall be approximately 120% of the expected ambient temperature and rate of rise shall have the setting of 8°C per minute.
- All elements shall be resettable and entirely solid state. Adequate special detectors as required for air-conditioning system shall be provided accordingly.

7.1.20.20 FIRE ALARM CONTROL PANEL

- The fire detector panel shall be based on high performance ring-bus technology. The panel shall be modular configuration. Shall be compact modular housing concept which allows several housing to be combined mechanically.
- High Flexibility with regard to existing or changing location requirement.
- Fire Alarm Control Panel (FACP) batteries are to be installed in a separate battery cabinet adjacent to the Main Panel.
- Calculations of battery capacity for the FACP & Extinguishing Control Panel to be provided for KM Approval.
- An appropriate number of auxiliary volt free contacts shall be provided for controlling the air-conditioning & ventilation plant and other equipment.
- An appropriate number of Interface modules shall be provided to Interface the Fire Alarm System with FM200 System, Deluge System, Fire Pumps, Fire Water Tank etc and these Interface modules shall be installed in air-conditioned rooms.
- All detectors installed inside the Switchgear rooms shall be accessible from the EOT crane.
- Desktop printer shall be provided with proper table for printing the events of the Main FACP or as an alternative inbuilt printer within the FACP is to be provided.
- Batteries shall be provided in a separate metal clad compartment separated from the associated FACP. This compartment shall be a compact enclosure, with battery shelves and to be ventilated adequately.
 - A. Fire Alarm system batteries shall be of Sealed type and the capacity shall be calculated for 72 hours standby and 1 hour alarm conditions.
- Fused power supply units shall be provided separately near the Main FACP, printer and Extinguishing Control panels.
- The minimum number of Loops shall be to suit the project, however, spare loops shall be available in all the FACP's considering the future extension. In



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

any case, each level inside the buildings shall be provided with a separate loop configuration arrangement.

- Detector removal tool kit shall be provided at site and kept inside the multi-rack, double door wall mounted cabinet inside the Fire pump room.
- Technical Data
 - A. Supply voltage: 240 V/50 Hz.
 - B. Emergency power supply : 2 x 12 ah, 12 V/max. 2 x 24 Ah
 - C. Quiescent current: 150 mA without operating module, 200mA with operating module.
 - D. Ambient temperature : 0°C to 50°C.
 - E. Housing: ABS. 10% glass fiber-reinforced or sheet steel min. Thickness 1.5mm.
 - F. Protection class: 1 to DIN EN 60950.
 - G. Type of protection: IP 30, IP55.
- Repeater Mimic Panel shall be provided in the Guard House
 - H. Additional Repeater Mimic Panels shall be provided inside all the Buildings.
 - I. Repeater Panel with Mimics (geographical representation of the substation) shall be made available on the facia of this Mimic Panel which shall include LED's for Fire/Fault/Deluge/Sprinkler/FM 200/TP System activation other than Power on LED etc.
 - J. Lamp test facility shall be available on the facia of this Repeater Panel.
 - K. Repeater panel shall have minimum options such as silencing of external sounders and resetting of cleared events.
 - L. Normally RED LEDs shall initiate fire detection, GREEN LEDs shall initiate deluge operation, AMBER LEDs for FM200 operation and YELLOW LEDs for Fault in the Fire Alarm System.

7.1.20.21 MANUAL PULL STATION

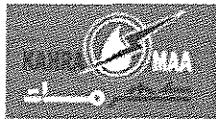
- Manual Pull Station (double action type only) shall be provided at several convenient points located in the natural path of exit, so that alarm can be given by operating personnel independently of automatic system.
- These shall be either "Pull Station" type or the word Fire Alarm in Arabic and English engraved. The color of these alarm points shall be red, manual pull station for particular zone shall be connected on the same circuit as the detector being provide for the zone.
- Fire Action Signboards shall be provided near all the Manual Pull Stations as per the local QCDD requirements.

7.1.20.22 ALARM DEVICES

- Both audible and visual alarm devices shall be provided. Devices connection shall be made to produce a general or primary alarm condition.

7.1.20.23 ALARM BELL

- Bell shall be under dome type at least 150mm diameter, finished in red stove enamelling and shall be capable of producing continuous ringing as required. The movement shall be housed in a metal enclosure, secured to metal back plate suitable for surface or concealed mounting. Both indoor and outdoor bells shall be provided. Bells for outdoor installation shall be weather proof protected against rain water and dust.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- One alarm bell shall be provided per compartment. Bells shall be distributed and connected in at least 2 alarm circuits.
- A minimum level of 65 db shall be produced by the sounders at any point in a building.

7.1.20.24 ALARM FLASHER

- An outside warning flasher shall be installed and shall activate simultaneously with alarm bell. Flash shall be red and visible enough to be noticed even during daytime for quick identification by the Civil Defense. The equipment shall have diameter not less than 100mm. and installed on a two meter pole above the highest building of the substation.

7.1.20.25 SHORT CIRCUIT LOOP ISOLATORS:

- Loop isolators compatible with the main fire alarm control panel shall be provided between each floor, between each building, between each basement, but the maximum number of devices between two isolators shall not be more than twenty or as per the manufacturer's recommendation whichever is less. Loop isolators shall also be provided at the start and end of each loop near the FACP.

7.1.20.26 ELECTRICAL INSTALLATIONS

- Electrical installations for Fire Detection and Alarm System shall be of fire resistant cables 1.5sqmm for initiating circuits and 2.5sqmm for notification and control / interlocking circuits. Electrical installations for Fire Detection and Alarm System must be equipped with steel conduits, junction boxes, glands, fittings, stuffing boxes with all required accessories and labelling.
- All cables associated with Fire Alarm installation shall be fire resistant 2 cores 1.5sqmm-2.5sqmm screened type. Cables shall comply with requirement BS 7629: Part 2, BS 6387 C, W & Z and approved by LPCB or equivalent.
- All steel conduits shall be hot dip galvanized inside and outside in accordance with BS 4568 part 1: 1970, BS EN 50086-1:1994, BS EN 50086-2:1996.
- Fittings and accessories shall be hot dip galvanized inside and outside in accordance with BS 4568 Part 2: 1970, BS EN 50086 – 1: 1994, BS EN 50086 – 2: 1996.

7.1.20.27 AUXILIARY EQUIPMENT

- Shutdown of air conditioning system shall make automatically upon receipt of alarm.
- Other auxiliary equipment such as fire dampers and fans shall activate on the first alarm.
- Upon restoration of the panel to normal condition auxiliary systems shall automatically operate again.

7.1.20.28 ALARM SYSTEM CONNECTION TO SCADA SYSTEM

- Provision for connection from Fire Control Panel is to be made through SCADA system for actuating an alarm and the following signals shall be transmitted to NCC:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

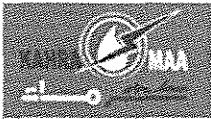
- A. Fire Alarm System Operated.
- B. Fire Alarm System Fault.
- C. Clean Agent System Activated – Control & relay Room.
- D. Clean Agent System Activated – LVAC Room.
- E. Clean Agent System Activated – Telecom Room.
- F. Clean Agent System Activated – VFD Rooms.
- G. Electric Fire Pump Running.
- H. Diesel Fire Pump Running.
- I. Deluge System Operated (Separate Signal for each Transformer & Reactor).
- J. Explosion Prevention System Activated (Separate Signal for each Transformer and Reactor).
- K. Explosion Prevention System Fault (Separate Signal for each Transformer and Reactor).
- L. All Fire protection system related signals shall be transmitted to the station from Main Fire Alarm Control panel only. Also required number of external relays (contact rating should match with relay voltage) shall be provided for all the signals.

7.1.20.29 FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

- Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit, the fire command center, and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:
 - A. Selective-talk type for use by firefighters and fire wardens.
 - B. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously.
 - C. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes audible signal to sound and high-intensity lamp to flash.
 - D. Selector panel controls shall provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
 - E. Display: Liquid-crystal digital (LCD) to indicate location of caller.
 - F. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated, factory-standard red finish, with handset.
 - i. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Warden Phone" or "Fire Emergency Phone."
 - ii. With "break-glass" type door access lock.
 - A. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved "Fire Warden Phone" "Fire Emergency Phone."
 - B. Handsets: push-to-talk-type sets with noise-cancelling microphone stored in a cabinet.

7.1.20.30 MAGNETIC DOOR HOLDERS

- Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Electromagnet: Requires no more than 3 W to develop 111 N holding force.
- B. Wall-Mounted Units: Flush mounted unless otherwise indicated.
- Material and Finish: Match door hardware.
- Interfaced with the Fire Alarm Control Unit to release in the event of an alarm activation.

7.1.20.31 REMOTE ANNUNCIATOR

- Description: Announcer functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
- Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

7.1.20.32 ADDRESSABLE INTERFACE DEVICE

- Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- Integral Relays: Capable of providing a direct signal to the following:
 - A. Elevator controllers to initiate elevator recall
 - B. Circuit-breakers for shunt trip for power shutdown
 - C. Ventilation dampers for control of smoke control systems
 - D. Audio Systems to "Mute"

7.1.20.33 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labelled by an NRTL.
- Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- Local functions and display at the digital alarm communicator transmitter shall include the following:
 - A. Verification that both telephone lines are available.
 - B. Programming device.
 - C. LED display.
 - D. Manual test report function and manual transmission clear indication.
 - E. Communications failure with the central station or fire-alarm control unit.
- Digital data transmission shall include the following:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Address of the alarm-initiating device.
- B. Address and Zone of the supervisory signal.
- C. Address and Zone of the trouble-initiating device.
- D. Loss of ac supply or loss of power.
- E. Low battery.
- F. Abnormal test signal.
- G. Communication bus failure.
- Secondary Power: Integral rechargeable battery and automatic charger.
- Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

7.1.20.34 SYSTEM PRINTER

- Printer shall be listed and labelled by an NRTL as an integral part of fire-alarm system.

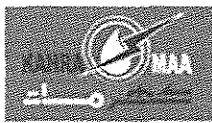
7.1.20.35 DEVICE GUARDS

- Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - A. Factory fabricated and furnished by manufacturer of device.
 - B. Finish: Paint of color to match the protected device.

EXECUTION

7.1.20.36 EQUIPMENT INSTALLATION

- Comply with NFPA 72 for installation of fire-alarm equipment.
- Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 1800 mm above the finished floor.
- Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - C. Connect new equipment to existing control panel in existing part of the building.
 - D. Connect new equipment to existing monitoring equipment at the supervising station.
 - E. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 150 mm below the ceiling.
- Device Location-Indicating Lights: Locate in public space near the device they monitor.
- Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 1800mm above the finished floor.
- Annunciator: Install with top of panel not more than 1800 mm above the finished floor.

7.1.20.37 CONNECTIONS

- For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, connect hardware and devices to fire-alarm system.
- F. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 1m from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - A. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
 - B. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 - C. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - D. Alarm-initiating connection to elevator recall system and components.
 - E. Alarm-initiating connection to activate emergency lighting control.
 - F. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - G. Supervisory connections at valve supervisory switches.
 - H. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - I. Supervisory connections at elevator shunt trip breaker.
 - J. Supervisory connections at fire-pump engine control panel.

7.1.20.38 IDENTIFICATION

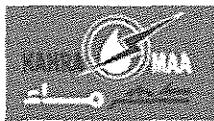
- Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- Install framed instructions in a location visible from fire-alarm control unit.

7.1.20.39 GROUNDING

- Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

7.1.20.40 FIELD QUALITY CONTROL

- Field tests shall be witnessed by the Engineer and Authorities having jurisdiction.



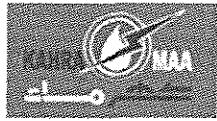
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- Tests and Inspections:
 - A. Visual Inspection: Conduct visual inspection prior to testing.
 - i. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - ii. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - B. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - C. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - D. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 - E. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - F. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- Fire-alarm system will be considered defective if it does not pass tests and inspections.
- Prepare test and inspection reports.
- Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

7.1.20.41 DEMONSTRATION

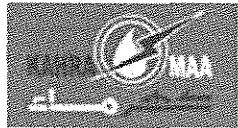
- Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

7.1.20.42 SPARE PARTS



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- For efficient and reliable operation of the system the contractor shall provide spare parts as per the minimum KM requirements and as per the recommendations from the concerned manufacturer for the safe and reliable operation of the complete Fire Protection System for 25 years. Please note that it remains contractors obligation to provide KM a list of recommended spares from each of the specialist vendor at the time of tender stage so as to ensure that KM review this requirement carefully (list of spares) before the award of the contract.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

APPENDIX A SECTION 7.2

MEPF SPECIFICATION

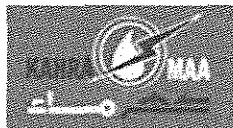
Plumbing/Public Health



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

CONTENTS

7.2	Division 22 – Plumbing and Public Health	3
7.2.1	22 0513 - Common Motor Requirements for Plumbing Equipment.....	3
7.2.2	22 0516 - Expansion Fittings and Loops for Plumbing Piping.....	6
7.2.3	22 0517 - Sleeves and Sleeve Seals for Plumbing Piping	9
7.2.4	22 0518 - Escutcheons for Plumbing Piping	10
7.2.5	22 0519 - Meters and Gauges for Plumbing Piping	11
7.2.6	22 0523 - General-Duty Valves for Plumbing Piping	14
7.2.7	22 0529 - Hangers and Supports for Plumbing Piping and Equipment	22
7.2.8	22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment	28
7.2.9	22 0553 - Identification for Plumbing Piping and Equipment	30
7.2.10	22 0719 - Plumbing Piping Insulation	33
7.2.11	22 0900 - Instrumentation and Control of Plumbing	41
7.2.12	22 1006 - Plumbing Piping Specialties	44
7.2.13	22 1116 - Domestic Water Piping	47
7.2.14	22 1119 - Domestic Water Piping Specialties	56
7.2.15	1300 - Facility Sanitary Sewerage	61
7.2.16	22 1319 - Sanitary Waste Piping Specialties	66
7.2.17	7.7.2. 22 1329 - Sanitary Sewerage Pumps	69
7.2.18	22 1400 - Facility Storm Drainage	73
7.2.19	22 1423 - Storm Drainage Piping Specialties	76
7.2.20	22 3400 - Domestic-Water Heaters	77



7. MECHANICAL, ELECTRICAL, PLUMBING AND FIRE FIGHTING

GENERAL REQUIREMENT

Unless otherwise stated in the Project Documentation, the Contractor shall comply with every requirement of the Qatar Construction Specification (QCS) that is relevant to the type of work forming any part of the Contract and shall adopt whichever permissible option or alternative is best suited to the needs of the construction work being undertaken.

7.2 Division 22 – Plumbing and Public Health

7.2.1 22 0513 - Common Motor Requirements for Plumbing Equipment

GENERAL

7.2.1.1. SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.

7.2.1.2. RELATED SECTIONS

- A. Section 22 1005 – Plumbing Pipes
- B. Section 22 3000 – Plumbing Equipment

7.2.1.3. REFERENCES

- A. EJMA (STDS) - EJMA Standards; Expansion Joint Manufacturers Association; 2003.

7.2.1.4. SUBMITTALS

- A. See Section 01 - Administrative Requirements, for submittal procedures.
- B. Contractor to employ an expert in this field to assess the requirements for expansion and contraction in the horizontal and vertical plane for all pipework.
- C. Product Data:
 - i. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions meter and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - ii. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- D. Design Data: Indicate selection calculations.
- E. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- F. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
- G. Maintenance Data: Include adjustment instructions.

7.2.1.5. REGULATORY REQUIREMENTS

- A. Conform to UL requirements.

7.2.1.6. EXTRA MATERIALS

- A. See Section 01 - Product Requirements, for additional provisions.
- B. Supply two sets of packing for each packed expansion joint.

PRODUCTS

7.2.1.7. FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers: Refer to Appendix A
- B. Inner Hose: Carbon Steel.
- C. Exterior Sleeve: Single braided stainless steel.
- D. Pressure Rating: 2300 kPa and 232 oC.
- E. Joint: Flanged.
- F. Size: Use pipe sized units.

7.2.1.8. EXPANSION JOINTS

- A. Manufacturers: Refer to Appendix A
- B. Pressure Rating: 2300 kPa and 204 oC
- C. Joint: Flanged.
- D. Size: Use pipe sized units.
- E. Application: All main core risers should be assessed and provided with steel packed sliding sleeve expansion joint where required.
- F. Expansion joints outside of core for 200mm diameter pipe and larger shall be packless bellow type with equalizing rings, stainless steel bellows, limit stops, internal telescoping sleeves and carbon steel bevelled welding ends.
- G. Expansion joints outside of core for 150mm diameter and smaller shall be packless bellows type with stainless steel bellows, anti-torque device, limit stops, guides and threaded pipe ends, or Victualic mover expansion couplings complete rigid couplings with EPDM gaskets.

7.2.1.9. ACCESSORIES

- A. Pipe: Stainless steel 316.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

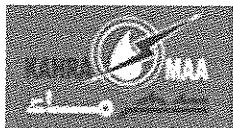
B. Pipe Alignment Guides:

- i. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 25 mm thick insulation, minimum 75 mm travel.

EXECUTION

7.2.1.10. INSTALLATION

- A. The contractor shall carry out a review of expansion and contraction associated with the piping system by the employment of a specialist in this field of work.
- B. The contractor shall coordinate and ensure that all associated elements of the analysis conducted is reviewed and agreed on by a structural engineer of record to verify the design intent and any impact on the structure to be considered. All associated works and agreements to be carried out between the structural engineering and contractor.
- C. The contract shall be responsible for all aspect of this work. Refer to item 1.4 for submittal and processes. Additionally this application should also be analyzed in association with expected pipe stress from seismic and wind driven structural movement.
- D. Install in accordance with manufacturer's instructions.
- E. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- F. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- G. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- H. Pipework passing across building expansion joints shall be provided with flexible connections that shall allow an axial displacement in the horizontal plane to match the building movement tolerance and an associated displacement in the vertical plane.
- I. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- J. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
- K. Pipe loops shall be:-
 - i. Fabricated from similar material to the pipe in which they are installed.
 - ii. Fabricated from a single length of pipe with pulled bends. No joints or fittings shall be permitted.
 - iii. Finished with a straight length of pipe no less than 15 x the diameter of the pipe.
 - iv. Rated to the same pressure as the main pipework.
 - v. Unless particularly specified otherwise bellows shall be:
 - vi. Fabricated from stainless steel.
 - vii. Installed strictly in accordance with the manufacturers recommendations.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- viii. Installed with 50% cold pull which shall be witnessed by the Engineer.
- ix. Pipelines shall not be pulled up for cold draw until the anchor points are rigid and firm.

7.2.2 22 0516 - Expansion Fittings and Loops for Plumbing Piping

GENERAL

7.2.2.1. SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.

7.2.2.2. RELATED SECTIONS

- A. Section 22 1005 – Plumbing Pipes
- B. Section 22 3000 – Plumbing Equipment

7.2.2.3. REFERENCES

- A. EJMA (STDS) - EJMA Standards; Expansion Joint Manufacturers Association; 2003.

7.2.2.4. SUBMITTALS

- A. See Section 01 - Administrative Requirements, for submittal procedures.
- B. Contractor to employ an expert in this field to assess the requirements for expansion and contraction in the horizontal and vertical plane for all pipework.
- C. Product Data:
 - i. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions meter and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - ii. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- D. Design Data: Indicate selection calculations.
- E. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- F. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
- G. Maintenance Data: Include adjustment instructions.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.2.2.5. REGULATORY REQUIREMENTS

- A. Conform to UL requirements.

7.2.2.6. EXTRA MATERIALS

- A. See Section 01 - Product Requirements, for additional provisions.
- B. Supply two sets of packing for each packed expansion joint.

PRODUCTS

7.2.2.7. FLEXIBLE PIPE CONNECTORS - STEEL PIPING

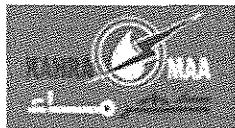
- A. Manufacturers: Refer to Appendix A
- B. Inner Hose: Carbon Steel.
- C. Exterior Sleeve: Single braided stainless steel.
- D. Pressure Rating: 2300 kPa and 232 oC.
- E. Joint: Flanged.
- F. Size: Use pipe sized units.

7.2.2.8. EXPANSION JOINTS

- A. Manufacturers: Refer to Appendix A
- B. Pressure Rating: 2300 kPa and 204 oC
- C. Joint: Flanged.
- D. Size: Use pipe sized units.
- E. Application: All main core risers should be assessed and provided with steel packed sliding sleeve expansion joint where required.
- F. Expansion joints outside of core for 200mm diameter pipe and larger shall be packless bellow type with equalizing rings, stainless steel bellows, limit stops, internal telescoping sleeves and carbon steel bevelled welding ends.
- G. Expansion joints outside of core for 150mm diameter and smaller shall be packless bellows type with stainless steel bellows, anti-torque device, limit stops, guides and threaded pipe ends, or Victualic mover expansion couplings complete rigid couplings with EPDM gaskets.

7.2.2.9. ACCESSORIES

- A. Pipe: Stainless steel 316.
- B. Pipe Alignment Guides:
 - i. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 25 mm thick insulation, minimum 75 mm travel.

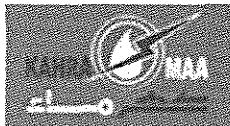


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

EXECUTION

7.2.2.10. INSTALLATION

- A. The contractor shall carry out a review of expansion and contraction associated with the piping system by the employment of a specialist in this field of work.
- B. The contractor shall coordinate and ensure that all associated elements of the analysis conducted is reviewed and agreed on by a structural engineer of record to verify the design intent and any impact on the structure to be considered. All associated works and agreements to be carried out between the structural engineering and contractor.
- C. The contract shall be responsible for all aspect of this work. Refer to item 1.4 for submittal and processes. Additionally this application should also be analyzed in association with expected pipe stress from seismic and wind driven structural movement.
- D. Install in accordance with manufacturer's instructions.
- E. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- F. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- G. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- H. Pipework passing across building expansion joints shall be provided with flexible connections that shall allow an axial displacement in the horizontal plane to match the building movement tolerance and an associated displacement in the vertical plane.
- I. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- J. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
- K. Pipe loops shall be:-
 - i. Fabricated from similar material to the pipe in which they are installed.
 - ii. Fabricated from a single length of pipe with pulled bends. No joints or fittings shall be permitted.
 - iii. Finished with a straight length of pipe no less than 15 x the diameter of the pipe.
 - iv. Rated to the same pressure as the main pipework.
 - v. Unless particularly specified otherwise bellows shall be:
 - vi. Fabricated from stainless steel.
 - vii. Installed strictly in accordance with the manufacturers recommendations.
 - viii. Installed with 50% cold pull which shall be witnessed by the Engineer.
 - ix. Pipelines shall not be pulled up for cold draw until the anchor points are rigid and firm.



7.2.3 22 0517 - Sleeves and Sleeve Seals for Plumbing Piping

GENERAL

7.2.3.1. SUMMARY

- A. Section Includes:
 - i. Escutcheons.
 - ii. Floor plates.
- B. Related Documents:
 - i. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

7.2.3.2. SUBMITTALS

- A. Product Data: For each type of product indicated.

PRODUCTS

7.2.3.3. ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With, chrome-plated or finishes required as per surface.

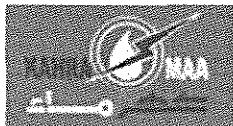
7.2.3.4. FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron with finishes required to match the surface

EXECUTION

7.2.3.5. INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
- C. Escutcheons for New Piping:
 - i. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - ii. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - iii. Insulated Piping: One-piece, stamped-steel type.
 - iv. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - v. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- D. Install floor plates for piping penetrations of equipment-room floors.
- E. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - i. New Piping: One-piece, floor-plate type.
 - ii. Existing Piping: Split-casting, floor-plate type.



7.2.3.6. FIELD QUALITY CONTROL

- F. Replace broken and damaged escutcheons and floor plates using new materials.

7.2.4 22 0518 - Escutcheons for Plumbing Piping

GENERAL

7.2.4.1. SUMMARY

- A. Section Includes:
- i. Escutcheons.
 - ii. Floor plates.
- B. Related Documents:
- i. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

7.2.4.2. SUBMITTALS

- A. Product Data: For each type of product indicated.

PRODUCTS

7.2.4.3. ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With, chrome-plated or finishes required as per surface.

7.2.4.4. FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron with finishes required to match the surface

EXECUTION

7.2.4.5. INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
- C. Escutcheons for New Piping:
- i. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - ii. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - iii. Insulated Piping: One-piece, stamped-steel type.
 - iv. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- v. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- D. Install floor plates for piping penetrations of equipment-room floors.
- E. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - i. New Piping: One-piece, floor-plate type.
 - ii. Existing Piping: Split-casting, floor-plate type.

7.2.4.6. FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

7.2.5 22 0519 - Meters and Gauges for Plumbing Piping

GENERAL

7.2.5.1. SUMMARY

- A. Section Includes:
 - i. Filled-system thermometers.
 - ii. Dial-type pressure gages.
 - iii. Gauge attachments.
 - iv. Test plugs.
 - v. Sight flow indicators.
- B. Related Sections:
 - i. Division 21 Section "Facility Fire-Suppression Water-Service Piping" for fire-protection water-service meters outside the building.
 - ii. Division 21 fire-suppression piping Sections for fire-protection pressure gages.
 - iii. Division 22 Section "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
 - iv. Division 22 Section " Domestic Water Piping" for water meters inside the building.

7.2.5.2. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Certificates: For each type of meter and gauge, from manufacturer.
- C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PRODUCTS

7.2.5.3. LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - i. Standard: ASME B40.200.
 - ii. Case: Cast aluminum 152-mm nominal size.
 - iii. Case Form: Straight unless otherwise indicated.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- iv. Tube: Glass with magnifying lens and red organic liquid.
- v. Tube Background: Non reflective aluminum with permanently etched scale markings graduated in deg F and deg C.
- vi. Window: Glass or plastic.
- vii. Stem: Aluminum or brass and of length to suit installation.
- viii. Design for Thermo well Installation: Bare stem.
- ix. Connector: 22 mm, with ASME B1.1 screw threads.
- x. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

7.2.5.4. PRESSURE GUAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

- i. Standard: ASME B40.100.
- ii. Case: Liquid-filled 152-mm nominal diameter.
- iii. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- iv. Pressure Connection: Brass, with 8mm ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- v. Movement: Mechanical, with link to pressure element and connection to pointer.
- vi. Dial: Non reflective aluminium with permanently etched scale markings graduated in psi and kPa.
- vii. Pointer: Dark-colored metal.
- viii. Window: Glass.
- ix. Ring: Stainless steel.
- x. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

7.2.5.5. GAUGE ATTACHMENTS

A. Valves: Brass ball with DN 8 ASME B1.20.1 pipe threads.

7.2.5.6. TEST PLUGS

- A. Description: Test-station fitting made for insertion into piping tee fitting.
- B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- C. Thread Size: DN 8 ASME B1.20.1 pipe thread.
- D. Minimum Pressure and Temperature Rating: 3450 kPa at 93 deg C.

7.2.5.7. SIGHT FLOW INDICATORS

- A. Description: Piping inline-installation device for visual verification of flow.
- B. Construction: Bronze or stainless-steel body, with sight glass and flapper indicator, and threaded or flanged ends.

EXECUTION

7.2.5.8. INSTALLATION

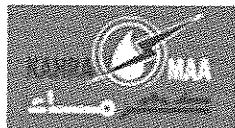


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Install thermo wells with socket extending a minimum of 51 mm into fluid to center of pipe and in vertical position in piping tees.
- B. Install thermo wells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermo wells with extension on insulated piping.
- D. Fill thermo wells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermo wells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermo wells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
 - i. Inlet and outlet of each water heater.
 - ii. Inlets and outlets of each domestic water heat exchanger.
 - iii. Inlet and outlet of each domestic hot-water storage tank.
 - iv. Inlet and outlet of each remote domestic water chiller.
- L. Install pressure gages in the following locations:
 - i. Building water service entrance into building.
 - ii. Inlet and outlet of each pressure-reducing valve.
 - iii. Suction and discharge of each domestic water pump.

7.2.5.9. CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

7.2.5.10. ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

7.2.5.11. PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be[one of] the following:
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be[one of] the following:
- C. Pressure gages at suction and discharge of each domestic water pump shall be[one of] the following:

7.2.5.12. PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 300 psi
- B. Scale Range for Domestic Water Piping: 0 to 300 psi

7.2.6 22 0523 - General-Duty Valves for Plumbing Piping

GENERAL

7.2.6.1. SUMMARY

A. Section Includes:

- i. DZR Brass ball valves.
- ii. Iron butterfly valves.
- iii. Bronze swing checks valves.
- iv. Iron, plate-type check valves.
- v. Bronze gate valves.
- vi. Iron gate valves.
- vii. Bronze globe valves.
- viii. Bronze Balancing valves
- ix. Iron Balancing valves
- x. Drain cocks
- xi. Thermostatic mixing valves

B. Related Sections:

- i. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
- ii. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- iii. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

7.2.6.2. DEFINITIONS

- A. CWP: Cold water working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non rising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

7.2.6.3. SUBMITTALS

- A. Product Data: For each type of valve indicated.

7.2.6.4. QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. WRAS Compliance: WRAS approved materials for potable-water service.

7.2.6.5. DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - ii. Protect internal parts against rust and corrosion.
 - iii. Protect threads, flange faces, grooves, and weld ends.
 - iv. Set angle, gate, and globe valves closed to prevent rattling.
 - v. Set ball and plug valves open to minimize exposure of functional surfaces.
 - vi. Set butterfly valves closed or slightly open.
 - vii. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - i. Maintain valve end protection.
 - ii. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

PRODUCTS

7.2.6.6. GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valves in Insulated Piping: With 50-mm stem extensions and the following features:
 - i. Gate Valves: With rising stem.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- ii. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- iii. Butterfly Valves: With extended neck.

E. Valve-End Connections:

- i. Flanged: With flanges according to BS EN 1092-2 for iron valves.
- ii. Threaded: With threads according to BS EN10226-2.

7.2.6.7. BRASS BALL VALVES

- A. Two-Piece, Full-Port, DZR Brass Ball Valves with DZR Brass Trim, ends threaded to BS EN 10226-2, PN25, and WRAS approved.
- B. Manufacturers: Refer to Appendix A
- C. Description:

- i. Pressure Rating: PN25
- ii. Operating Temperature range: -10 to 186° C
- iii. Body Design: Two piece.
- iv. Body Material: DZR brass
- v. Ends: Taper threaded to BS EN 10226-2
- vi. Seats: PTFE WRAS approved
- vii. Stem: DZR Brass.
- viii. Ball: Chrome-plated DZR brass.
- ix. Port: Full.

7.2.6.8. BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze/DZR Brass trim, ends threaded to BS EN 10226-2, PN25, WRAS approved.
 - B. Manufacturers: Refer to Appendix A
 - C. Description:
- i. Pressure Rating: PN25
 - ii. Operating Temperature range: -10 to 186° C
 - iii. Body Design: Two piece.
 - iv. Body Material: Bronze
 - v. Ends: Taper threaded to BS EN 10226-2
 - vi. Seats: PTFE WRAS approved
 - vii. Stem: DZR Brass.
 - viii. Ball: Bronze/ DZR brass chrome plated
 - ix. Port: Full.

7.2.6.9. IRON, BUTTERFLY VALVES

- A. Ductile Iron, Fully lugged butterfly Valves with EPDM liner and aluminum - bronze disc to BS EN 593:2009, suitable for flanges conforming to BS EN 1092-2, PN16, WRAS approved. Lever operated: 65 -150mm, Gear operated: 200mm & above.
- B. Description:
 - i. Standard: BS EN 1092-2.
 - ii. Pressure rating: PN16



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- iii. Body Design: Fully Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- iv. Body Material: ASTM A 536, ductile iron(Epoxy coated)
- v. Seat: EPDM, WRAS approved.
- vi. Stem: One- or two-piece stainless steel.
- vii. Disc: Aluminum bronze.

7.2.6.10. BRONZE LIFT CHECK VALVES

- A. PN20, Bronze Lift Check Valves with Bronze Disc,
- B. Description:
 - i. Standard: BS EN 12266-1
 - ii. Pressure Rating: PN20
 - iii. Operating temperature range: -10 to 180°C.
 - iv. Body Design: Horizontal pipe runs.
 - v. Body Material: CC491K, bronze.
 - vi. Ends: Threaded.
 - vii. Disc: Bronze.

7.2.6.11. BRONZE SWING CHECK VALVES

- A. A. PN25, Bronze Swing Check Valves with Bronze Disc, threaded to BS EN 10226-2, BSI Kitemark approved.
- B. Description:
 - i. Standard: BS5154
 - ii. Pressure Rating: PN25
 - iii. Temperature range: -10 to 186°C
 - iv. Body Material: Bronze BS EN1982 CC491K
 - v. Cap: Bronze BS EN 1982 CC491K
 - vi. Hinge: Bronze
 - vii. Ends: Threaded.
 - viii. Disc: Bronze BS EN 1982 CC491K
- C. PN25, Bronze Swing Check Valves with Resilient Disc, threads to BS EN 10226-2, BSI Kitemark approved.
- D. Description:
 - i. Standard: BS5154, Series B
 - ii. Pressure Rating: PN25
 - iii. Temperature range: -10 to 100°C
 - iv. Body Material: Bronze BS EN1982 CC491K
 - v. Cap: Bronze BS EN 1982 CC491K
 - vi. Hinge : Bronze
 - vii. Ends: Threaded.
 - viii. Disc: Nitrile Rubber

7.2.6.12. IRON SWING CHECK VALVES

- A. PN16, Iron Swing Check Valves with Metal Seat, flanged ends to BS EN 1092-2 PN16 rated.
- B. Description:
 - i. Standard: Flanged BS EN 1092-2



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- ii. Pressure Rating: PN16
 - iii. Temperature range: -10 to 220° C
 - iv. Body Material: BS EN 1561 GJL-250, Cast iron with bolted cap.
 - v. Ends: Flanged.
 - vi. Trim: Bronze BS EN 1982 CC491K
 - vii. Gasket: Asbestos free.
- C. PN16, Iron Swing Check Valves with Resilient Seat, flanged ends to BS EN 1092-2 PN16 rated.
- D. Description:
- i. Standard: Flanged BS EN 1092-2
 - ii. Pressure Rating: PN16
 - iii. Temperature range: -10 to 65° C
 - iv. Body Material: BS EN 1561 GJL-250, Cast iron with bolted cap
 - v. Disc ring: Nitrile rubber
 - vi. Ends: Flanged.
 - vii. Trim: Bronze BS EN 1982 CC491K
 - viii. Gasket: Asbestos free.

7.2.6.13. IRON, PLATE-TYPE CHECK VALVES

- A. PN25, Iron, Dual-Plate Check Valves with Resilient seat, suitable for flange connection to BS EN 1092-2
- B. Description:
- i. Standard: BS EN 558 Series 16.
 - ii. Pressure Rating: PN25
 - iii. Temperature range: -10 to 120° C
 - iv. Body Design: Wafer, spring-loaded plates.
 - v. Body Material: EN –JGS-500-7, Ductile iron.
 - vi. Seat: EPDM
 - vii. Stem : Stainless steel
 - viii. Spring: Stainless steel

7.2.6.14. BRONZE GATE VALVES

- A. PN20, Non rising stem, Bronze Gate Valves, WRAS and BSI Kite-mark approved
- B. Description:
- i. Standard: BS EN 12288:2010 Series B
 - ii. Pressure Rating: PN20
 - iii. Temperature range: -10 to 180°C
 - iv. Body Material: Bronze with integral seat and screw-in bonnet.
 - v. Ends: Threaded to BS EN 10226-2.
 - vi. Stem: DZR Brass.
 - vii. Disc: Solid wedge, bronze.
 - viii. Packing: Asbestos free , Graphite
 - ix. Hand wheel: Malleable iron or aluminum

7.2.6.15. IRON GATE VALVES

- A. PN16, Non rising stem, Iron Gate Valves, flanged ends to BS EN 1092-2:PN16.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

B. Standard: BS EN 1171:2002 & hydrotested to BS EN 12266-1:2003

C. Pressure Rating: PN16

- i. Temperature range: -10 to 120° C
- ii. Body Material: Cast iron with bolted bonnet.
- iii. Ends: Flanged to BS EN 1092-2:PN16
- iv. Trim: Bronze.
- v. Disc: Solid wedge.
- vi. Packing and Gasket: Asbestos free, Graphite

D. PN16, OS&Y, Iron Gate Valves, flanged ends to BS EN 1092-2; PN16

E. Description:

- i. Standard: BS EN 1171:2002 & hydrotested to BS EN 12266-1:2003
- ii. Pressure Rating: PN16
- iii. Temperature range: -10 to 200° C
- iv. Body Material: Cast iron with bolted bonnet, BS EN1561 GJL-250
- v. Bonnet/Yoke: Cast Iron ,BS EN 1561 GJL-250
- vi. Ends: Flanged to BS EN 1092-2:PN16
- vii. Trim: Bronze.
- viii. Disc: Solid wedge.
- ix. Packing and Gasket: Asbestos free, Graphite

7.2.6.16. BRONZE GLOBE VALVES

A. PN20, Bronze Globe Valves, metal disc, threads to BS EN 10226-2.

B. Description:

- i. Standard: BS 5154:1991, PN20 Series B
- ii. Pressure Rating: PN20
- iii. Temperature range:-10 to 180° C
- iv. Body Material: bronze with integral seat and screw-in bonnet.
- v. Ends: Threaded to BS EN 10226-2
- vi. Stem and Disc: Brass
- vii. Packing: Asbestos free.
- viii. Handwheel: Malleable iron
- ix.

7.2.6.17. IRON GLOBE VALVES

A. PN16, Iron Globe Valves, Flanged ends to BS EN 1092-2 PN16.

B. Description:

- i. Standard: BS EN 13789:2010.
- ii. Pressure Rating: PN16
- iii. Temperature rating: -10 to 220° C
- iv. Body Material: Cast iron with bolted bonnet, BS EN 1561 GJL-250
- v. Ends: Flanged to BS EN 1092-2 PN16
- vi. Trim: Bronze.
- vii. Packing and Gasket: Asbestos free.

7.2.6.18. Bronze BALANCING VALVES

A. PN25, Fixed orifice Bronze Double regulating valves threaded ends to BS 2779 & BS EN 10226, WRAS approved.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

B. Description:

- i. Standard: BS 7350:1990
- ii. Pressure Rating: PN25
- iii. Temperature range: -10 to 120 °C
- iv. Body Material: Bronze BS EN 1982 CC491K
- v. Ends : Threaded to BS 2779 & BS EN 10226-2
- vi. Trim: DZR copper alloy
- vii. Test points : DZR Copper alloy
- viii. O-Ring seal: EPDM rubber
- ix. Accuracy : +/-5%

7.2.6.19. IRON, BALANCING VALVES

- A. PN16, Fully lugged Butterfly valves, WRAS approved in combination with flow measuring device
- B. Ductile Iron, Fully lugged butterfly Valves with EPDM liner and aluminum - bronze disc to BS EN 593:2009, suitable for flanges conforming to BS EN 1092-2, PN16, WRAS approved. Lever operated: 65 -150mm, Gear operated: 200mm & above.
- C. Flow measuring device: Stainless steel orifice plate and extension tubes with built in DZR test points suitable to mount on flanges to BS EN 1092-1+2, PN16 /PN25.

D. Description:

- i. Standard: BS EN 1092-2.
- ii. Pressure rating: PN16
- iii. Body Design: Fully Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- iv. Body Material: ASTM A 536, ductile iron(Epoxy coated)
- v. Seat: EPDM, WRAS approved.
- vi. Stem: One- or two-piece stainless steel.
- vii. Disc: Aluminium bronze.

7.2.6.20. Drain cocks

- A. Bronze lockshield type, Draining tap, WRAS approved

B. Description:

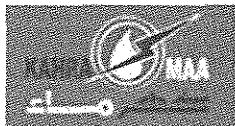
- i. Standard: BS 2879,Type 2
- ii. Pressure Rating: PN10
- iii. Temperature range: 0 to 110 °C
- iv. Body Material: Bronze BS EN 1982 CC491K
- v. Inlet End : Threaded to BS 21 Taper male
- vi. Outlet end: Ribbed for hose connection
- vii. Operation: Lockshield

7.2.6.21. Thermostatic Mixing valve

- A. DZR lockshield type, with integral ball, check valve and strainer

B. Description:

- i. Standard: D 08 specification under TMV scheme
- ii. Max working pressure: 10 bar



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- iii. Temperature setting range: 35 to 46 °C
- iv. Minimum Hot to Mix temp: 10 °C
- v. Minimum flow pressure: 0.2 bar
- vi. Body Material: DZR brass
- vii. Ball : DZR brass
- viii. Ball seal : PTFE
- ix. T-handle : Al Alloy
- x. Reduction union: DZR brass
- xi. Spring: Stainless steel
- xii. Strainer screen: 1.5mm, Stainless steel
- xiii. Operation: Lockshield

EXECUTION

7.2.6.22. EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

7.2.6.23. VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - i. Swing Check Valves: In horizontal position with hinge pin level.
 - ii. Lift Check Valves: With stem upright and plumb.

7.2.6.24. ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

7.2.6.25. GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - i. Shutoff Service: Ball, butterfly or gate valves.
 - ii. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - iii. Throttling Service: Globe ball, or butterfly valves.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

iv. Pump-Discharge Check Valves:

- a. 50MM and Smaller: Bronze swing check valves with bronze disc.
 - b. 65MM and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient seat check valves.
 - c. 65MM and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified pressure ratings are not available, the same types of valves with higher ratings may be substituted.

7.2.6.26. DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe 50MM and Smaller:

- i. Bronze Valves:
- ii. Bronze Angle Valves:
- iii. Ball Valves:
- iv. Bronze Swing Check Valves:
- v. Bronze Gate Valves:
- vi. Bronze Globe Valves:

B. Pipe 65MM and Larger:

- i. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100):
- ii. Iron, Flanged Butterfly Valves:
- iii. Iron Swing Check Valves:
- iv. Iron, Plate-Type Check Valves:
- v. Iron Gate Valves:
- vi. Iron Globe Valves:

7.2.6.27. SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe 50MM and Smaller:

- i. Bronze Valves:
- ii. Bronze Swing Check Valves.

B. Pipe 65MM and Larger:

- i. Iron Valves,
- ii. Iron Swing Check Valves
- iii. Iron Gate Valves:

7.2.7 22 0529 - Hangers and Supports for Plumbing Piping and Equipment

GENERAL

7.2.7.1. SUMMARY

A. Section Includes:

- i. Metal pipe hangers and supports.
- ii. Trapeze pipe hangers.
- iii. Fastener systems.
- iv. Pipe stands.
- v. Pipe positioning systems.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

vi. Equipment supports.

B. Related Sections:

- i. Division 21 fire-suppression piping Sections for pipe hangers for fire-suppression piping.
- ii. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
- iii. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

7.2.7.2. PERFORMANCE REQUIREMENTS

- A. Electro galvanized, Grooved body, split clamps with EPDM lining will be used for supporting PVC pipes. The clamps should have a safe working load of at least 100 kgs for sizes up to 2", and 200 kgs from 2 ½" onwards.
- B. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - i. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - ii. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - iii. Design seismic-restraint hangers and supports for piping and equipment.

7.2.7.3. QUALITY ASSURANCE.

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to BS EN 1011-2:2001 Welding - Recommendations for welding of metallic materials - Part 2,."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to BS 1501 225 490 B Code.

PRODUCTS

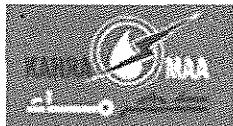
7.2.7.4. METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

- i. Galvanized Metallic Coatings: Pre galvanized or hot dipped.
- ii. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
- iii. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel for the drainage pipes and SS threaded rods at the plant room and non-conditioned spaces

B. Stainless-Steel Pipe Hangers and Supports:

- i. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
- ii. Padded Hangers: Hanger with pipe insulation pad or cushion to support bearing surface of piping.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- iii. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel

7.2.7.5. TRAPEZE PIPE HANGERS

- C. Description: BS 3974: Pipe hangers, Slides and Roller type supports; BS 4346, or field-fabricated pipe-support assembly made from structural carbon-steel shapes. carbon-steel hanger rods, nuts, saddles, and U-bolts.

7.2.7.6. METAL FRAMING SYSTEMS

- D. MFMA Manufacturer Metal Framing Systems:
 - A. Manufacturers: Refer to Appendix A
 - B. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - C. Channels: Continuous slotted steel channel within turned lips.
 - D. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - E. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel /stainless steel where appropriate application as described within this document elsewhere.

7.2.7.7. THERMAL-HANGER SHIELD INSERTS

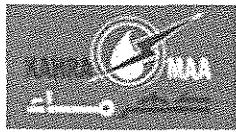
- A. Manufacturers: Refer to Appendix A
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings
- C. Insulation-Insert Material for Hot and Cold Piping: High density rubber fire rated equal to the insulation thickness.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover entire circumference of pipe.

7.2.7.8. FASTENER SYSTEMS.

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated stainless steel anchors, for use in hardened cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

7.2.7.9. PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. High-Type, Single-Pipe Stand:
 - i. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- ii. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - iii. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- D. High-Type, Multiple-Pipe Stand:
- i. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - ii. Bases: One or more; plastic.
 - iii. Vertical Members: Two or more protective-coated-steel channels.
 - iv. Horizontal Member: Protective-coated-steel channel.
 - v. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- E. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

7.2.7.10. EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

EXECUTION

7.2.7.11. HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with BS 3799 for install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with BS 3799. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - i. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - ii. Field fabricate from, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - i. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 100 mm thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - ii. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions..
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, 65mm and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
 - i. Attach clamps and spacers to piping.
 - ii. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - iii. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - iv. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe 100mm and larger if pipe is installed on rollers.
- N. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

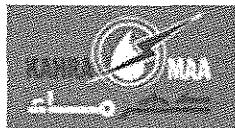
7.2.7.12. EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

7.2.7.13. METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with BS EN 1011-2:2001 Welding - Recommendations for welding of metallic materials - Part 2: procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - i. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - ii. Obtain fusion without undercut or overlap.
 - iii. Remove welding flux immediately.
 - iv. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

7.2.7.14. ADJUSTING



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

7.2.7.15. PAINTING

- A. Touch up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
- B. Apply paint by brush or spray to provide a minimum dry film thickness of 0.05 mm.
- C. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal
- D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint.

7.2.7.16. HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are provided in this Section in a table1 format below.
- B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use Rubber inserts for insulated piping and tubing. Inner diameter of the rubber insert should match with the outer diameter of the pipe, and thickness of rubber insert should match the thickness of the insulation.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- Adjustable, Steel Clevis Hangers For suspension of non-insulated or insulated, stationary pipes.
 - Adjustable Roller Hangers For suspension of pipes from single rod if horizontal movement caused by expansion and contraction might occur.
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- Extension Pipe or Riser Clamps For support of pipe risers
 - Carbon- or Alloy-Steel Riser Clamps For support of pipe risers if longer ends are required for riser clamps.

Table 1

Pipe Size (mm)	Horizontal Piping (meters)			Vertical Piping (meters)		
	Steel	Copper	ABS/PVC	Steel	Copper	ABS/PVC
15	2.1	1.5	0.7	2.4	2.0	1.3
20	2.1	1.5	0.7	3.0	2.4	1.5
25 -32	2.4	1.8	0.9	3.0	2.4	1.8
40	2.7	2.4	1.0	3.6	3.0	1.8
50	3.0	2.4	1.0	3.6	3.0	2.0
65	3.3	2.7	1.0	4.5	3.6	2.0
80	3.7	3.0	1.3	4.5	3.6	2.5
100 – 125	4.0	3.7	1.5	5.0	4.0	3.0
150	5.2	4.0	2.0	6.0	5.0	3.5



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Pipe Size (mm)	Horizontal Piping (meters)			Vertical Piping (meters)		
	Steel	Copper	ABS/PVC	Steel	Copper	ABS/PVC
200	5.5	5.0				
250	6.0	5.5				
300	7.0	6.0				
350	7.5					
400	8.0					
450	8.5					
500	9					

7.2.7.17. Submittals

- A. All material submittals shall include a detailed, clause wise compliance statement.
- B. All material submittals shall include detailed catalogues, product literature, and descriptions of all equipment and fittings with selection charts, capacities, etc.
- C. All material submittals shall include copies of relevant standards.
- D. Provide schematic drawings of installation of each support.
- E. Material selection data to be submitted.
- F. Shop drawings to include typical details for both vertical and horizontal pipe work including locations.
- G. Contractor to submit details and calculations of how proposed loads can be safely accommodated by the structure.
- H. Complete range of pipe supports should be from one manufacturer only. Combination of manufacturers will not be acceptable.

7.2.8 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment

GENERAL

7.2.8.1. SUMMARY

- A. This Section includes the following:
 - i. Isolation pads.
 - ii. Isolation mounts.
 - iii. Restrained elastomeric isolation mounts.
 - iv. Spring hangers.
 - v. Spring hangers with vertical-limit stops.
 - vi. Pipe riser resilient supports.
 - vii. Resilient pipe guides.

7.2.8.2. DEFINITIONS

- A. IBC: International Building Code.

7.2.8.3. SUBMITTALS

- A. Product Data: For the following:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- i. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
- ii. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

7.2.8.4. QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

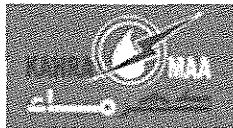
PRODUCTS

7.2.8.5. VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work.
- B. Manufacturers: Subject to compliance with requirements, proposed products will be accepted:
 - i. Pads Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - ii. Resilient Material: Oil- and water-resistant neoprene or rubber Mounts
 - iii. Neoprene: Shock-absorbing materials compounded according to the BS standard.
- C. Spring Isolators Freestanding, laterally stable, open-spring isolators.
 - i. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - ii. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - iii. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - iv. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure..
 - v. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
 - vi. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - vii. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - viii. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

7.2.8.6. VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work
 - i. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- B. Inertia Base Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- i. Design Requirements: Lowest possible mounting height with not less than 25-mm clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
- ii. Include supports for suction and discharge elbows for pumps.
- iii. Structural Steel: Steel shapes, plates, and bars complying with Bases shall have shape to accommodate supported equipment.
- iv. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- v. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

EXECUTION

7.2.8.7. EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

7.2.8.8. ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of sprint isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

7.2.9 22 0553 - Identification for Plumbing Piping and Equipment

GENERAL

7.2.9.1. SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe Markers.

7.2.9.2. RELATED SECTIONS

- A. Section 09 - Painting and Coating: Identification painting.

7.2.9.3. REFERENCES

- A. BS 1710 - Scheme for identification of piping systems
- B. BS 4800 - Colours Standards

7.2.9.4. SUBMITTALS



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. See Section 01 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Shop Drawings, Product Data & Samples,
- F. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- G. Project Record Documents: Record actual locations of tagged valves.

PRODUCTS

7.2.9.5. EQUIPMENT IDENTIFICATION

- A. All pumps, tanks, backflow prevention devices, fan systems, etc., as well as their motor starters, shall be identified by nameplates as hereinafter specified. Equipment nameplate shall state make, model, serial No capacity, area served and power fed from details.
 - i. Nameplates shall be 1.5mm thick, white laminated Bakelite with engraved black core lettering. Equipment plates shall be 40mm with 5mm lettering. Plates shall be adhered in place with an adhesive obtainable from the plate manufacturer.
 - ii. Nameplates shall identify the particular equipment in the following manner:
 - d. Example: Cold Water Pump No. 1: Cold. W. Pump No. 1.
 - e. Provide in duplicate, framed charts (under glass), which shall illustrate the equipment identification system, location of equipment, area or department the equipment serves, or any other data as requested by the Owner.
 - f. One framed chart illustrating the equipment installed in each equipment room or other locations where equipment is installed shall be mounted on a wall (where directed) of the room or location that the particular chart represents. The duplicate charts shall be delivered to the Operating Engineer.
 - g. Provide nameplates on all roof exhaust fans indicating fan number and areas served.
 - h. All nameplates on equipment located outdoors shall be of brass and shall be riveted to the item of equipment.

7.2.9.6. VALVE TAGS

- A. For every valve provide laminated white Bakelite tag with black core letters. Tags shall be secured to valves by means of a nickel-plated bead chain. Valve tags for each service shall have numerals on one face, starting with a number (to be determined) and consecutive from thereon, and abbreviated identifications of services as noted on the Drawings for the particular service, on the opposite.
- B. Upon completion of the work, furnish to the Owner, a complete schedule of all valves installed. Schedule shall mention the location of valve and the service controlled, etc. Schedules shall be mounted under glass, in a satin finish aluminum frame, or shall be provided in loose-leaf form complete with a hard



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

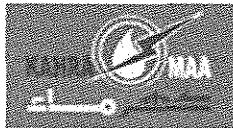
cover binder and plastic protective envelopes for each sheet. Form of schedule shall be determined by the Owner.

7.2.9.7. PIPE SERVICE MARKING

- A. All pipes for any service shall be identified as to their service after application of insulation and/or final painting, by colour code banding and legend. Marking shall indicate pipe content and direction of fluid flow to fully comply with requirements of schedule for the identification of piping system ANSI- A13.1 including the following minimum requirements.
 - i. All markers shall be in positions visible to personnel. Marking shall conform to pipe service identification (abbreviations) as noted on the Drawings.
 - ii. Paint pipe content banding, legend, and flow direction marker at each valve, at every point of pipe entry and exit where a line goes through a wall, on each riser and tee joint, and at 15m intervals on long continuous runs of pipe. Arrows (flow direction markers) shall point away from content marking, and in direction of flow. If flow can be in both directions, apply double-headed arrows. All vertical piping to be identified at least once for each storey interval of the building
 - iii. Background Banding (Paint):
 - a. Materials Inherently Hazardous
Flammable or Explosive (Gas or Fuel Oil): Yellow
Chemically Active or Toxic, Acid: Yellow
Extreme Temperature & Pressure Yellows
 - b. Materials of Inherently Low Hazard Freon, Brine, Sewer, Dom.: Liquid Green
Water, Chilled Water, Condenser Water Air: Blue
Fire Quenching Materials Water, Foam, CO₂: Red
 - c. Width of color band for outside diameter of insulated pipe and/ or uninsulated pipe.
19 mm thru 50 mm - 200 mm width
65 mm thru 150 mm - 300 mm
200 mm thru 250 mm - 600 mm
Over 250 mm - 800 mm
 - d. Color of Letters:
Fire Quenching Materials - White
Materials Inherently Hazardous -Black
Materials of Inherently Low Hazard -White
 - e. Outside diameter of insulated pipe and/ or uninsulated pipe and height of stenciled letters:
Pipe Diameter Letter Height
19 mm thru 32 mm: 12mm
65 mm thru 150 mm: 6mm

EXECUTION

7.2.9.8. PREPARATION



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 for stencil painting.

7.2.9.9. INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 150 to 200 mm below finished grade, directly above buried pipe.
- G. Identify pumps and valves with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to terminal boxes or valves with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 20 mm diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 6 m on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction. Vertical piping to be identified at least once for each story interval of the building.
- M. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

7.2.10 22 0719 - Plumbing Piping Insulation

GENERAL

7.2.10.1. SECTION INCLUDES

- A. Piping insulation.
- B. Equipment Insulation
- C. Jackets and accessories.

7.2.10.2. RELATED SECTIONS

- A. Section 22 1005 - Plumbing Piping
- B. Section 23 2113 - Hydronic Piping
- C. REFERENCES
- D. BS476 Fire tests on building material and structure parts 4-6-7
- E. S874 Methods for determining thermal insulating properties
- F. BS1710 Specification for identification of pipelines and services
- G. S2972 Methods of test for inorganic thermal insulating
- H. BS3119 Test methods for flameproof materials
- I. BS3120 Performance requirements for flameproof requirements



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- J. BS3533 Glossary of terms relating to thermal insulation
- K. BS3927 Phenolic Foam for thermal insulation in the form of slabs and profiled sections
- L. BS3958 Thermal insulating materials parts 1-6
- M. BS4735 Laboratory method of test for assessment of horizontal burning characteristics of specimens no larger than 150mm x 50mm x 12mm (nominal) of cellular plastics a small frame.
- N. BS5422 Specification for the use of thermal insulating materials
- O. BS5970 Code of practice for thermal insulation of pipework and equipment
- P. BS EN 150 5659-2 Plastics, smoke generation, determination of optical density by a single chamber test
- Q. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- R. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; 2003.
- S. ISO 15665:2003 Acoustics -- Acoustic insulation for pipes, valves and flanges
- T. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2007.
- U. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.

7.2.10.3. SUBMITTALS

- A. See Section 01 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Samples: Submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

7.2.10.4. QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of documented experience.
- C. The installer shall be an insulating firm with at least 5 years of successful insulation experience on projects with pipe, duct and equipment insulations similar to that required for this project.
- D. All insulation materials and accessories for piping, ductwork and equipment shall meet the requirements of Qatar Civil Defence ratings shall be determined by approved third party inspection bodies such as: Underwriters' Laboratories, Inc. All accessories and materials such as coatings, adhesive and sealer are to be shipped to the job in unopened containers as received from the manufacturer. These accessory materials are to be applied at can consistency and are not to be diluted in any form.
- E. All accessories, including adhesives, mastics, tapes, cements, etc., shall have the same component ratings as listed above.
- F. Prior to application, the installer shall certify in writing, that all products to be used will meet the above requirements.

7.2.10.5. GENERAL



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. All materials shall be used in accordance with the manufacturers technical data sheet, material safety data sheet and application method statement.
- B. All materials shall be new and fully dried and must be maintained in this condition during the progress of the works.
- C. All insulating materials shall be proofed against rotting, mould, fungus growth and attack by vermin.
- D. Adequate precautions shall be taken against any hazard to health involved in the use of any cleaner, adhesive or material in connection with the application and handling of insulation material. The manufacturer of any such material shall be consulted in respect of safe handling and working. The Contractor shall ensure that all operatives, for whom he is directly indirectly responsible for, conform with the working practices for safe handling of hazardous materials as set out in the COSHH Regulations and the Safety Plan for the Contract prepared by the Contractor to the satisfaction of the Employer and the Consultant.
- E. All cements and adhesives shall be as recommended by the manufacturer of the insulation. Insulation, insulation jacket, canvas and adhesive shall be fire retardant in accordance with BS EN 476.
- F. Insulation supplier shall provide thickness calculations. The minimum thickness shall be 19mm. The thickness calculation shall minimize heat loss and prevent condensation.
- G. Extent of Thermal Insulation
 - i. The Contractor shall insulate and finish the following services.
 - ii. Domestic Hot Water Tank
 - iii. Domestic Chilled drinking water tank and ancillaries
- H. Fire Standards
 - i. Unless otherwise specified within the specifications, the following standards shall be adhered to.
 - ii. All thermal insulating materials shall have a Class O fire rating in accordance with Building Regulations, Part B (Fire safety). Tested in accordance with BS476 Part 4 or Parts 6 and 7.
 - iii. The finish of all thermal insulating materials shall comply with BS476 Part 7 Class 1 spread of flame.
 - iv. The insulating materials and finishes shall not produce smoke or toxic fumes when subject to fire (as British Standards).
 - v. All thermal insulation and its finished surfaces shall comply with the Fire Officers Requirements for the particular building, service, position, etc. It shall be responsibility of the Contractor to gain the Fire Officers approval for all the insulation material and finishes he proposes to use, in compliance with this section of the Specification, before work is started.
 - vi. All insulating materials shall be consistent and where the finish selected for a particular application may cause harm or pollute in any manner the areas in which they contained, this shall be brought to the attention of the Consultant and where appropriate the finish changed. The cost of any changes shall be borne by the Contractor.
 - vii. In particular, mineral fibre insulation shall not be used in kitchen, food stores and other similar places where harm could result from its use.
 - viii. The Contractor shall submit to the Consultant, for approval, samples of insulating materials and finishes at his request. Samples submitted may be sent to a selected laboratory for testing and report at the Contractors



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

expense. Work undertaken without the Consultant's approval may be rejected. If rejected, the work shall be removed and replaced at the Contractor's expense.

7.2.10.6. DELIVERY, STORAGE, AND PROTECTION

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

7.2.10.7. ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PRODUCTS

7.2.10.8. REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Spread of Flame shall be to BS 476 Part 5 - Class P and fire propagation shall be to BS 476 Part 6 – Class O
- B. The thermal insulation shall be in accordance with the QCS regulations unless specified differently in the Project Documentation. However QCS approval is required before any changes will be permitted.
- C. The whole of the insulation work shall be carried out by an approved specialist insulation contractor. All allowances shall be included for arranging a specialist subcontractor accordingly and for informing the specialist subcontractor of all conditions relating to contract and for coordinating his works with the remainder of the Works.
- D. In addition to complying with the relevant standards, all insulating material shall be free from asbestos.
- E. The insulating material shall be acceptable only if they are equal to or better than the grades or classes of the fire resistance as follows:
 - i. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; 2003.
 - ii. BS 476 Fire tests on building materials and structures
 - iii. BS 4735 Laboratory method of test for assessment of horizontal burning characteristics of specimens no larger than 150mm x 50mm x 12mm (nominal) of cellular plastics a small frame.
- F. All insulation finishes and covering shall be classified as Class 1 surface spread when tested in accordance with BS 476, Part 7. They shall not in any way attack the insulation or the surface to which the insulation is being applied and shall be suitable for working temperatures.
- G. In order to ensure that the insulation applied is in all respects in accordance with the Specification, sections shall, as required by the Consultant, be cut from the finished insulation. The Contractor is as allow his price for the removal and replacement of two sections of each type of insulation. If however, defects sections shall be replaced at no cost to the Contract. If further defects are revealed then the Consultant shall have the right, when in his opinion it is necessary, to issue instructions for any part or the whole of the insulation to be removed and replaced. The replacement with new insulation shall be to the



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

satisfaction of the Consultant and the cutting out and replacement shall be at no cost to the Contract.

- H. Particular attention shall be paid to the finished appearances of all thermal insulation which must present a neat and symmetrical appearance running true in the line with pipe layouts, etc.
- I. Any rough, irregular and badly finished surfaces shall be stripped down and re-insulated to the Consultant's satisfaction.
- J. All systems are to have been tested and approved by the Consultant prior to installation of insulation
- K. All thermal insulation shall be non-corrosive to the metal, water repellent and fire retardant.
- L. All metal surfaces shall be thoroughly cleaned and treated with approved corrosion inhibitor before applying the insulation. Insulation can be applied directly to galvanized surfaces.
- M. Lead bearing inserts shall be provided at all supports to ensure that the insulation is not compressed or damaged. The inserts shall be treated hardwood or approved plastic.
- N. The vapour barrier shall be continuous and not punctured at any point.
- O. The fibre glass cloth shall be soaked in a compound as approved by the Consultant and shall be overlapped at least 50 mm at transverse and longitudinal cloth joints.
- P. Vapour seal materials shall be fire resistant, non-toxic, weather resistant, and anti-fungus quality. Bitumen based products shall not be used.
- Q. Mechanical fasteners shall be used when installing slab or roll insulation. The fasteners shall be the self adhesive type and only fixed after cleaning to ensure proper adhesion.
- R. Acoustic Insulation:
 - i. All waste, soil, storm and drainage pipes between residential units particularly when crossing noise sensitive spaces from different occupancies shall be externally wrapped with proprietary lagging, such as SoundLag 4525C or approved equivalent. Lagging shall be rated for at least Rw30dB.
 - ii. Where waste, soil, storm and drainage pipes pass through or over noise sensitive areas, the construction enclosing piping should be rated at Rw45-50dB. This will require heavy construction of plasterboard, or alternatively may be satisfied by an acoustic rated PVC pipe in conjunction with wrapping the pipes with a composite of acoustic foam (nominally 50mm thick) and a loaded vinyl with a surface mass of 8kg/m².

7.2.10.9. GLASS FIBER

- A. Manufacturers: Refer to Appendix A
- B. Insulation: rigid molded, noncombustible.
 - i. Density: not less than 65 kg/Cu m³;
 - ii. Thermal conductivity: not more than 0.032 W/m²/K at 50oC with self applied aluminum craft paper.
- C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E 96/E 96M of 0.02 perm-inches(0.029 ng/Pa s m).
- D. Tie Wire: 1.22 mm stainless steel with twisted ends on maximum 300 mm centers.
- E. All fiberglass insulation shall be completely sealed at all joints.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

F. For Acoustic Insulation:

- i. To ASTM C1071
- ii. Density: not less than 48 kg/m³; 50mm thickness

7.2.10.10. POLYISOCYANURATE CELLULAR PLASTIC (PHENOLIC FOAM)

- A. Density: Shall not less than 35kg/m³ for all interior piping and 50 kg/m³ for external pipework.
- B. Service Temperature
 - i. Minimum Service Temperature: 0 degrees C.
 - ii. Maximum Service Temperature: 120 degrees C.
- C. Cover: All pipe insulation to be factory covered with reinforced aluminum foil/kraft paper laminate.
- D. Connection: Waterproof vapor barrier adhesive.
- E. Fire Rating: Class "O" fire rating and test certificate from independent laboratory.

7.2.10.11. ELASTOMERIC FOAM

- A. Insulation properties:
 - i. Thermal conductivity 0.033 W/mK for 24° C
 - ii. Density shall be between 60-70 kg/m³.
 - iii. Fire rating per BS Part 7 shall be minimum Class 1,
 - iv. fire propagation shall be to BS 476 Part 6 - Class O.
 - v. Water vapour permeability shall be maximum 0.09 microgram/N.h.

7.2.10.12. Valves, fittings and all other appurtenances

- A. Valves, fittings and all other appurtenances through which water passes shall be insulated with mitred sections of preformed insulation of a thickness equal to the insulation on the adjoining pipe. Permeability factor shall be greater than or equal to 7000.

7.2.10.13. CROSS LINKED POLYETHYLENE FOAM

- A. Cross-linked closed cell self-adhesive polyolefin foam reinforced by an alupet foil to be used for chilled water, AC and condensate piping.
 - i. Thermal Conductivity: 0.034 W/m·K at 23° C, as per ASTM C518 standard
 - ii. Density: 30 kg/m³
 - iii. Water Vapor Permeability: 0.00 permeability as per ASTM E96 standard
 - iv. Water Absorption: 0.3% by volume as per BS EN 12087:1997 Method 2A
 - v. Smoke Density and Toxicity: D_s ≤ 200, in accordance with ISO 5659-2 IMO Resolution MSC 61(67), 1996; Annex 1, Part 2
 - vi. Working temperature: from -50° C to 105° C (as per DIN EN 14706)
 - vii. VOC level: < 4 µg / m² / hr (as per ASTM D5116)
 - viii. Antifungal: as per ASTM G21
 - ix. Antimicrobial: as per ISO 22196
 - x. Environmental concerns: ODP = 0; GWP < 5 (proved by test report issued by accredited lab)



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- B. Fire-retardant grade, self-extinguishing and attaining Class O as per BS 476 Part 7 (Surface Spread of Flame) and Part 6 (Fire Propagation).

7.2.10.14. Light weight-loaded vinyl

- A. For Acoustic Insulation: Tough reinforced aluminum foil skin applied to a 5kg/m² flexible barrier backed with 25mm thick convoluted, hydrolysis, resistant, combustion modified, acoustic foam.

7.2.10.15. Insulation for equipment

- A. Storage tanks and equipment shall be supplied complete with a factory applied layer of high density, CFC free polyurethane foam insulation. The dimensions and properties of the polyurethane insulation shall be sufficient to ensure that heat loss under normal operating conditions does not exceed 90 watts per square meter of surface area.
- B. The polyurethane shall be protected against mechanical damage and moist atmosphere by an outer shell.
 - i. Apparatus Casings which are not provided with insulation
 - ii. Material: rigid polyurethane
 - iii. Thickness 50 mm
 - iv. Density: 24 kg/Cu m.
 - v. All joints are to be sealed in cold adhesive compound.
 - vi. Ensure that any access panels are insulated to the same standard and are openable.

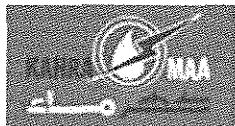
EXECUTION

7.2.10.16. EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

7.2.10.17. INSTALLATION FOR PIPING

- A. Install in accordance with manufacturer's instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. Glass fiber insulated pipes conveying fluids below ambient temperature:
- E. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
- F. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
- H. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
- I. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- J. Inserts and Shields:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- i. Application: Piping 50 mm diameter or larger.
- ii. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
- iii. Insert location: Between support shield and piping and under the finish jacket.
- iv. Insert configuration: Minimum 150 mm long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- v. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- K. Insulate entire hot water and cooled water system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- L. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.
- M. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces Finish with canvas jacket sized for finish painting.
- N. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with stainless steel jacket with seams located on bottom side of horizontal piping.
- O. All condensate drains within plant rooms or other internal areas shall be insulated with 25mm thick rigid fiberglass or 10mm thick foam rubber insulation.
- P. Thickness of insulation for cooled and hot water refer to BS 5422:2001.

7.2.10.18. INSTALLATION FOR EQUIPMENT

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- G. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- H. Inserts and Shields:
 - i. Application: Equipment 40 mm diameter or larger.
 - ii. Shields: Galvanized steel between hangers and inserts.
 - iii. Insert location: Between support shield and equipment and under the finish jacket.
 - iv. Insert configuration: Minimum 150 mm long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - v. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Finish insulation at supports, protrusions, and interruptions.
- J. Equipment in Mechanical Equipment Rooms or Finished Spaces:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- K. Finish with stainless steel jacket.
- L. Exterior Applications: Provide vapor barrier jacket or finish with lass mesh reinforced vapor barrier cement. Cover with aluminum or stainless steel jacket with seams located on bottom side of horizontal equipment.
- M. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

7.2.11 22 0900 - Instrumentation and Control of Plumbing

GENERAL

7.2.11.1. SECTION INCLUDES

- A. Water meters.
- B. Flow meters.
- C. Pressure Gauges and pressure Gauge taps.
- D. Thermometers and thermometer wells.
- E. Static pressure Gauges.

7.2.11.2. RELATED SECTIONS

- A. Section 23 2113 - Hydronic Piping.
- B. Section 23 0943 - Pneumatic Control System for HVAC.
- C. Section 23 0923 - Direct-Digital Control System for HVAC.
- D. Section 23 0993 - Sequence of Operations for HVAC Controls.

7.2.11.3. REFERENCES

- A. BS 5235 - BS 5235 Specification for dial-type expansion thermometers; 1975
- B. BS EN 837-1:1998 Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
- C. BS EN 14154 - Water meters. General requirements
- D. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Underwriters Laboratories Inc.; 2005.

7.2.11.4. SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- C. Project Record Documents: Record actual locations of components and instrumentation.
- D. Operation and Maintenance Data.

7.2.11.5. ENVIRONMENTAL REQUIREMENTS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PRODUCTS



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

7.2.11.6. WATER METERS

- A. Manufacturers: Refer to Appendix A
- B. Meter: Meter with monitoring signal to building management system.
 - i. Temperature Service: up to 93 degrees C.
 - ii. Accuracy: 1-1/2 percent.
 - iii. For Hot water system: meter with low flow cut-off ability.

7.2.11.7. PRESSURE GAUGES

- A. Manufacturers: Refer to Appendix A
- B. Gauge: Pressure gauges shall be dial type with dial range to cover twice the average working pressure. UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background. Gauge shall be complete with shut-off valve.
- C. Case: Steel with brass bourdon tube.

7.2.11.8. PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 1034 kPa.
- B. Needle Valve: Brass, 6mm NPT for minimum 1034 kPa.
- C. Pulsation Damper: Pressure snubber, brass with 6 mm connections.
- D. Syphon: Steel, Schedule 40, 6 mm angle or straight pattern.

7.2.11.9. DIAL THERMOMETERS

- A. Manufacturers: Refer to Appendix A

7.2.11.10. THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

7.2.11.11. TEST PLUGS

- A. 6 mm or 13 mm brass fitting and cap for receiving 3 mm outside diameter pressure or temperature probe with neoprene core for temperatures up to 93 degrees C.
- B. Flow Meters
 - i. Manufacturers: Refer to Appendix A
 - ii. Flow meter shall be a single turbine type insertion flow meter.
 - iii. The wetted material shall be constructed of 316L stainless steel.
 - iv. Flow meter accuracy shall not exceed +/- 1% with velocities from 3 to 30 fps.
 - v. Provide output to BMS.
 - vi. Install flow meters according to manufacturers' instructions paying particular attention to the upstream and downstream piping requirements.

EXECUTION

7.2.11.12. INSTALLATION



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Install in accordance with manufacturer's instructions.
- B. Contractor to submit calibration certificate of gauges from testing lab prior to do any installation or using for pressure testing checks.
- C. Install pressure gauges in piping tee with gauge cock at the most readable position. Select gauges with bottom side or rear inlet as appropriate.
- D. Install snubbers on all pressure gauges installed in close proximity of pump discharge.
- E. Provide red set hands to indicate normal or critical pressure in gauges subjected to variable pressures.
- F. Use remote reading type pressure gauges with armoured capillary tubes, when installed above 2 Ms from FFL.
- G. Install positive displacement meters with isolating valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.
- H. Provide one pressure Gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to Gauge.
- I. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 60 mm for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- J. Install meter in accordance with Kahramma Regulations
- K. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 0943.
- L. Coil and conceal excess capillary on remote element instruments.
- M. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- N. Install Gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- O. Adjust Gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- P. Locate test plugs adjacent thermometers and thermometer sockets.

7.2.11.13. SCHEDULE

- A. Pressure Gauges and Location:
 - i. Pumps,
 - ii. Expansion tanks,
 - iii. Pressure tanks,
 - iv. Pressure reducing valves,
 - v. Backflow prevention,
- B. Pressure Gauge Tappings and Location:
 - i. Control valves 20 mm & larger inlets and outlets.
- C. Stem Type Thermometers and Location:
 - i. Headers to central equipment,
 - ii. Domestic hot water supply and recirculation,
- D. Thermometer Sockets and Location:
 - i. Located on the upstream and downstream side of all hot water balancing valves for testing purposes
- E. Dial Thermometers and Location:
 - i. Water storage tank



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- F. Install four level switches in sump for:
 - i. low level – control to switch off pumps
 - ii. level 1 – control to operate pump 1
 - iii. level 2 – control to operate pump 2
 - iv. high level – signal to control panel and BMS for high water alarm
- G. Provide flow meter on the discharge of the pumps and monitor at both the local control panel and BMS

7.2.12 22 1006 - Plumbing Piping Specialities

GENERAL

7.2.12.1. SECTION INCLUDES

- A. Floor/Roof Drains
- B. Cleanouts.
- C. Hose bibs.
- D. Backflow preventers.
- E. Water hammer arrestors.
- F. Interceptors.
- G. Thermostatic mixing valves.

7.2.12.2. RELATED SECTIONS

- A. Section 01 - Summary: Product requirements for - furnished kitchen equipment.
- B. Section 01 - Product Requirements: Procedures for [Client]-supplied products.
- C. Section 22 1005 - Plumbing Piping.
- D. Section 22 4000 - Plumbing Fixtures.
- E. Section 22 3000 - Plumbing Equipment.
- F. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

7.2.12.3. REFERENCES

- A. PDI-WH 201 - Water Hammer Arrestors; Plumbing and Drainage Institute; 2006.
- B. BE EN 12056 - Gravity drainage systems inside buildings.

7.2.12.4. SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Certificates: Certify that grease interceptors meet or exceed specified requirements.
- E. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- F. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors
- G. Operation Data: Indicate frequency of treatment required for interceptors.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- H. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

7.2.12.5. QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

7.2.12.6. DELIVERY, STORAGE, AND PROTECTION

- A. Accept specialties on site in original factory packaging. Inspect for damage.

7.2.12.7. EXTRA MATERIALS

- A. See Section 01 - Product Requirements, for additional provisions.
B. Supply for use in maintenance of project:

- i. Two loose keys for outside hose bibs.
- ii. Two hose end vacuum breakers for hose bibs.

PRODUCTS

7.2.12.8. ROOF DRAINS

- A. Manufacturers: Refer to appendix A
B. Floor drains in finished areas:
 - i. Body Stainless steel 316.
 - ii. Strainer: Round stainless steel.
 - iii. Accessories: Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp

C. Floor drains in mechanical rooms and unfinished areas
 - i. Body: epoxy coated cast body with seepage flange,
 - ii. Accessories: Adjustable collar, clamping device and medium duty nickel bronze grate. Provide integral backwater valve with floor drain where indicated on drawings.

7.2.12.9. CLEANOUTS

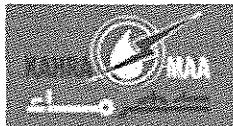
- A. Provide cleanouts at the base of all vertical stack, storm, sanitary waste pipe and also in all horizontal above & underground pipe at distance of 30m between each other.

7.2.12.10. HOSE BIBBS

- A. Manufacturers: Refer to appendix A
B. Interior Hose Bibbs:
 - i. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with hand wheel, integral vacuum breaker in conformance with ASSE 1011.

7.2.12.11. BACK WATER VALVES

- A. Manufacturers: Refer to appendix A
B. Cast Iron Back Water Valves: Lacquered cast iron body and cover, brass valve, extension sleeve, and access cover.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- C. Plastic Back Water Valves: ABS body and valve, extension sleeve, and access cover.

7.2.12.12. BACKFLOW PREVENTERS

- A. Manufacturers: Refer to appendix A
B. Reduced Pressure Backflow Preventers:
i. Bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

7.2.12.13. DOUBLE CHECK VALVE ASSEMBLIES

- A. Manufacturers: Refer to appendix A
B. Double Check Valve Assemblies:
i. Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

7.2.12.14. WATER HAMMER ARRESTORS

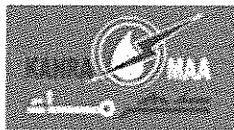
- A. Manufacturers: Refer to appendix A
B. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -73 to 149 degrees C and maximum 1700 kPa working pressure.

7.2.12.15. SUMPS AND INTERCEPTORS

- A. Manufacturers: Refer to appendix A
B. Grease Interceptors: Locally manufactured to DM standard
i. Construction:
Material: GRP.
Rough-in: On floor.
Accessories: Multi-weir baffle assembly, integral deep seal trap, removable integral flow control, sediment bucket.
Capacity: for differential refer to drawings
ii. Accessories:
Volume control shut-off valve on outlet.
Stem thermometer on outlet.
Strainer stop checks on inlets.
Grease Level Indicator connected to BMS/Alarm

7.2.12.16. LEVEL SWITCH

- A. Level switches (high/low levels alarm and indications) shall be supplied and installed in the sump pits and waste collection water for the proper operation of the pumps as indicated on Drawings. The switches shall be of float switch/ Probe rod type. The lead-lag selection of pumps shall be changed automatically after each cycle.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

EXECUTION

7.2.12.17. INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout lugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- F. Pipe relief from backflow prevention to nearest drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories sinks washing machine outlets
- H. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 20 mm minimum, and minimum 450 mm long.
- I. Pit Cover should be custom fabricated light duty stainless steel grate and frame complete with anchor strips. Grate to be in two sections. Provide openings for all pipe drops. Grating openings to be 13mm wide maximum.

7.2.13 22 1116 - Domestic Water Piping

GENERAL

7.2.13.1. SUMMARY

- A. Section Includes:
 - i. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - ii. Encasement for piping.
 - iii. Specialty valves.
 - iv. Flexible connectors.
 - v. Water meters furnished by utility company for installation by Contractor.
 - vi. Water meters.
- B. Related Section:
 - i. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

7.2.13.2. PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions.

7.2.13.3. SUBMITTALS

- A. Water meters.
- B. Backflow preventers, Vacuum breakers Backflow preventers and vacuum breakers.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - i. Fire-suppression-water piping.
 - ii. Domestic water piping.
 - iii. HVAC hydronic piping.
- D. Field quality-control reports.

7.2.13.4. QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with BS:EN (British European) standards for potable domestic water piping and components.

7.2.13.5. COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PRODUCTS

7.2.13.6. PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

7.2.13.7. PPR PIPING

- A. Hot & Cold water Pipes and fittings:
- B. PN-25 polypropylene pipes with aluminum cladding manufactured with compliance to the DIN 8077/8078, and Fittings to the DIN 16962 with a PN-25 pressure class.
- C. Pipes and fittings shall be joined by poly-fusion method, using a fusion welding machine as per pipe manufacturer's recommendation, as suitable for their piping system.
- D. Threaded fittings shall be used to connect to other piping systems, fixtures, etc., fitting with metal insert shall be sealed with Teflon tape, and all PPR fittings with metal inserts should be made of Brass plated by a nickel layer.
- E. PP-R piping system shall be installed with special pre-caution for thermal expansion especially for exposed installation, thermal expansion coefficient of the selected material should not exceed 0.035mm/m.K.
- F. All pipes and fitting used to transport the hot water should be insulated as per the DIN1988, thermal conductivity of the selected material should not exceed 0.21W/m.C
- G. All P-R pipes shall not be installed or stored under direct UV light. Pipes on roof shall be insulated and cladded.
- H. Pipe bending shall be generally avoided, PP-R pipes and fittings shall be certified for potable water use by a recognized European Standard. DVGW or approval equivalent.
- I. All system components should be able to resist an emergency operating temperature up to 110C. Pipes and fittings should be produced by the same manufacturer using the same raw material source with the natural color of the



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

polypropylene without any additives or coloring of the pipes and fittings. Contractor to ensure that the velocity of the flow will not exceed the 1.5m/s inside the floors and not to exceed the 2.0m/s in riser pipes. In order to minimize the friction and pressure losses in the network only elbows with Non-centric profiles shall be used.

7.2.13.8. PEX TUBE AND FITTINGS

- A. Cold and hot water distribution pipe work embedded within builder's work inside toilets, bathrooms, kitchen shall be composed of :
- B. PN20 Cross linked polyethylene pipe according to DIN 16892 and 16893 and should be NSF approved and should comply with the requirements of the ASTM F876/877 pulled in a corrugated conduit of ordinary polyethylene. Fittings of DZR construction. Proposed pipes should be DVGW & AENOR approved.
- C. The Inner Pipe shall be a cross linked polyethylene. Pipe withstanding up to 95 deg. °C at a max. Pressure of 10 bar without deformation or Damage. Short time temperature loading up to 110deg.C
- D. Pipes manufacturer shall offer 50 years grantee for the pipes and 10 years for the complete system.
- E. All pipes shall be stamped on equal intervals showing clearly the name of the manufacturers along with the pressure and temperature rating of these pipes
- F. All pipes shall be laid so that the 16mm PEX water pipe can be replaced if necessary.
- G. Fittings& Accessories:
 - i. Pipes shall be connected to the different fittings via a wall box of reinforced plastic fitted with bronze elbow suitable for 15mm or 20mm threaded connection. The box should be suitably designed in order to enable the replacement of existing pipes in the even of their damage.
 - ii. Both pipes and fittings to be produced by the same manufacturer.

7.2.13.9. SPECIALTY VALVES

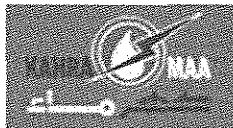
- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers."

7.2.13.10. TRANSITION FITTINGS

- A. General Requirements:
 - i. Same size as pipes to be joined.
 - ii. Pressure rating at least equal to pipes to be joined.
 - iii. End connections compatible with pipes to be joined.
 - iv. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

7.2.13.11. DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

i. Description:

Pressure Rating: 150 psig.

End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

i. Pressure Rating: 150 psig.

ii. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Couplings:

i. Description:

Galvanized-steel coupling..

End Connections: Female threaded.

Lining: Inert and noncorrosive, thermoplastic.

7.2.13.12. FLEXIBLE CONNECTORS

A. Manufacturers: Refer to Appendix A

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

i. Working-Pressure Rating: Minimum 200 psig

ii. End Connections 50mm and Smaller: Threaded copper pipe or plain-end copper tube.

iii. End Connections 65mm and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

i. Working-Pressure Rating: Minimum 200 psig.

ii. End Connections 50mm and Smaller: Threaded steel-pipe nipple.

iii. End Connections 65mm and Larger: Flanged steel nipple.

7.2.13.13. WATER METERS.

A. Displacement-Type Water Meters:

i. Manufacturers: Refer to Appendix A

ii. Description:

Standard: AWWA C700.

Pressure Rating: 150 psig working pressure.

Registration: In gallons or cubic meters as required by utility.

Case: Bronze.

End Connections: Threaded.

EXECUTION

7.2.13.14. EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

7.2.13.15. PIPING INSTALLATION

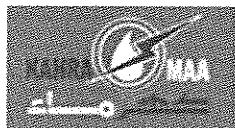
A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- E. Install domestic water piping level with 0.25 percent slope downward toward drain.
- F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- G. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping adjacent to equipment and specialties to allow service and maintenance.
- L. Install piping to permit valve servicing.
- M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.
- P. Install PEX piping with loop at each change of direction of more than 90 degrees.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- S. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

7.2.13.16. JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - i. Apply appropriate tape or thread compound to external pipe threads.
 - ii. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - i. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - ii. PVC Piping: Join according to ASTM D 2855.
- H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

7.2.13.17. VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping 50mm and smaller. Use butterfly or gate valves for piping 65mm and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - i. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - ii. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping 50mm and smaller and butterfly



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

valves for piping 65mm and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

7.2.13.18. TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - i. 40mm and Smaller: Fitting-type coupling.
 - ii. 50mm and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping 50mm and Smaller: Plastic-to-metal transition fittings.

7.2.13.19. DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

7.2.13.20. FLEXIBLE CONNECTOR INSTALLATION

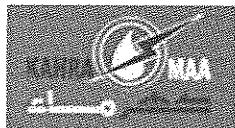
- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

7.2.13.21. WATER METER INSTALLATION

- A. Rough-in domestic water piping for water meter installation according to utility company's requirements.
- B. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.
- C. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

7.2.13.22. HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 10mm.
- E. Install EPDM rubber lined hangers for hot and cold piping with the following maximum horizontal spacing and minimum rod diameters:
 - i. 25mm to 50mm and Smaller: 10-mm rod.
 - ii. 50mm to 200mm 13-mm rod.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- F. Install supports for vertical piping every 1500 mm for 50mm and smaller, and every 1800mm.
- G. Install rubber lined hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - i. 50mm and Smaller: 1200 mm.
 - ii. 65mm to 150mm 48 inches -1200 mm13-mm rod.
- H. Install supports for vertical PVC piping every 1200 mm.
- I. Support piping and tubing not listed in this article according to manufacturer's written instructions.

7.2.13.23. CONNECTIONS

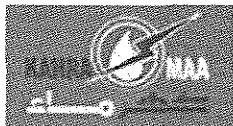
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - i. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - ii. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - iii. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - iv. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for 65mm and larger.

7.2.13.24. IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

7.2.13.25. FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - i. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - ii. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - iii. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing in and before setting fixtures.
 - iv. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- v. Re inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for re inspection.
- vi. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

- i. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- ii. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- iii. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- iv. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- v. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
- vi. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

7.2.13.26. ADJUSTING

A. Perform the following adjustments before operation:

- i. Close drain valves, hydrants, and hose bibbs.
- ii. Open shutoff valves to fully open position.
- iii. Open throttling valves to proper setting.
- iv. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
- v. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
- vi. Adjust calibrated balancing valves to flows indicated.
- vii. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
- viii. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- ix. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
- x. Check plumbing specialties and verify proper settings, adjustments, and operation.
- xi. Clean non-potable domestic water piping as follows:
 - a. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - b. Use purging procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, follow procedures described below:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- c. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
 - C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

7.2.13.27. VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - i. Shutoff Duty: Use ball or gate valves for piping 50mm and smaller. Use butterfly, ball, or gate valves with flanged ends for piping 65mm and larger.
 - ii. Hot-Water Circulation Piping, Balancing Duty: balancing valves.
 - iii. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.
- D. PPR valves matching piping materials may be used.

7.2.14 22 1119 - Domestic Water Piping Specialties

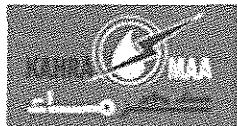
GENERAL

7.2.14.1. SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - i. Vacuum breakers.
 - ii. Backflow preventers.
 - iii. Water pressure-reducing valves.
 - iv. Balancing valves.
 - v. Strainers.
 - vi. Hose bibbs.
 - vii. Drain valves.
 - viii. Water hammer arresters.
 - ix. Air vents.
 - x. Trap-seal primer valves.
- B. Related Sections include the following:
 - i. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - ii. Division 22 Section "Domestic Water Piping" for water meters.
 - iii. Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.

7.2.14.2. PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125psig unless otherwise indicated.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

7.2.14.3. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

7.2.14.4. QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PRODUCTS

7.2.14.5. VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers.
 - i. Standard: ASSE 1001.
 - ii. Size: as required to match connected piping.
 - iii. Body: Bronze.
 - iv. Inlet and Outlet Connections: Threaded.
 - v. Finish: Rough Bronze chrome coated
- B. Hose-Connection Vacuum Breakers
 - i. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - ii. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - iii. Standard: ASSE 1011.
 - iv. Body: Bronze, non removable, with manual drain.
 - v. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - vi. Finish: rough bronze with chrome coated.
- C. Pressure Vacuum Breakers :
 - i. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - ii. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Valves: Ball type, on inlet and outlet.

7.2.14.6. BACKFLOW PREVENTERS

- A. Double-Check Backflow-Prevention Assemblies
 - i. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - ii. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - iii. Standard: ASSE 1015.
 - iv. Operation: Continuous-pressure applications, unless otherwise indicated.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- v. Pressure Loss: 5psig
- vi. Size: as mentioned in the drawing and wherever required
- vii. Body: Bronze for 50mm and smaller; stainless steel for 65mm and larger.
- viii. End Connections: Threaded for 50mm and smaller; flanged for 65mm and larger.
- ix. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of 50mm and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of 65mm and larger.
 - b. Dual-Check-Valve Backflow Preventers
- x. Standard: ASSE 1024.
- xi. Operation: Continuous-pressure applications.
- xii. Body: Bronze with union inlet.

7.2.14.7. WATER PRESSURE-REDUCING VALVES

A. Water Regulators

- i. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- ii. Standard: ASSE 1003.
- iii. Pressure Rating: Initial working pressure of 150 psig
- iv. For Inlet and outlet pressure ratings please refer to drawings.
- v. Body: Bronze 50mm and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for 65mm and above.
- vi. Valves for Booster Heater Water Supply: Include integral bypass.

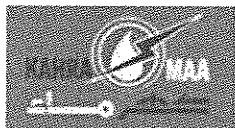
7.2.14.8. TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

- i. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- ii. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- iii. Standard: ASSE 1017.
- iv. Pressure Rating: 125 psig
- v. Type: Thermostatically controlled water mixing valve.
- vi. Material: Bronze body with corrosion-resistant interior components.
- vii. Connections: Threaded[union] inlets and outlet.
- viii. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
- ix. Tempered-Water Setting: 40 deg C

B. Primary, Thermostatic, Water Mixing Valves

- i. Standard: ASSE 1017.
- ii. Pressure Rating: 125 psig
- iii. Type: thermostatically controlled water mixing valve.
- iv. Material: Bronze body with corrosion-resistant interior components.
- v. Connections: Threaded inlets and outlet.
- vi. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- vii. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
- viii. Tempered-Water Setting: 40 deg C.
- ix. Valve Finish: Polished, chrome plated.

7.2.14.9. STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers

- i. Pressure Rating: 125psig minimum, unless otherwise indicated.
- ii. Body: Bronze for 50mm and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for 65mm and larger.
- iii. End Connections: Threaded 50mm and smaller; flanged for 65mm and larger.
- iv. Screen: Stainless steel with round perforations, unless otherwise indicated.
- v. Perforation Size:
 - a. Strainers 50mm and Smaller: 0.51 mm
 - b. Strainers 65mm to 100mm 1.14 mm.

7.2.14.10. HOSE BIBBS

A. Hose Bibbs

- i. Standard: ASME A112.18.1 for sediment faucets.
- ii. Body Material: Bronze.
- iii. Seat: Bronze, replaceable.
- iv. Supply Connections: 15mm or 22mm threaded or solder-joint inlet.
- v. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
- vi. Pressure Rating: 125 psig
- vii. Vacuum Breaker: nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
- viii. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
- ix. Finish for Finished Rooms: Chrome or nickel plated.
- x. Include operating key with each operating-key hose bib.
- xi. Include wall flange with each chrome- or nickel-plated hose bib.

7.2.14.11. WATER HAMMER ARRESTERS

A. Water Hammer Arresters

- i. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- ii. Standard: ASSE 1010 or PDI-WH 201.

7.2.14.12. AIR VENTS

A. Bolted-Construction Automatic Air Vents >:

- i. Body: Bronze.
- ii. Pressure Rating: 125-psig minimum pressure rating at 60 deg C.
- iii. Float: Replaceable, corrosion-resistant metal.
- iv. Mechanism and Seat: Stainless steel.
- v. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- i. Body: Stainless steel.
- ii. Pressure Rating: 150-psig minimum pressure rating.
- iii. Float: Replaceable, corrosion-resistant metal.
- iv. Mechanism and Seat: Stainless steel.
- v. Size: 15mm minimum inlet.
- vi. Inlet and Vent Outlet End Connections: Threaded.

7.2.14.13. TRAP-SEAL PRIMER VALVES

A. Drainage-Type, Trap-Seal Primer Valves

- i. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- ii. Standard: ASSE 1044, lavatory P-trap with 10mm minimum, trap makeup connection.
- iii. Material: Chrome-plated, cast brass.

EXECUTION

7.2.14.14. INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - i. Locate backflow preventers in same room as connected equipment or system.
 - ii. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - iii. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - i. Install thermometers and water regulators if specified.
 - ii. Install cabinet-type units recessed in or surface mounted on wall as specified.
 - iii. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve and pump.
- G. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - i. Install shutoff valve on outlet if specified..
- H. Install water hammer arresters in water piping according to PDI-WH 201.
- I. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- J. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- K. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- L. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

7.2.14.15. LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - i. Pressure vacuum breakers.
 - ii. Intermediate atmospheric-vent backflow preventers.
 - iii. Double-check backflow-prevention assemblies.
 - iv. Dual-check-valve backflow preventers.
 - v. Water pressure-reducing valves.
 - vi. Primary, thermostatic, water mixing valves.
 - vii. Manifold, thermostatic, water-mixing-valve assemblies.
 - viii. Primary water tempering valves.
 - ix. Hose stations.
 - x. Supply-type, trap-seal primer valves.
 - xi. Trap-seal primer systems.

7.2.14.16. ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

7.2.15 1300 - Facility Sanitary Sewerage

GENERAL

7.2.15.1. SECTION INCLUDES

- A. Sanitary Sewerage

7.2.15.2. RELATED SECTIONS

- A. Section 22 0719 Plumbing Piping Insulation
- B. Section 22 1005 Plumbing Piping
- C. Section 22 1006 Plumbing Piping Specialties
- D. Section 22 1400 Storm Drainage
- E. Section 22 3000 Plumbing Equipment
- F. Section 22 4000 Plumbing Fixtures

7.2.15.3. REFERENCES

- A. BS 743 – Materials for damp-proof courses
- B. BS EN 598 - Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- C. BE EN 877 - Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance.
- D. BS 2494 - Specification for elastomeric joint rings for pipework and pipeline
- E. BS 2494 – Elastomeric seals for joints in pipework and pipelines
- F. BS 4515 – Unplasticised PVC soil and ventilation pipes
- G. BS 4660 or to EN standard - Unplasticized polyvinyl chloride (PVC-U) pipes and plastic fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage
- H. BS 5254 or to EN standard– Polypropylene waste pipe and fittings
- I. BS 5572 or to EN standard – Sanitary pipework
- J. BS 6076 – Tubular polythene film for use as protective sleeving for buried iron pipes and fittings
- K. BE EN 12056 - Gravity drainage systems inside buildings.

7.2.15.4. SUBMITTALS

- A. See Section 01 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on piping, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
 - i. Submit preliminary layout of finished ceiling areas indicating only piping locations coordinated with ceiling installation.
 - ii. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories. Indicate system controls.
 - iii. Submit shop drawings to authority having jurisdiction for approval. Submit proof of approval to.
- D. Project Record Documents: Record actual locations of pipings and deviations of piping from drawings. Indicate drain and test locations.
- E. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- F. Each type of imported pipe bedding material.
- G. Each type of filter material.

7.2.15.5. QUALITY ASSURANCE

- A. Maintain one copy of referenced design and installation standard on site.
- B. Conform to UL requirements.
- C. Design system under direct supervision of a Professional Fire Protection Engineer experienced in design of this type of work and licensed in Qatar.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience approved by manufacturer.
- F. It is the responsibility of this Contractor to make a detailed review of all drawings during the tender period, in order to fully comprehend the extent of the work to be completed. These drawings are schematic in nature and show the intent for the minimum requirements of the systems. Obstructions to pipe routing and obstructions to the location of piping are not shown on these



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

drawings. It is this Contractor's responsibility to locate and detail these obstructions as part of the scope of work. In addition it is this Contractor's responsibility to acquaint himself of all the drawings from the other disciplines – structural, electrical, and mechanical, during the tender phase, so that all of the interferences can be appreciated at the time of tender. No extras will be given for conditions that were known at the time of tender.

- G. Give sufficient notice so that inspection may be made at the following stages
- Excavated surfaces
 - Concealed or underground services.

7.2.15.6. PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

7.2.15.7. DELIVERY, STORAGE, AND PROTECTION

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PRODUCTS

7.2.15.8. SANITARY, WASTE, CONDENSATE, AND VENT PIPING

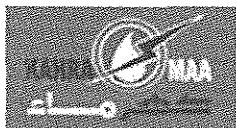
- PVCu Soil & waste systems shall be manufactured to BS EN 1329 :2000 formerly BS4514 & BS 5255,
- All pipes and fittings shall strictly comply to the requirements of BSEN 1329 and carry the British Standard Kite mark where appropriate. Pipes and fittings shall be manufactured at the same manufacturing location and under the same quality control system
- Soil & Vent pipes, sizes 160mm, 110mm & 82mm shall be manufactured using PVCu with ring seal joints that will allow for expansion and contraction within the system
- Waste pipes, 50mm and below shall be manufactured from either High Temperature resistant MUPVC to BS EN 1566 or ABS to BS EN 1455 – 1: 200 with solvent weld joints. Where appropriate, all pipes and fittings shall carry the British Standard Kite mark and be manufactured under a single quality control regime in the same location.
- Soil & Waste pipe sizing will reflect the number of discharge units that drain into the system as laid down by BS EN12056 – 2.

7.2.15.9. KITCHEN WASTE PIPING FOR RESTAURANTS

- HDPE pipes shall stands for High Density Polyethylene with SDR 26 shall be used with fusion welded fittings to manufacturers recommendations . Polyethylene is a semi crystalline thermoplastic that can have different densities. By coloring with 2% of "carbon black" the PE gets its black color.
- HDPE has a high resistance against acids, bases and aqueous salt-solutions. Below 60°C it is practically unsolvable in organic solutions. The pipes and fittings shall conform the EN1519 specifications as below:

7.2.15.10. PIPE HANGERS AND SUPPORTS

- A. For Drain, Waste, and Vent Pipe:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- i. Hangers for Pipe Sizes 15 mm to 40 mm: Malleable iron, adjustable swivel, split ring.
- ii. Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
- iii. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- iv. Wall Support for Pipe Sizes to 80 mm: Cast iron hook.
- v. Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.
- vi. Vertical Support: Steel riser clamp.
- vii. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- viii. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- ix. Construction of brackets and hanger exposing to weather shall be of stainless steel grade 316.

EXECUTION

7.2.15.11. SANITARY DRAINAGE

A. Laying

- i. Lay in straight lines between changes in direction or grade with sockets pointing up hill. If other pipes are adjacent, set each pipe true to line and complete each joint before laying the next pipe. If work is not continuous cap open ends to prevent entry of foreign matter.

B. Identification

- i. Lay a detectable strip or plastic tape in the trench after pipe laying, testing and initial backfilling.
- ii. Pipe underlay
- iii. Bed piping on a continuous underlay of bedding material, at least 75 mm thick after compaction. Grade the underlay evenly to the gradient of the pipeline.
- iv. If necessary, form chases to prevent projections such as sockets and flanges from bearing on the trench bottom or underlay.

C. Pipe surrounds

- i. Place the material in the pipe surround in layers \leq 200 mm loose thickness, and compact without damaging or displacing the piping.

D. Anchor blocks

- i. If necessary to restrain lateral and axial movement of the stormwater pipes provide reinforced concrete anchor blocks at junctions and changes of grade or direction. The top face of each block shall be covered with two layers of compressible packing complying with BS 743.

E. Encasement

- i. Encase the pipeline in concrete at least 150 mm above and below the pipe, and 150 mm each side or the width of the trench, whichever is the greater. Where pipes with flexible joints are used, the concrete protection shall be interrupted over its full cross-section at each pipe joint by a shaped compressible filler of bitumen impregnated insulating board to BS 1142 or equally compressible material.

F. Thermal movement



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- i. Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints where pipe flexibility is not sufficient to absorb movement. Make sure that movement does not strain branch connections.

7.2.15.12. PIPING

A. Finishes

- i. Finish exposed piping, including fittings and supports, as follows:
 - a. In internal locations such as toilet and kitchen areas shall be chrome plate copper piping.
 - b. Externally, and steel piping and iron fittings internally shall be painted.
 - c. In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces) the contractor may leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.

B. Finish valves to match connected piping.

C. Conform to the Pipe support schedule.

D. Tolerances

- i. Conform to the Pipeline tolerances table. These tolerances are conditional on falls to outlets being maintained and no part of a pipeline being at less than the designated gradient.

	Permissible angular deviation from alignment	Permissible displacement from alignment
Horizontal	1 in 300	15 mm
Vertical	1 in 500	5 mm

E. Acoustic Insulation

- F. All waste and drainage pipes between residential units particularly when crossing noise sensitive spaces from different occupancies shall be externally wrapped with acoustic insulation. Refer to Section 22 0719 Plumbing Piping Insulation.

7.2.15.13. Pipe Hangers and Supports:

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 15 mm space between finished covering and adjacent work.
- C. Place hangers within 300 mm of each horizontal elbow.
- D. Use hangers with 40 mm minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- E. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

7.2.15.14. SERVICE CONNECTIONS



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage

7.2.15.15. COMPLETION

- A. On completion clean and flush the whole installation.

7.2.16 22 1319 - Sanitary Waste Piping Specialties

GENERAL

7.2.16.1. SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
- i. Backwater valves.
 - ii. Cleanouts.
 - iii. Floor drains.
 - iv. Trench drains.
 - v. Channel drainage systems.
 - vi. Air-admittance valves.
 - vii. Grease interceptors.
 - viii. Oil interceptors.
- B. Related Sections include the following:
- i. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.
 - ii. Division 22 Section "Plumbing Fixtures" for hair interceptors.
 - iii. Division 22 Section "Healthcare Plumbing Fixtures" for plaster sink interceptors.

7.2.16.2. DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

7.2.16.3. SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
- i. FOG disposal systems.
 - ii. Grease interceptors.
 - iii. Grease removal devices.
 - iv. Oil interceptors.

7.2.16.4. Shop Drawings:

- A. Show fabrication and installation details for frost-resistant vent terminals.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- i. Wiring Diagrams: Power, signal, and control wiring.
- ii. Field quality-control test reports.
- iii. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

7.2.16.5. QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

7.2.16.6. COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements..
- B. Coordinate size and location of roof penetrations.

PRODUCTS

7.2.16.7. BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves
 - i. Standard: ASME A112.14.1.
 - ii. Size: Same as connected piping.
 - iii. Body: Cast iron.
 - iv. Cover: Cast iron with Threaded access check valve.
 - v. End Connections: Hubless
 - vi. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
 - vii. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

7.2.16.8. CLEANOUTS

- A. Exposed Metal Cleanouts
 - i. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - ii. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - iii. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings Insert manufacturer's name; product name or designation or a comparable product by one of the following:
 - iv. Closure: Stainless-steel plug with seal.

7.2.16.9. Cast-Iron Wall Cleanouts

- A. Standard: ASME A112.36.2M. Include wall access.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- B. Size: Same as connected drainage piping.
- C. Body: Hub less, cast-iron soil pipe test tee as required to match connected piping.
- D. Wall Access: Round, [deep, chrome-plated bronze] [flat, chrome-plated brass or stainless-steel] cover plate with screw.
- E. Wall Access: nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

7.2.16.10. FLOOR DRAINS

A. Cast-Iron Floor Drains

- i. Standard: ASME A112.6.3 with backwater valve.
- ii. Pattern: drain.
- iii. Body Material: Gray iron
- iv. Seepage Flange: Required.
- v. Anchor Flange Required.
- vi. Clamping Device: Required.
- vii. Outlet: Bottom
- viii. Coating on Interior and Exposed Exterior Surfaces:.
- ix. Top or Strainer Material: Nickel bronze or Stainless steel
- x. Top of Body and Strainer Finish: to the Architectural finishes.
- xi. Top Shape: Square.

B. Stainless-Steel Floor Drains

- i. Standard: ASME A112.3.1
- ii. Outlet: Bottom
- iii. Top or Strainer Material: Stainless steel
- iv. Top Shape: Square.
- v. Seepage Flange:
- vi. Anchor Flange:
- vii. Clamping Device:
- viii. Trap-Primer Connection:

7.2.16.11. TRENCH DRAINS

A. Trench Drains

- i. Standard: ASME A112.6.3 for trench drains.
- ii. Material: Ductile or gray iron and SS 316 at the Kitchen areas.
- iii. Grate Material: Ductile iron or gray iron,Stainless steel.
- iv. Grate Finish: To the Architectural finishes.
- v. CHANNEL DRAINAGE SYSTEMS

B. Stainless-Steel Channel Drainage Systems

- i. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Standard: ASME A112.3.1, for trench drains.
 - b. Channel Sections: Interlocking-joint, stainless-steel with level invert.
 - c. Grates: Manufacturer's designation medium duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

7.2.16.12. GREASE INTERCEPTORS

- A. Grease Interceptors refer to drawing for interceptors sizes
 - i. Standard: Comply to Qatar Municipality Guidelines .

7.2.16.13. OIL INTERCEPTORS

- A. Oil Interceptors refer to drawing for sizes.
 - i. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - ii. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - iii. Type: Factory-fabricated interceptor for separating and removing light oil Insert type of oil from wastewater.
 - iv. Body Material: Cast iron
 - v. Interior Lining: Corrosion-resistant enamel
 - vi. Exterior Coating: Corrosion-resistant enamel
 - vii. Cleanout: Integra or field installed on outlet].

7.2.17 7.7.2.22 1329 - Sanitary Sewerage Pumps

GENERAL

7.2.17.1. SUMMARY

- A. Section Includes:
 - i. Packaged, submersible sewage-pump units.
 - ii. Packaged wastewater-pump units.
- B. Related Sections:
 - i. Division 22 Section "Facility Packaged Sewage Pumping Stations" for applications in site-construction sewage pumping.
 - ii. Division 22 Section "Sump Pumps" for applications in storm-drainage systems.

7.2.17.2. SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profile. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

7.2.17.3. QUALITY ASSURANCE

- A. Each pump shall be tested and approved in accordance with national and international standards (IEC34-1, HI, CSA) and ISO 9906.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.2.17.4. DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

7.2.17.5. COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PRODUCTS

7.2.17.6. Submersible, Quick-Disconnect, Grinder Sewage Pumps:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Description: Factory-assembled and -tested, grinder sewage-pump unit with twin guide-rail supports.
- C. Pump Type: Submersible, end-suction, single-stage, close-coupled, centrifugal sewage pumps. Major pump components shall be of cast iron with smooth surfaces devoid of blow holes or other casting irregularities. All exposed nuts or bolts shall be made of stainless steel. The outer surfaces of the pump shall be protected by suitable painting system including a two-component high-solid top coating. Discharge connection sealing design shall incorporate metal-to-metal contact between machined surfaces.
- D. Pump Casing: Pump casing shall be single-piece grey cast iron non-concentric design with smooth passages. The casing shall have a mating flange machined, correct positioned for a flushing device.
- E. Impeller: Cast iron; statically and dynamically balanced, with stainless-steel cutter, grinder, or slicer assembly; capable of handling solids; and keyed and secured to shaft. The grinder device should be able to cut solids into 5×15 mm particles or shred pumped solids into fine slurry as they pass through the pump inlet to enable unobstructed passage through the narrow pipes of the system.
- F. Pump and Motor Shaft: Pump and motor shaft shall be a solid continuous shaft. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be of stainless steel.
- G. Seal: Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seals, each having an independent spring system.
- H. Flushing Device: For automatic de slogging of the pump sump, improving the environmental conditions and reduce the costs for cleaning of the pump station a flush valve shall be able to be fitted to the pump volute at the indicated mating flange. The flush valve shall transform the pump into a jet stream mixer during the first 20-40 sec (adjustable) of a pumping period. The flush valve function shall be based on the ejector principle and the operation shall be automatic and induced by the pump flow and pressure. No electrical components or extra cabling will be accepted. One flush valve shall be sufficient in handling a pump sump of up to a diameter of 2.0 meter
- I. Motor: The pump motor shall be induction type with a squirrel cage rotor, housed in an air filled watertight chamber. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 180



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

degree C (355 degree F). The stator shall be heat-shrink fitted into the stator housing. The motor shall be specifically designed for submersible pump usage and designed for continuous duty pumping media of up to 50 degree C. Thermal switches shall be embedded in the stator lead coils to monitor the temperature of each phase winding. The motor shall have a voltage tolerance of plus or minus 10%. A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no load characteristics. Pump/Motor unit mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Float leakage sensor to detect water in the stator housing. When activated, the control will stop the motor and activate an alarm. The manufacturer shall provide a control and status relay to be mounted into any control panel.

J. Controls:

- i. **Switch Type:** The outer casing of float switch should be resistant to most aggressive liquids. Liquid temperature Min. 0°C (32°F) / Max. 60°C (140°F). Ingress protection IP 68 / Approvals CE, CSA, SEMKO, NEMKO, DEMKO. Cable length-13m or above.
- ii. **Level sensor:** Level transmitting unit for measuring liquid level. The output is a standard 4-20mA direct current. Medium temperature 0 – 60°C; Liquid density 0,65 – 1,5 g/cm³; Degree of protection IP68; Cable length 20m; Standards CE directive EN61058.
- iii. **Control panel:**
 - a. Manufactured and tested by the pump manufacturer itself.
 - b. **Automatic Alternator:** Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - c. The panel should contain the whole electrical equipment, including the pump controller, and all other electrical components which are necessary to control the whole station.
 - d. Panel specification depends on the local demands, the equipment of the complete station and local laws.
- iv. **Control-Interface Features:**
 - a. **Remote Alarm Contacts:** For remote alarm interface.
 - b. **Building Automation System Interface:** Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 1. On-off status of pump.
 2. Alarm status.
- v. **Guide-Rail Supports:**
 - a. **Standard:** SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
 - b. **Guide Rails:** Twin guide rail system; Vertical pipes or structural members, made of stainless steel or other corrosion-resistant metal.
 - c. **Stationary Elbow:** Fixed discharge-elbow fitting with flange.
 - d. **Lifting Cable:** Stainless steel; attached to pump and cover at manhole.

7.2.17.7. Packaged, Submersible, Grinder, Sewage-Pump Units:



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, grinder, sewage-pump unit.
- C. Control: Manufacturer's standard panel.
- D. Controls: Automatic, with float switches and alternator.
- E. Basin: Watertight and of size required for pumps, with inlet pipe connection and gastight cover with pump discharge and vent connections.

7.2.17.8. PACKAGED WASTEWATER-PUMP UNITS

- A. Description: Factory-assembled and -tested, automatic-operation, effluent-pump unit with basin.
- B. Control: Float switch.
- C. Basin: Watertight plastic with inlet pipe connection and gastight cover with vent and pump discharge connections.
- D. Capacities and Characteristics:
- E. Pump Capacity: Refer to drawings
- F. Total Dynamic Head: Refer to the drawings
- G. Discharge Pipe Size: As per the required flow
- H. Electrical Characteristics:
 - i. Volts: 400V or as per local regulations
 - ii. Phases: Three.
 - iii. Hertz: 50.

EXECUTION

7.2.17.9. EARTHWORK

- A. Excavation and filling are specified in Division 31 Section "Earth Moving."

7.2.17.10. CONNECTIONS

- A. Comply with requirements for piping specified in Division 22 Section "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

7.2.17.11. FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - i. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - i. Perform each visual and mechanical inspection.
 - ii. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- iii. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- iv. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- v. Pumps and controls will be considered defective if they do not pass tests and inspections.
- vi. Prepare test and inspection reports.

7.2.17.12. STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.

7.2.17.13. ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

7.2.18 22 1400 - Facility Storm Drainage

GENERAL

7.2.18.1. SECTION INCLUDES

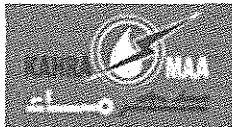
- A. Storm Drainage (Hard Surface Area)

7.2.18.2. RELATED SECTIONS

- A. Section 22 0719 Plumbing Piping Insulation
- B. Section 22 1005 Plumbing Piping
- C. Section 22 1006 Plumbing Piping Specialties
- D. Section 22 1300 Sanitary Sewerage
- E. Section 22 3000 Plumbing Equipment
- F. Section 22 4000 Plumbing Fixtures

7.2.18.3. SUBMITTALS

- A. See Section 01 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on piping, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
 - i. Submit preliminary layout of finished ceiling areas indicating only piping locations coordinated with ceiling installation.
 - ii. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories. Indicate system controls.
 - iii. Submit shop drawings to authority having jurisdiction for approval. Submit proof of approval to.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSS
(Packages A, B, C, D & E)**

- D. Project Record Documents: Record actual locations of piping's and deviations of piping from drawings. Indicate drain and test locations.
- E. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- F. Each type of filter material.

7.2.18.4. QUALITY ASSURANCE

- A. Maintain one copy of referenced design and installation standard on site.
- B. Conform to UL requirements.
- C. Design system under direct supervision of a Professional Fire Protection Engineer experienced in design of this type of work and licensed in Qatar.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience approved by manufacturer.
- F. It is the responsibility of this Contractor to make a detailed review of all drawings during the tender period, in order to fully comprehend the extent of the work to be completed. These drawings are schematic in nature and show the intent for the minimum requirements of the systems. Obstructions to pipe routing and obstructions to the location of piping are not shown on these drawings. It is this Contractor's responsibility to locate and detail these obstructions as part of the scope of work. In addition it is this Contractor's responsibility to acquaint himself of all the drawings from the other disciplines – structural, electrical, and mechanical, during the tender phase, so that all of the interferences can be appreciated at the time of tender. No extras will be given for conditions that were known at the time of tender.

7.2.18.5. DELIVERY, STORAGE, AND PROTECTION

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

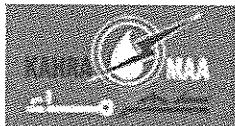
PRODUCTS

7.2.18.6. STORM PIPING

- A. Storm water piping inside the building, shall be PVC sewer pipe and fittings, SDR 35, to CSA B182.2M (or BS 4660 and BS 5481 and to EN 12056 standard).

7.2.18.7. PIPE HANGERS AND SUPPORTS

- A. For Storm Drainage Pipe:
 - i. Hangers for Pipe Sizes 15 mm to 40 mm: Malleable iron, adjustable swivel, split ring.
 - ii. Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
 - iii. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - iv. Wall Support for Pipe Sizes to 80 mm: Cast iron hook.
 - v. Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- vi. Vertical Support: Steel riser clamp.
- vii. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- viii. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- ix. Construction of brackets and hanger exposing to weather shall be of stainless steel grade 316.

EXECUTION

7.2.18.8. Stormwater drains (Hard Surface Area)

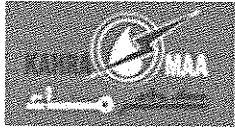
- A. Provide storm water drains to connect new rainwater points for, surface drains, to the outlet point or point of connection. Make sure that location of piping will not interfere with other services and building elements not yet installed or built. Subject to the preceding and documented layouts, follow the most direct route with the least number of changes in direction.
- B. Downpipe connections: Turn up branch pipelines with bends to meet the downpipe, finishing 50 mm (nominal) above finished ground or pavement level. Seal joints between downpipes and drains.
- C. Identification:
 - i. Lay a detectable strip or plastic tape in the trench after pipe laying, testing and initial backfilling.
- D. Thermal movement
 - i. Arrange piping to accommodate thermal expansion. Provide proprietary expansion joints where pipe flexibility is not sufficient to absorb movement. Make sure that movement does not strain branch connections.
- E. Acoustic Insulation
 - i. Rainwater/ storm water downpipes will require acoustic treatment to achieve two principles, i.e.: radiated noise from water movement in the pipes and noise flanking between adjoining occupancies. Refer to Section 22 0719 Plumbing Piping Insulation

7.2.18.9. Pipe Hangers and Supports

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 15 mm space between finished covering and adjacent work.
- C. Place hangers within 300 mm of each horizontal elbow.
- D. Use hangers with 40 mm minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- E. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- H. Provide hangers adjacent to motor driven equipment with vibration isolation.

7.2.18.10. TESTING

- A. Pre-completion tests



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- i. Air or water pressure test downpipes within buildings to the relevant British Standards
- ii. Air or water pressure test site storm water drains and main internal drains to the relevant British Standards
- iii. If leaks are found, rectify and re-test.

7.2.18.11. COMPLETION

- A. Clean and flush the whole installation

7.2.19 22 1423 - Storm Drainage Piping Specialties

GENERAL

7.2.19.1. SUMMARY

- A. Section Includes:
 - i. Roof drains.
 - ii. Cleanouts.
 - iii. Trench drains.

7.2.19.2. SUBMITTALS

- A. Product Data: For each type of product indicated.

7.2.19.3. QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PRODUCTS

7.2.19.4. METAL ROOF DRAINS

- A. Cast-Iron, Large-Sump, General-Purpose Roof Drains :
 - i. Standard: ASME A112.6.4, for general-purpose roof drains.
 - ii. Body Material: Ductile iron
 - iii. Dimension of Body: Nominal 400mm diameter.
 - iv. Combination Flashing Ring and Gravel Stop.
 - v. Flow-Control Weirs
 - vi. Outlet: Bottom
 - vii. Under deck Clamp:
- B. Cast-Iron, Medium-Sump, General-Purpose Roof Drains
 - i. Standard: ASME A112.6.4, for general-purpose roof drains.
 - ii. Body Material: Cast iron.
 - iii. Dimension of Body: 305-mm diameter.
 - iv. Combination Flashing Ring and Gravel Stop:
 - v. Outlet: Bottom
 - vi. Extension Collars:
 - vii. Under deck Clamp:

EXECUTION

7.2.19.5. INSTALLATION



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - i. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - ii. Install expansion joints, if indicated, in roof drain outlets.
 - iii. Position roof drains for easy access and maintenance.
- B. Install test tees in vertical conductors and near floor.
- C. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- D. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
- E. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- F. Install through-penetration fire stop assemblies in plastic conductors at concrete floor penetrations.
- G. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

7.2.20 22 3400 - Domestic-Water Heaters

GENERAL

7.2.20.1. SUMMARY

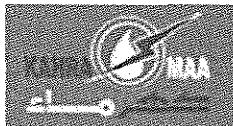
- A. Section Includes:
 - i. Domestic- Electric Water Heaters.

7.2.20.2. PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions.
- B. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified, and the unit will be fully operational after the seismic event."

7.2.20.3. SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated please refer schedules.
- B. Shop Drawings:
 - i. Wiring Diagrams: For power, signal, and control wiring.
- C. Seismic Qualification Certificates: For fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.
 - i. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- ii. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- iii. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of commercial, gas-fired, domestic-water heater, from manufacturer UL certification.
- E. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.
- I. Warranty: 10 years warranty for the shell and 1 year for the controls.

7.2.20.4. QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance:
 - i. Fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

7.2.20.5. COORDINATION

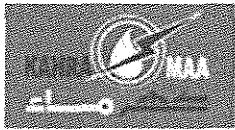
- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

7.2.20.6. WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - i. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - ii. Warranty Periods: From date of Substantial Completion.
 - a. Storage Tank: Ten years.
 - b. Controls and Other Components: One year

PRODUCTS

7.2.20.7. DOMESTIC-WATER HEATER



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- A. Description: UL 1453, commercial, storage, electric water heater; with capacity more than 151 liters.
- B. Storage Tank Construction: ASME labeled, steel with 1035 kPa working pressure rating.
- C. Heating Elements: Electric, screw in or bolt-on, immersion type according to the following:
 - i. More than 9-kW Input: Elements arranged in multiples of 3.
- D. Heating Elements: Electric, screw in or bolt-on, immersion type arranged in multiples of 3.
- E. Staging: Not exceeding 18 kW per step.
- F. Temperature Control: Adjustable immersion thermostats.
- G. Safety Control: Automatic, high temperature-limit and low-water cutoffs.
- H. Special Requirements: NSF 5 construction.
- I. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
 - i. Exception: Omit where water heater has integral vacuum relieving device.

EXECUTION

7.2.20.8. DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Division 03 Section.
- C. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
- D. Maintain manufacturer's recommended clearances.
- E. Arrange units so controls and devices that require servicing are accessible.
- F. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 450-mm centers around the full perimeter of concrete base.
- G. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
- H. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- I. Install anchor bolts to elevations required for proper attachment to supported equipment.
- J. Anchor domestic-water heaters to substrate.
- K. General: install water heaters on concrete bases the length and width of the equipment plus 300 mm by 150 mm high. Set and connect units according to manufacturer's written instructions.
- L. Install units plumb, level, and firmly anchored in locations indicated.
- M. Maintain manufacturers recommended clearances. Install so controls and devices are accessible for service.
- N. Anchor water heaters and storage tanks to substrate.
- O. Install seismic restraints as indicated.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- P. Install electric booster heaters with thermometer, pressure gage, and pressure regulator on hot-water inlet; and thermometer, pressure gage, and shock absorber on boosted-temperature, hot-water outlet.
- Q. Install temperature and pressure relief valves in top portion of storage water heater tanks and hot-water storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.
- R. Install vacuum relief valves in cold-water-inlet piping.
- S. Install vacuum relief valves in water heaters and hot-water storage tanks that have copper lining.
- T. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that
- U. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- V. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- W. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- X. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section "Domestic Water Piping Specialties."
- Y. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gauges for Plumbing Piping."
- Z. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- AA. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- BB. Fill domestic-water heaters with water.
- CC. Charge domestic-water compression tanks with air.

7.2.20.9. CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Division 22 Section "Domestic Water Piping."
- B. Drawings indicate general arrangement of piping, fittings, and specialties.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.2.20.10. IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

7.2.20.11. FIELD QUALITY CONTROL

- A. Perform tests and inspections.

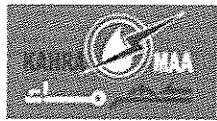
- i. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- ii. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- iii. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
- iv. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

- C. Prepare test and inspection reports.

7.2.20.12. DEMONSTRATION

- A. Engage a factory-authorized service representative to Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, water heaters.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

APPENDIX A SECTION 7.3

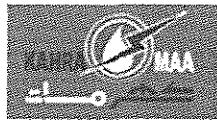
MEPF SPECIFICATION

HVAC/Mechanical



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.3 Division 23 – HVAC3
7.3.1 23 0130 - HVAC Air Duct Cleaning.....	3
7.3.2 23 0500 - Common Work Results for HVAC	7
7.3.3 23 0513 - Common Motor Requirements for HVAC Equipment.....	30
7.3.4 23 0516 - Expansion Fittings and Loops for HVAC Piping	35
7.3.5 23 0517 - Sleeves and sleeve seals for HVAC Piping.....	42
7.3.6 23 0519 - Meters and Gauges.....	46
7.3.7 23 0523 - General-Duty Valves for HVAC Piping.....	53
7.3.823 0529 - Hangers and Supports for HVAC Piping and Equipment.....	79
7.3.9 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment.....	87
7.3.10 23 0553 - Identification for HVAC Piping and Equipment	103
7.3.11 23 0593 - Testing, Adjusting and Balancing for HVAC.....	107
7.3.12 23 0713 - Ductwork Insulation.....	119
7.3.13 23 0716 - HVAC Equipment Insulation.....	129
7.3.14 23 0719 - HVAC Piping Insulation	140
7.3.15 23 0800 - Commissioning of HVAC	150
7.3.16 23 0900 - Instrumentation and Control for HVAC	161
7.3.17 23 0993 – SCADA Sequence of Operation for HVAC Controls	173
7.3.18 23 1113 - Facility Fuel Oil Piping	186
7.3.19 23 2113 - Hydronic Piping.....	192
7.3.20 23 2113.13 - Underground Hydronic Piping	205
7.3.21 23 2114 - Hydronic Specialties	209
7.3.22 23 2123 - Hydronic Pumps.....	217
7.3.23 23 2300 - Refrigerant Piping.....	224
7.3.24 23 2500 - HVAC Water Treatment.....	228
7.3.25 23 3113 - Metal Ducts	236
7.3.26 23 3300 - Air Duct Accessories	246
7.3.27 23 3319 - Duct Silencers.....	255
7.3.28 23 3413 - Axial HVAC Fans.....	263
7.3.29 23 3416 - Centrifugal HVAC Fans	269
7.3.30 23 3700 - Air Outlets and Inlets	275
7.3.31 23 6423 – Scroll Water Chillers	280
7.3.32 23 6426 - Rotary Screw Water Chillers	296
7.3.33 23 7200 - Air-to-Air Energy Recovery Equipment	309
7.3.34 23 7400 - Central Station Air Handling Units and Outside Air Handling Units.....	313
7.3.35 23 8126 - Split System Cooling	329
7.3.36 23 8219 - Fan Coil Units	341
7.3.37 23 8999 Schedule of Approved Manufacturers.....	347
7.3.38 23 9999 MPF Services–Schedule of Guarantees,Warranties & Spares for MPF Service ..	348



7. MECHANICAL, ELECTRICAL, PLUMBING AND FIRE FIGHTING

GENERAL REQUIREMENT

Unless otherwise stated in the Project Documentation, the Contractor shall comply with every requirement of the Qatar Construction Specification (QCS) that is relevant to the type of work forming any part of the Contract and shall adopt whichever permissible option or alternative is best suited to the needs of the construction work being undertaken.

7.3 Division 23 – HVAC

7.3.1 23 0130 - HVAC Air Duct Cleaning

GENERAL

1.1 SUMMARY

- This section includes:
 1. Cleaning of HVAC duct system, equipment, and related components. This cleaning process shall form part of the project during installation and pre-commissioning stage.
 2. Testing and inspection agency employed by Employer.
- Related Sections:
 1. Section 23 0800 - Commissioning of HVAC.

1.2 REFERENCES:

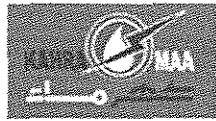
- HVCA TR 19 – Guide to good practice. Internal cleanliness of ventilation systems

1.3 General Requirements

- For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see HVCA TR 19 for more details.

1.4 SUBMITTALS

- Contractor to provide the following information as part of a complete and comprehensive technical submittal
 1. Submit qualifications of proposed cleaning Contractor for approval.
 2. Submit qualifications of proposed testing and inspection agency for approval.
 3. Project Cleanliness Evaluation and Cleaning Plan
 4. Manufacturer's data sheets on each product to be used.
 5. Material Safety Data Sheets (MSDS): For all chemical products proposed to be used in the cleaning process; submit directly to Employer.
 6. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section certified by one of the following:
 8. Nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.
 9. Or subsequently approved by the Engineer
 10. Cleaning contractor to demonstrate a minimum of three years documented experience.
 11. Cleaning contractor to provide a project supervisor certified by same organization that certified the cleaning Contractor.
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats

1.5 Quality Assurance

- Information Available to Contractor: Upon request, Owner will provide the following:
One copy of original construction drawings of HVAC system.
- Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
 1. Certified by one of the following:
NADCA, National Air Duct Cleaners Association: www.nadca.com
Nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.
 2. Having minimum of three years documented experience.
 3. Employing for this project a supervisor certified by same organization that certified the cleaning contractor.

PRODUCTS

1.6 TOOLS AND EQUIPMENT

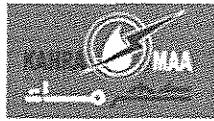
- Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

1.7 REPLACEMENT PRODUCTS

- Fibrous Glass Insulation: Provide material complying with UL 181 equivalent to existing material in quality and thickness.

1.8 SURFACE TREATMENTS

- Anti-Microbial Materials: EPA registered specifically for use on non-porous HVAC system surfaces and applied per manufacturer's instructions.
- Surface Coating for Fibrous Glass Materials: Water-based, zero VOC; flame spread index less than 25, smoke developed index less than 450, when tested in accordance with ASTM E 84.



EXECUTION

1.9 PROJECT CONDITIONS

- Comply with applicable local requirements.
- Perform cleaning, inspection, and remediation in accordance with the recommendations of HVCA TR19 Cleanliness in Ductwork Systems to PDI level 2 and as specified
- Obtain Employer's approval of proposed temporary locations for large equipment.
- Designate a decontamination area and obtain Employer's approval.
- When portions of the facility are to remain occupied or in operation during cleaning activities, provide adequate controls or containment to prevent access to spaces being cleaned by unauthorized persons and provide detailed instructions to Employer as to these controls or containment.
- If unforeseen mold or other biological contamination is encountered, notify Engineer immediately, identifying areas affected and extent and type of contamination.

1.10 EXAMINATION

- Coordinate cleaning plan with project indoor air quality control plan.
- Inspect the system as required to determine appropriate methods, tools, equipment, and protection.
- Start of cleaning work constitutes acceptance of existing conditions.
- When concealed spaces are later made accessible, examine and document interior conditions prior to beginning cleaning.
- Document all instances of mold growth, rodent droppings, other biological hazards, and damaged system components.

1.11 PREPARATION

- When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.
- Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Employer.
 2. Make new openings in HVAC components in accordance with DW 144 & HVAC TR 19; do not compromise the structural integrity of the system.
 3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion to the satisfaction of the Engineer; replace damaged tile.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

1.12 CLEANING

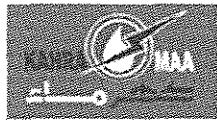
- Use any cleaning method recommended by NADCA ACR, HVCA TR19 Cleanliness in Ductwork Systems unless otherwise specified; do not use methods prohibited by NADCA ACR, HVCA TR19 Cleanliness in Ductwork Systems which will damage HVAC components or other work, or which will significantly alter the integrity of the system.
- Obtain Employer's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- Ducts: Mechanically clean all portions of ducts.
- Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- Coils: Measure static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.
- Fibrous Glass Material: Use HEPA vacuuming equipment, under constant negative pressure, do not permit to get wet, and do not damage surfaces; replace material damaged by cleaning operations.
- Existing Damaged Fibrous Glass Material: Report to Architect all evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture that cannot be remedied by cleaning or resurfacing with an acceptable insulation repair coating.
 - Remove irremediable material and clean underlying surfaces.
- Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

1.13 REPAIR

- Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- Reseal new openings in accordance with DW 144
- Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Employer in project report documents.

1.14 FIELD QUALITY CONTROL

- Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, HVCA TR19 Cleanliness in Ductwork Systems, re-clean and re-inspect.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- Notify Architect when cleaned components are ready for inspection.
- Notify Employer's testing and inspection agency when cleaned components are ready for inspection.
- At a time agreed with the Engineer, but prior to practical completion, the installer shall demonstrate the internal cleanliness of all ductwork systems are within the recommendations contained within HVCA TR/19 by the deposit thickness test (DTT). Sufficient samples shall be taken to demonstrate the overall cleanliness of all ventilation systems.
- Any systems or parts of systems found to be outside the specified limits shall be cleaned by the installer and retested until the results are satisfactory at no cost to the contract.
- A certificate of cleanliness shall be submitted to the Engineer detailing the DTT tests as part of a ductwork completion report and included in the record documentation. The report shall include details of any systems that were cleaned, the cleaning method used and COSHH data on any chemicals used for cleaning or biocidal treatment. Recommendations for future testing and cleaning shall also be provided.
- When directed, re-clean components until they pass.
- Contractor shall bear the costs of retesting due to inadequate cleaning.
- Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

1.15 ANTI-MICROBIAL TREATMENT

- When directed, apply anti-microbial treatment to internal surfaces.
- Apply anti-microbial agent after removal of surface deposits and debris.
- Apply anti-microbial treatments and coatings in strict accordance with the manufacturer's written recommendations and EPA registration listing.
- Spray coatings directly onto interior ductwork surfaces; do not "fog" into air stream.

1.16 ADJUSTING

- After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers

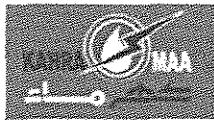
1.17 WASTE MANAGEMENT

- Double-bag all waste and debris in 6 mm polyethylene bags.
- Dispose of debris off-site in accordance with applicable federal, state and local requirements.

7.3.2 23 0500 - Common Work Results for HVAC

General

1.1 Summary

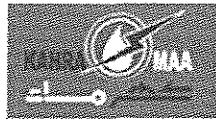


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- This Section includes materials and installation methods performed by all mechanical services trades.
- Related Sections
 1. 23 0513 - Common Motor Requirements for HVAC Equipment
 2. 23 0529 - Hangers and Supports for HVAC Piping and Equipment
 3. 23 0553 - Identification for HVAC Piping and Equipment
 4. 23 2113 - Hydronic Piping
 5. 23 3113 - Metal Ducts

1.2 References

- Publications listed below (including amendments, addenda, revisions, supplement and errata), and other relevant international standards indicated on other sections under Divisions 21, 22 and 23 shall form a part of this specification to the extent referenced:
 1. BS EN 1011-3:2000 – Welding. Recommendations for welding of metallic materials. Arc welding of stainless steels.
 2. BS EN 1011-4:2000 - Welding. Recommendations for welding of metallic materials. Arc welding of aluminium and aluminium alloys
 3. BS EN ISO 1461:2009 – Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
 4. BS 2640:1982 – Specification for Class II oxy-acetylene welding of carbon steel pipework for carrying fluids.
 5. BS 2971:1991 – Specification for class II arc welding of carbon steel pipework for carrying fluids.
 6. BS EN ISO 6158:2011 – Metallic and other inorganic coatings. Electrodeposited coatings of chromium for engineering purposes.
 7. BS 6496:1984 – Specification for powder organic coatings for application and stoving to aluminium alloy extrusions, sheet and preformed sections for external architectural purposes, and for the finish on aluminium alloy extrusions, sheet and preformed sections coated with powder organic coatings.
 8. BS 6497:1984 – Specification for powder organic coatings for application and stoving to hot-dip galvanized hot-rolled steel sections and preformed steel sheet for windows and associated external architectural purposes, and for the finish on galvanized steel sections and preformed sheet coated with powder organic coatings.
 9. BS EN ISO 7599:2010 – Anodizing of aluminium and its alloys. General specifications for anodic oxidation coatings on aluminium.
 10. BS ISO 10074:2010 – Anodizing of aluminium and its alloys. Specification for hard anodic oxidation coatings on aluminium and its alloys.
 11. BS EN 14324:2004 – Brazing. Guidance on the application of brazed joints.
 12. BS EN ISO 28722:2011 – Vitreous and porcelain enamels. Characteristics of enamel coatings applied to steel panels intended for architecture
 13. BS EN 60445:2007 – Basic and safety principles for man-machine interface, marking and identification. Identification of equipment terminals and conductor terminations.
 14. IEC 60529:2004 – Degrees of Protection Provided by Enclosures (IP Code)
 15. The EHS Fire Life Safety Guidance and associated NFPA Codes
 16. HVCA Code of Practice for Welding of Carbon Steel Pipework TR/5



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

General Requirements

1.3 Submittals

- Contractor to provide the following information as part of a complete and comprehensive technical submittal.
 1. Full product data for all relevant materials
 2. Pointwise compliance statement against the contract specification
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats.

Products

1.4 Manufacturers

- Materials and products proposed by the Contractor shall be compliant with the Specification. All material submittals shall be approved by the Engineer prior to procurement.
- Refer the Approved Suppliers List in the "General Requirements and Scope of Works".

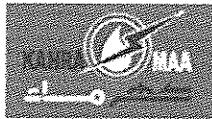
1.5 Equipment Capacities

- All equipment capacities, etc. shall be listed for job site operating conditions.
- All equipment sensitive to altitudes or ambient temperatures, to be de-rated and method of de-rating shall be as recommended by the manufacturer and, or shown on Shop Drawings or other submittal documents subject to Consultant's approval.
- Where operating conditions shown differ from the laboratory test conditions, the equipment to be de-rated and the method of de-rating shall be shown in any of the following documents subject to Consultant's approval, but not limited to:
 1. Shop Drawings
 2. Material submittal
 3. Method Statement
 4. Request for Information

1.6 Materials

- Where materials or equipment are not described in detail they shall be of the best quality available and shall comply with the appropriate BS or equivalent standard. The Contractor shall, if required, submit drawings or samples of such materials or equipment to the Engineer for his approval before use on the Contract works.
- Grades of metals, section dimensions and properties to be to the appropriate British Standard. When not specified, select grades and sections appropriate for the purpose.
- Prefinished metal may be used if methods of fabrication do not damage or alter appearance of finish and finish is adequately protected.
- Fastenings to be to the appropriate British Standard and, unless specified otherwise, to be of the same metal as the component, with matching coating or finish.

1.7 Combustibility and Spread of Flames



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- The fire rating of materials used shall comply with the requirements of the Building Regulations and the recommendations given in BS 5588-9 or relevant local standard in compliance with the Authority Having Jurisdiction.

1.8 Fire Stopping Materials

- Fire stopping materials/systems shall be flexible to allow for normal movement of building structure and penetrating item(s) without affecting the adhesion or integrity of the system.
- Fire stopping materials shall not require hazardous waste disposal of used containers/packages.
- Provide fire stopping materials free of solvents which will not experience shrinkage while curing.

1.9 Acoustic Enclosures

- Where required, acoustic enclosures shall be provided to isolate the noise-producing equipment from the space in which it is installed to meet the required noise reduction or the maximum permitted ambient NR level.
- Removable panels shall give access to items requiring cleaning, adjustment, replacement and other maintenance. Where enclosures are designed for personnel access, internal lighting and viewing panels shall be provided. Access doors shall be openable from both sides.
- Enclosures shall be isolated from the noise-producing equipment and from the building structure.
- Provisions shall be made to dissipate heat emitted from the noise-producing equipment where necessary.

1.10 Acoustic Lagging

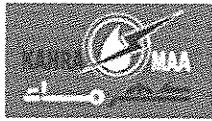
- Where acoustic lagging for fitment to ductwork and/or pipework is called for on the drawings or in other parts of the specification, this shall consist of a resilient layer wrapped around the duct/pipe, together with an outer high mass skin.
 1. Resilient Layer, 50mm (minimum) thickness of mineral rock wool having a density of approximately 100 kg/m³ or 50mm (minimum) thick Lamella mat at a density of 45 kg/m³.
 2. Outer mass barrier shall be a sound reducing barrier mat material of minimum superficial weight 5 kg/m² unless otherwise specified.
- All materials including proprietary acoustic lagging products incorporating laminations shall be non combustible and to the approval of the fire officer. This applies to adhesives used in proprietary laminations.

1.11 Screws

The screws used for fixing accessory cover plates shall be of the dome slotted raised head countersunk type, finished to match the respective plates where metallic plates are used.

1.12 Lubricants

Lubricants used on a particular item of equipment shall be mutually compatible. Lubrication points shall be self-sealing or have captive dust caps. Oil reservoirs shall be located in positions at the same static pressure as the bearing served.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

Execution

1.13 Delivery, Storage and Handling

- Handling and Storages:
 1. Ship and store all products and materials in a manner that will protect them from damage, weather and entry of debris. Provide conditioned storage either on site or off to store all equipment that is sensitive to extreme temperature.
 2. If items are damaged, do not install, but take immediate steps to obtain replacement at no cost to the Client.
 3. Store materials suitably sheltered from the elements, but readily accessible for inspection by the Consultant until installed.
 4. Store all items subject to moisture damage in dry locations preferably equipped with suitable environmental conditioning system.
- Delivery:
 1. Deliver materials in manufacturer's unopened container fully identified with manufacturer's name, trade name, type, class, grade, size and colour.
 2. The contractor is responsible for associated costs with delivery and storage.

1.14 Workmanship

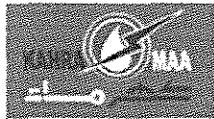
- The Contractor shall employ suitably qualified tradesman to install the mechanical services to the highest standard. The minimum standard for each service is laid down within this document.
- All workmanship shall be strictly in accordance with BS8000 Parts 13, 14 & 15.

1.15 Warranty

- Guarantee all material and workmanship for a period of two (2) years from date of final acceptance by the Client, except that where guarantees or warranties for longer terms are specified herein, such longer term to apply.
- Within 24 hours after notification, correct any defects that occur during the warranty period at no additional cost to the Client, all to the satisfaction of the Client and Consultant.
- Obtain similar warranties and guarantees from subcontractors, manufacturers, suppliers and sub-trade specialists.

1.16 Spares

- Contractor shall provide a list of spares required for each installed item of equipment as recommended by the manufacturer(s) and/or its authorized installer/representative of the corresponding equipment.
- Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- Contractor shall provide all required spares as specified in the "General Requirements and Scope of Works".



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1.17 Examination

- Examine areas and conditions under which work is to be performed and notify the Engineer in writing of conditions detrimental to proper and timely completion of the work.
- Verify that openings are properly sized and in suitable condition to receive the work of this section.

1.18 Access for Maintenance

The Contractor shall ensure that all plant and equipment is easily accessible by maintenance staff and adequate space allowed for maintenance and replacement of plant. Full standing headroom is required over the maximum possible area with easy safe access free from obstruction given to all equipment and instruments required for normal operation. All escape routes shall have a clear floor space with full standing headroom.

1.19 Access Doors and Panels

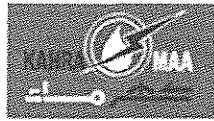
- Wherever any item of mechanical equipment requiring accessibility, maintenance or adjustments is concealed, ensure adequate access, or provide an access door or panel and arrange for its installation by the main Contractor.
- Doors shall be sized to allow proper and easy access, and located to suit the concealed device. In removable acoustic panel ceilings, no access doors are required. Use authority labeled fire-rated access doors in all fire rated walls and ceilings which act as fire barriers and match the door type with the ceiling type and applied finish.
- Submit for the Engineer's review, floor plans and shop drawings showing the size, type and exact location of all access doors and panels.
- All access doors and panels shall be shown on the record drawings. Notations, adjacent to each access door shown on the drawings, shall indicate frequency of maintenance required for item or items above or behind the doors.

1.20 Provision for Handling Major Plant

- Suitable provisions by means of eyebolts or other methods approved by the Engineer shall be made to facilitate handling all plant covered by this Specification.
- Each screwed eyebolt shall be provided with a collar firmly bedded down on a faced seating.

1.21 Fixing to Building Fabric

- Building services, components and equipment shall be fixed to the building fabric using screws or bolts, as specified, of the maximum size permitted by the fixing holes provided.
- Screw-fixing to solid brickwork, blockwork or concrete shall be made using substantial proprietary metal or plastic plugs, ensuring that both plug and screw are well embedded into the masonry behind any applied finish. Screw-fixings to sheet metal shall be made using sheet steel metal screws.
- Through-the-wall bolt fixings shall consist of a bolt sufficiently long to pass right through the wall, a spreader plate under the head and a nut and washer.
- Bolt fixings to solid brickwork, blockwork or concrete shall be made using self-drilling anchors. Bolt fixings to hollow background shall be made using toggle bolts or expanding rubber rawl-nuts.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014**

**Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- Bolt fixings to structural steelwork shall be by means of clamps and adapters of the Lindaptor pattern, installed in the manner recommended by their manufacturer. Holes must not be cut in structural steelwork nor must anything be welded on.
- Unless otherwise specified, the foundations and trenches with floor plates for pipes etc will be provided by the Main Contractor during the construction of the foundations and building.
- All adjustments of foundation levels and all bedding and grouting on foundations and cementing into floors or walls will be carried out by the Main Contractor together with all leveling and adjusting of plant and equipment on foundations preparatory to grouting up.

1.22 Dissimilar Metals

- The Contractor shall take every precaution, including the provision of dielectric couplings, to ensure that no chemical or electrolytic action takes place where dissimilar metals and/or materials are used together. This is of particular importance where aluminium and aluminium alloys are one of the surfaces.
- The Contractor shall keep the points of contact of dissimilar metals to a minimum.

1.23 Hangers, Inserts Sleeves, Supports & Foundation Bolts

- Provide hangers, inserts, sleeves and supports required to accommodate the equipment and materials of this Division.
- Except for plywood backboards, do not use wood to fasten outlet boxes or electrical equipment, except where wood forms a part of the building structure at the point of installation.
- Metal supports, screws, bolts and hardware shall be galvanized.
- Apply cold galvanizing compound on all newly cut ferrous metal surface immediately after cutting.
- Provide separate supports as required for electrical apparatus erected on or in any wall or partition. All such supporting work shall be approved by the Engineer prior to installation.
- The Contractor shall supply to approved dimensions all necessary foundation bolts, nuts, plates and frames for the whole equipment covered by this Specification.
- The Contractor shall be responsible for aligning and leveling up each item of equipment supplied under this Contract using steel shims as necessary, and for placing the holding down bolts in the correct position.

1.24 Installation of Pipework

- General:
 1. The Contractor shall provide, install and co-ordinate all hangers, inserts, sleeves, supports, brackets and foundation bolts.
 2. All supporting work and fixing methods shall be appropriate to the building structure and shall be reviewed by the Engineer.
 3. Provide fire stop caulking material between the sleeve and the pipe for the full depth of the sleeve.
- Sleeves:

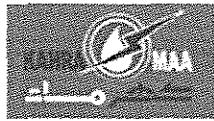


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. Install pipe duct sleeves with an inside dimension large enough to include the specified thickness of insulation.
- Pipe-work Supports:
 1. Supports shall be either of the following pipe hangers or rods, clips, rollers and chairs, etc., as required for the particular duty and for stable and efficient support.
 2. Supports shall allow for thermal expansion of the pipework.
- Supports for Equipment:
 1. Every item of plant and equipment shall be separately supported to avoid the weight being imposed on adjacent pipework and ductwork, and to allow removal without disturbance to adjacent equipment and ductwork.
- Fixing:
 1. All pipework shall be fixed at least 150mm from any electrical conduit or lighting and power cables.
 2. Pipes shall be spaced in ducts, ceiling spaces and voids, trenches and below floors in a manner that permits subsequent access to any pipe for maintenance or removal without disturbance to the remaining pipework and for the application of insulation.
- Painting:
 1. All steel pipework and supports, whether welded or screwed, shall be painted with one coat of 'Red Oxide' paint after the completion of all tests.
- Cutting:
 1. Piping shall be cut clean and square with the axis of the pipe, except where a bevelled edge is required for welding, using a saw, pipe cutting tool or machine.
 2. Before installation the ends of the pipe shall be correctly prepared by filing or grinding and any internal burrs shall be removed by filing or reaming to a distinct countersink.
 3. The Engineer may call upon the Contractor to disconnect any pipes for inspection; should inspection reveal any neglect of reaming the Contractor will be required to remove, re-fix and retest at his own expense as much of the pipework as may be deemed necessary by the Engineer.

1.25 Installation of Fire Stopping

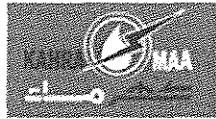
- Penetrations through fire resisting walls and / or floors for services (cable trays, conduits, pipes tubes, etc) should be sealed with suitable fire stop system in accordance with ASTM E-814 or ANSI/UL 1479 so that the fire resistance of the element is not impaired. Further information is provided in Section 8.3.5 of NFPA 101.



- Fire compartments penetrated by pipework or ductwork shall be fire-stopped using a proprietary system, or other method approved by the Approving Authority, that maintains the fire and smoke rating of the compartment. The type of fire stopping device/material(s) shall meet with the local Fire Authority approval.
- Fire stopping is also required between façade and the floor assemblies. The provisions in 8.9.3 of NFPA 5000 are intended to restrict the interior vertical passage of flame and hot gasses from one floor to another at the location where the floor intersects the interior of an exterior curtain wall assembly.
- Every floor assembly (that is required to be a fire barrier) shall extend to, and be tight against, the internal face of the exterior curtain wall. Additionally voids created at the intersection of the exterior curtain wall assemblies and the floor slab shall be sealed with approved materials.
- The system or method used shall also maintain the thermal insulation and vapor barrier performance of the service and the acoustic performance of the compartment. Appropriate allowances shall be made for movement of mechanical services.
- Certified test data shall be provided for all methods and materials used.
- The system or method used shall also maintain the thermal insulation and vapor barrier performance of the service and the acoustic performance of the compartment.
- Appropriate allowances shall be made for movement of mechanical and plumbing services.
- Clean substrate of dirt, dust, grease, oil, loose materials, rust or other matter that may affect the proper fitting or adhesion of the fire stopping materials.
- Seal all holes or voids made by penetrations to ensure an air, smoke and water-tight seal.
- Identify all locations requiring fire stopping and coordinate the work of this section with work performed under other sections of the Project to provide a uniform system of fire stopping.
- Schedule installation of fire stopping after completion of penetrating item installation but prior to covering or concealing of openings.
- Do not proceed with installation of fire stop materials when temperatures exceed the manufacturer's recommended limitations for installation.

1.26 Installation of Acoustic Lagging

- Wrap the duct/pipe with the resilient layer and seal using proprietary duct tape. Apply the barrier mat so that it overlaps the joint by at least 50mm.
- For proprietary acoustic lagging laminated products, it is acceptable to cut back the resilient layer by 50mm to facilitate an overlap with the adjacent piece.
- Using metal pins and large fixing washers:
 1. Pins shall have a perforated metal base plate, and be non self adhesive but fixed to the duct surface with a suitable glue or other fixant, spaced at a maximum of 300mm centres.
 2. The mineral wool and outer mass layer will be laid over the pins, which will then protrude to be cut back to a minimum length and sealed with washers.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- The outer mass skin on large ducts having a minimum diameter/rectangular cross section dimension of 750mm, the acoustic lagging combination shall be over strapped to provide additional support using 25mm wide metal straps lagged duct corners/edges which are vulnerable to damage should be protected by 50x50 MET L angles fixed/located in position by metal straps and shall not at any point come into direct contact with the ductwork/pipework, especially at flanged joints and hangers.
- The Contractor shall ensure that the acoustic lagging does not come into contact with the building structure. In addition, the whole acoustic lagging system shall be tightly fitted, with the resilient layer under slight compression at all points to eliminate voids and prevent flexing of the outer mass skin.
- As an alternative, any of several proprietary acoustic duct lagging products may be used. These must first be passed to the Engineer for approval. Proprietary acoustic duct lagging products shall have equivalent acoustic performance to that stated in the specification for site assembled combinations.

1.27 Adhesive Bonding

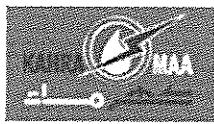
- Prepare surfaces of metals to receive adhesives by degreasing and abrading mechanically or chemically.
- Use adhesives to manufacturer's recommendations.
- Form bond under pressure.

1.28 Fabrication of Pipework

- All necessary pipe headers shall be shop fabricated and no site cutting, welding or fabrication will be allowed. Also all fabricated pipes and fittings shall be thoroughly cleaned of rust, scale and other foreign matter and painted with red-oxide paint. Flange faces shall be treated with anti-rust compound and protected by wooden discs during transit and storage on site.
- Site welding: where allowed on any pipe-work, must be in accordance with the appropriate British Standards Specification as described in other clauses of this Specification.
- Thermal Cutting: After cutting, grind off material which is liable to corrode.

1.29 Soldered Joints

- General requirements:
 1. All capillary fittings on copper pipelines shall be to BS 864, part 2 being of either the integral solder ring or of the end feed type. The procedure for making capillary joints shall be as recommended by the respective fitting manufacturer, and as follows: -
 2. The use of lead/tin solder in the integral ring of capillary fittings and in the feeding of end feed fittings is prohibited on all domestic hot and cold water services.
 3. Only lead-free solders shall be permitted.
- Cleaning:
 1. In order to promote solder flow and bonding, surfaces to be jointed shall be cleaned free from dirt, oxide films, residual grease and oil.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

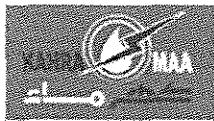
2. The sockets of all fittings (including the lip) and the tube end for a distance up to 10mm beyond the end of the fitting shall be thoroughly cleaned using fine (00) sand cloth, steel-wool or non-woven nylon pads impregnated with silicon carbide or aluminium oxide abrasives.
3. Special wire brushes shall be used for the cleaning of sockets of 28mm and smaller size. Where machines using wire brushes are used for cleaning tube ends and sockets etc., these shall be approved by the Engineer before being used.
4. Care shall be exercised to prevent particles of steel wool, or the chosen cleaning material, entering the fittings or pipe. Any particles entering the fitting or pipe shall be removed.
5. All surfaces, once cleaned, shall not be touched with bare hands or oily gloves since the deposition of skin oils, lubricating oils or grease impairs solder flow and wetting. Under no circumstances shall emery cloth be used for cleaning purposes.

• **Fluxing:**

1. All flux shall be that recommended by the fitting manufacturer and where possible shall be cold water soluble. Flux shall be thoroughly stirred as each tin is opened and at frequent intervals during use.
2. Flux shall be applied sparingly yet adequately by means of a small brush or a clean cloth. All cloths shall be changed frequently and not be allowed to pick up dirt. Brushes shall be cleaned or changed frequently and not be allowed to pick up dirt. Flux shall not be applied using fingers.
3. The cleaned surfaces shall be fluxed as quickly as possible, and if fluxing is not carried out within 1.5 hours of cleaning, then all joint surfaces shall be re-cleaned. Once fluxed tube and fittings shall be immediately assembled.
4. All prepared joints shall be completed within a single working day. Fluxed and assembled joints remaining unsoldered at the end of the day shall be disassembled and wiped free of flux. They shall be re-cleaned, re-fluxed and re-assembled when work resumes.
5. Particular care shall be exercised to avoid leaving excessive flux inside or outside a completed joint. Only enough flux shall be applied to the cleaned surface to form a thin film over the areas to be joined.
6. Fittings and tube ends shall not be dipped into the flux.

• **Assembling:**

1. The joint shall be assembled by inserting the tube into the fitting socket ensuring that the tube is firmly up to the tube stop, then given a twist to help spread the flux over the two surfaces. Any excess flux shall be removed with a clean cloth before heat is applied.



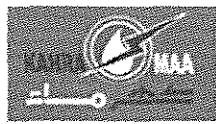
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

• Heating:

1. Heat shall be applied by means of an approved type torch. Oxy-acetylene torches shall not be used for heating capillary fittings. The flame shall be played on the fitting and kept moving to heat the whole joint area and to prevent local overheating.
2. Overheated joints and joints showing charred flux shall be rejected. In the case of integral solder ring fittings, heating shall be continued until a complete ring of solder appears round the mouth of the socket.
3. Heating shall then be stopped and the joint allowed to cool without disturbance. Additional solder shall not be applied and any joint found to have additional solder applied will be rejected. In the case of end feed fittings the joint shall be heated as stated above.
4. When the joint is hot enough, 3mm solder wire or rod shall be applied to the mouth of the socket and should melt on contact with the tube and be drawn into the fitting by capillary action. Pre-tinning shall not be allowed and the length of solder wire or rod used shall not exceed the diameter of the tube being jointed.

• Testing:

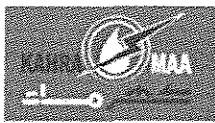
1. Before any capillary joints are installed, a tee joint typical of the size to be employed at the site shall be made at the bench. This joint shall be prepared and sectioned in the presence of the Engineer. If accepted by the Engineer as a satisfactory joint, and being reasonably free from flux and foreign matter, the joint shall be labeled and retained by the Engineer for possible future reference.
2. Before any section of pipework employing capillary joints is pressure tested, the Engineer shall select a minimum of two fittings or 1.00% of the total number of fittings from each section and each service. These fittings shall be cut out and sectioned in the presence of the Engineer and at the expense of the Contractor.
3. All joints cut out for examination shall be replaced at the Contractor's expense. The cut-out and sectioned fittings shall be examined by the Engineer for the excessive use of both flux and solder and to ensure that the tube has been cut square with the axis of the pipe and that all burrs have been removed.
4. In the event of any joint not complying with all the relevant clauses of this Specification or the bench produced reference joint, then further joints shall be cut out for examination up to a maximum of 10%. If, in the opinion of the Engineer, these additional joints show faults, then all remaining joints shall be replaced at the expense of the Contractor.
5. In the event of excessive flux usage being the only fault, then at the sole discretion of the Engineer, the Contractor may be asked to arrange to have the installations cleaned of flux by an approved



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

method and by an approved Specialist Contractor and at the Contractor's expense. In this latter case, joints shall again be removed, as previously specified, after the cleaning operation to prove the effectiveness of the cleaning process.

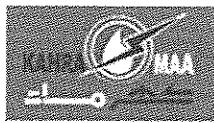
- Applying coatings:
 1. Apply after fabrication is complete and all fixing holes have been drilled unless otherwise specified.
 2. Before applying coating remove all paint, grease, flux, rust, burrs and sharp arises. Make good all defects which would show after application of coating and finish surfaces smooth.
- **1.30 Welding of Carbon Steel**
 - Comply with the HVCA Code of Practice for Welding of Carbon Steel Pipework TR/5
 - Steel pipelines and pipe assemblies:
 1. Oxy-acetylene Welding: comply with BS 2640
 2. Arc-welding: comply with BS 2971
 - Certifications:
 1. The Contractor shall ensure that every welder employed on the project holds the required Certificates as stipulated throughout this Specification.
 2. The Contractor shall be responsible for providing the Engineer, or his representative, with copies of the welder approval certificates and supporting information. Any necessary testing/retesting shall be at the Mechanical Contractor's expense.
 3. The name of welders, together with the Certificate of Competency shall be submitted to the Engineer for his approval before any such welder executes any welding.
 - General:
 1. Each welder on the project shall be provided with a steel marker die by his Employer, and after he has completed a welded joint, he shall then mark same with his identification symbol. The symbol for each welder shall be agreed with the Engineer prior to commencement of work on site.
 2. The radiographic, ultrasonic, macro etching and bend testing of welds shall be carried out by an HVCA Approved Inspector selected by the Engineer.
 3. The Engineer will place a strong emphasis on the standard of welding and the associated quality control procedures in order that the welding meets the required standards in all cases.
 4. An approved independent specialist acting as sole arbiter shall carry out all visual and non-destructive examination. Personnel engaged in radiographic, magnetic particle or ultrasonic examination and interpretation



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

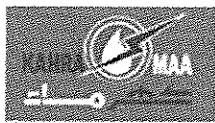
shall hold appropriate NDE certification which shall be submitted to the CA prior to commencement of the Works.

5. Prior to completion of the Works submit to the Engineer a statement signed by the independent specialist responsible welding examination and non-destructive testing stating compliance with the requirements of the specification.
6. All examination and testing of welds together with the resulting remedial work shall be at no additional cost to the contract.
7. Care shall be taken during welding operations that the welding metal or flux does not project into the bore of the pipe. Welds shall be of good clean metal, free from slag inclusions and porosity, of even thickness and contour, well fused with the parent metal, annealed and finished smooth.
8. Where tack welds are used to secure alignment, there shall be four equally spaced and to the same standard as the final weld, this is, they shall have full penetration at the throat, vee or fillet and be of a length equal to twice the pipe wall thickness. Manufactured welding fittings shall be used as far as possible and shall be black mild steel butt welded type complying with the relevant standards.
9. Immediately on completion every weld shall be painted with zinc chromate paint.
10. All welds shall be visually examined on the outside surface and where practical, in the bore with the aid of optical instruments if necessary by an approved independent specialist.
11. Inspection reports detailing welding inspection activities formed during that period shall be submitted to the Engineer at agreed intervals.
12. Non-destructive examination shall be used progressively during the installation of the Works as part of quality control.
13. Where the use of magnetic particle examination is agreed, it shall be undertaken in accordance with BS EN ISO 9934-1.
14. Should any of the second batch of welds fail then the Engineer shall have the right to instruct the cutting out and replacement of all welds and the replacement of all welders previously employed on site at no additional cost. The installer shall take all necessary measures, subject to agreement with the Engineer, in order that subsequent welding shall be in compliance with the required standards.
15. If a considerable proportion of welded joints by a particular operator are found to be unacceptable, all welds by this welder shall be completely removed and replaced at no additional cost.
16. Thoroughly clean surfaces to be joined. Ensure accurate fit using clamps and jigs where practical. Use tack welds only for temporary attachment.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

17. Make joints with parent and filter metal fully bonded throughout with no inclusions, holes porosity or cracks.
18. All welding shall be executed by competent qualified/certified welding operators fully experienced in the type and size of welding being carried out. Any welding found to be carried out by persons not holding a valid Welder Approval Certificate will be rejected.
19. Any weld not permanently marked with a welder's individual identification code shall be examined by an independent specialist to include both visual and non-destructive testing. Should testing fail the weld shall be cut out and replaced at no cost to the contract.
20. All welds shall be permanently marked with the welder's individual identification code placed adjacent to each completed weld. A log of all welders, their qualifications and a record of the work carried out by them shall be kept on site at all times and shall be available for inspection.
21. On completion of the first ten production butt welds made by each welder, five of these welds shall be selected by the Engineer and examined by a HVCA Approved Inspector to the following standards: -
22. For radiographic tests, Class II welds to either BS 2640, BS 2971, BS EN 1435 shall all be judged as to their acceptability based on the defects levels laid down in BS 2640 and BS 2910 "Methods for the radiographic examination of fusion welded circumferential butt joints in steel pipes".
23. Radiographic examination shall be undertaken in accordance with BS EN 1435. The regulations regarding ionizing radiation hazards to site personnel and the public must be adhered to. The radiographic testing shall be evenly distributed over the whole of the works and shall be evenly split between all welders employed on the works on a pro rata basis.
24. Where radiographic testing is considered to be unsuitable (i.e. close proximity of occupied wards, etc.), then with the agreement of the Engineer, or his representative, ultrasonic testing to BS 3923 Part 1, "Methods of Ultrasonic examination of welds" shall be used, the selection of welds to be required for radiographic testings.
25. Where radiographic testing is prohibited on site, ultrasonic testing shall be undertaken in lieu. Where the use of ultrasonic examination is agreed it shall be undertaken in accordance with BS EN 1714. A method statement, clearly defining the preparation and methodology of the tests shall be submitted to the Engineer for approval, prior to the testing.
26. The decision of the HVCA Approved Inspector on the acceptability of any weld shall be binding on the Contractor. Should any of the five welds tested be rejected or required to be repaired then the Contractor shall provide at his own expense, radiographic/ ultrasonic evidence of the acceptability of all that particular welder's welds. During the remainder of the project, welds for full circumference radiographic/ultrasonic examination may be selected by the



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

27. Should any production weld be rejected or need repair then a further two welds performed by the same welder shall be selected by the Engineer and subject to radiographic/ultrasonic interpretation and in the event of a rejection or repair being required the Engineer again reserves the right to reject all previous welds or ask the Contractor to provide at his own expense, radiographic/ultrasonic evidence of the acceptability of all that particular welder's welds.
28. Where Oxy-Acetylene or arc welding with CO₂ masking is employed, a British Standard bend test shall be carried out on any weld. The number of welds to be tested, before the Engineer reserves the right to reject a particular welder's welds, shall be as for examinations outlined above.
29. All branch welds shall be SET-ON branches and the distance between nearest points of two adjacent branch welds shall be not less than twice the diameter of the larger pipe. The hole in the main shall be equal to the bore of the branch and where branches are 25mm or less in diameter the hole in the main shall be drilled. Where the holes are flame cut all loose scale, oxide, etc., shall be removed before welding the branch. Where swept branches are used the branch shall be used as a template for the hole in the main.
30. On completion of the first ten production branch welds made by each welder, five of these welds shall be selected by the Engineer and subjected to radiographic/ultrasonic examination by an HVCA Approved Inspector.
31. One of the five welds shall be cut out, prepared and a macro-etch examination to the relevant British Standard carried out. A side bend test shall be carried out on this selected weld. Where Oxy-Acetylene or arc welding with CO₂ masking is employed, at least two of the five welds shall be prepared for macro-etch examination and side bend tested.
32. The report on the results of the test shall be provided by the HVCA Approved Inspector and forwarded to the Engineer.
33. Tube ends for welding shall be bevelled. No sharp or gusseted bends will be permitted. Where branch joints, bosses and drain pockets are made, special attention shall be given to ensure that there is no obstruction by welding metal or tube projection and to ensure that full bore is maintained. All welds shall be carefully made up so as to ensure perfect continuity of the cross section so joined. Square ends of pipes shall not be flame cut.
34. All un-galvanized mild steel pipe 100mm and above shall be arc-welded. Where arc welding is employed on the site it shall be used for all steel welding flanges.
35. All slip-on welding flanges shall be neck and bore welded.
36. The building fabric shall be protected by using suitable mats and every precaution against scorching or fire damage shall be taken.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014

Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Two suitable fire extinguishers for use in an emergency shall be provided in the immediate vicinity of the work by the Contractor. Prevent weld spatter falling on surfaces of materials which will be self-finished and visible in completed work. Remove all traces of flux residue, slag and weld spatter.

37. All welding shall be done under skilled supervision.
38. In the event of the use of electric welding, an adequately silenced engine driven generator shall be provided under this contract. The use of temporary power mains provided by the Contractor may be made by arrangement. Under no circumstances shall the Client's supply be used.
39. All work shall comply with the Health and Safety at Work Act while radiographic/ultrasonic examination of welds on site is taking place.
40. Allowance shall be made in the quotation / tender for the following: -
 - a. The radiographic/ultrasonic testing of the first five production butt and branch welds of each welder and report of the results.
 - b. Re-radiographic/ultrasonic examination of welds found to be faulty and proof of the acceptability of the particular welder's past welds.
 - c. All other costs incurred, including cutting-out, preparation of weld specimens, removing, remaking and re-testing faulty welds and making good the pipelines shall be borne by the Contractor.

1.31 Welding of Stainless Steel

- Comply with BS EN 1011-3.
- Use double bevel butt welds, backing bars to remove heat, jiggling, tack welds and any other measures necessary to minimize distortion. Remove slight distortion by light hammering, taking care not to damage surface finish.

1.32 Welding of Aluminium Alloys

- Comply with BS EN 1011-4.

1.33 Brazing

- Comply with BS EN 14324.

1.34 Powder Coating

- Aluminum Alloys: comply with BS 6496.
- Galvanized Steel: comply with BS 6497.

1.35 Vitreous Enamelling of Steel Surfaces

- Comply with BS EN ISO 28722.

1.36 Electroplating

- Anodizing of aluminium and its alloys:

1. Comply with BS EN ISO 7599.
2. Provide a certificate of assurance that anodizing has been carried out as specified.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Chromium Plating: comply with BS EN ISO 6158.
- Galvanizing: comply with BS EN ISO 1461.

1.37 Protection of Plant And Equipment

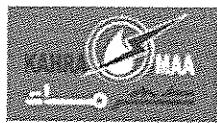
- In addition to requirements indicated elsewhere in the Contract Documents, insofar as protection is concerned (i.e. protection of the whole of the installation during storage and during execution of the works) the protection of all items of plant, specialist equipment and machinery primer from damage on site and from adverse environmental conditions up to the time the building is handed over shall be included as part of this Contract, such protection being to the following minimum standards:
- In the case of factory finished cubicle type equipment, all top and side edges shall be protected with timber battens forming angle sections with industrial felt packing between the timber and the plant. These protective angles shall be cross braced with further timber battens to form an open crate with additional protection over any particular fragile section i.e. instruments, mimic panels etc. The top surface of any such crate exceeding 0.30sq.m. shall be completely boarded in. In addition a strong transparent plastic sheet or bag of not less than 500 gauge thickness shall be arranged over or under the protective timber to provide a dust and damp proof membrane.
- In the case of electrical control panels and like equipment, allow for the provision and maintenance of temporary internal electrical heaters and for the cost of electricity and wiring thereto, in circumstances where the Engineer considers that such equipment would otherwise deteriorate due to damp conditions prior to handing over.
- Electric motors, starters, switchboards and the like shall be enclosed in a plastic sheet or bag, as described above. All stainless steel equipment shall be covered with a P.V.C. wrapper until handover. All ferrous parts shall be coated with grease.
- When necessary to remove, or partly remove, the protection for installation, or making connections to the plant, allow for replacing protection to the standard specified under this heading, immediately the said operation is completed.
- Allow for providing dust sheets as and where required. All parts of the plant which are liable to rust shall be covered with tallow for protection during the progress of the work. Upon completion this tallow shall be cleaned off and the parts polished. Accessory plates shall be protected up to the time of handover by a suitable P.V.C. envelope.

1.38 Protection of Bright Machined Parts

A protective film shall be applied to all bright machined surfaces by the manufacturer before dispatch to the works and this shall be kept intact until it has to be removed for installation, testing or commissioning purposes. If the surface is then exposed a further protective coating shall be applied and only removed at Date of Completion. Damage to bright machined surfaces shall be properly repaired to the Engineer's satisfaction or the component replaced.

1.39 Painting

- All services plant and equipment shall be painted in accordance with this Section of this Specification. Services shall include but are not limited to the following:
 1. Pipework.
 2. Water storage tanks and vessels.
 3. Oil tanks.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- 4. Condensate receivers and hot wells.
 - 5. Equipment frameworks.
 - 6. Ferrous supports brackets and steelwork.
 - 7. Accessways (as applicable).
 - 8. Thermal insulation (as applicable).
 - 9. Ductwork (as applicable).
- Ferrous Sheet Materials:
 - 1. Apply a protective coating of paint after suitable preparation, or treat with the manufacturer's approved corrosion-resisting metal finishing process.
 - 2. Any deterioration or damage to the manufacturer's protective coating shall be made good as if bare metal.
 - 3. The surfaces of all ferrous metalwork including pipework, brackets, hangers, steelwork, etc which are not protected by galvanizing, works-applied primer, or protective paint shall be suitably prepared and painted with one coat of zinc phosphate primer. All such surfaces, with the exception of pipework which is to be insulated, shall have a two coat decorative finish to an agreed colour.
 - 4. All parts fabricated by the Contractor, e.g. brackets and supports, suspension supports, flanges, screwed joints, steelwork, etc., shall be thoroughly cleaned removing all rust, grease, oil, dirt and surface corrosion using wire brush, emery paper and degreasing media as required after fabrication. It shall then be painted one coat of either zinc phosphate, zinc chromate or calcium plumate with a further coat after erection.
 - 5. The external surfaces including pipework, hangers, supports etc., which are not to be insulated, and are not galvanized or otherwise protected against corrosion, shall be primed and finished with a paint system to BS EN ISO 12944.
 - 6. Where the protective paint coating has been damaged or the surfaces show signs of rust the affected areas shall be cleaned as above prior to repainting, to the satisfaction of the Engineer.
 - Galvanized surfaces shall be inspected and the galvanizing protection repaired where damaged using a suitable zinc paint process.
 - All exposed metalwork within plantrooms, tankrooms, service subways and other similar plant areas shall be painted after preparation as detailed above with undercoats and finishing coat of a colour to be agreed with the Engineer. In all cases the actual grade of paint to be used shall be suitable for the surface operating temperature and approved by the manufacturer as being correct for the application concerned.
 - The paint manufacturer to be used shall be approved by the Engineer.
 - All painting shall be carried out by skilled tradesmen.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- At the completion of the Contract all parts of the installation shall be thoroughly cleaned. All equipment, panels etc. shall be cleaned of all grease, dirt, metal cuttings, etc., which may have accumulated. Any discolouration or other damage to parts of the building or its finish or furnishing due to the failure of the Contractor to properly clean the equipment shall be the liability of the Contractor with the necessary remedial works instructed by the Engineer.
- If, on final inspection before handover, cleaning has not been carried out to the satisfaction of the Engineer, the Contractor shall, at his own expense, clean the plant again. If, on handover, the plant is found to be in an unclean state, the Engineer may clean or have cleaned any plant, the cost of which shall be borne by the Contractor.
- The detailed specification of any coating shall be entirely suitable for the material to which it is applied, the form of that material and the conditions to which the component will be subject in service. All coatings shall comply with the appropriate International or British Standards.
- Welding, drilling, punching, cutting and bending shall be done before the component is metal coated. Metal coated work shall be adequately protected from damage at all times. Damage to metal coated work shall be properly repaired to the Engineer's satisfaction or the component replaced.
- Where surfaces will be subjected to temperatures above 100°C, the finishing coats shall be heat-resisting paint, and the primer normally omitted.
- Those parts of the installation required to be left unpainted (e.g. brass work), shall be so left.
- Packaged plant assemblies shall be supplied finish painted by the manufacturer. Details shall be submitted to show that specified procedures have been followed.
- Paint shall be applied to manufacturers' recommendations. A method statement together with a description of surface preparation and paint product technical data sheets shall be submitted. All constituents of the complete painting system are to be compatible with the material of the surface to be painted and evidence of this shall be submitted.
- Any modification proposed to the specified paint scheme shall be shown to be at least equivalent to the specified scheme, and be fully compatible with any adjacent scheme.
- All paints used in a single scheme shall be supplied by the same manufacturer and applied by the same Contractor.
- Primers in which red oxide (red iron oxide) is the primary colouring agent shall not be used.
- The quality of surface preparation specified must be presented at the time of priming.
- Areas to be welded shall be masked off prior to priming, and after welding be prepared and primed as described.
- Where required, steelwork items shall be hot-dip galvanized to BS EN ISO 1461 or BS EN 10326 as applicable.
- Prior to surface preparation the steel surfaces shall be cleaned of dirt, grease, loose rust and other contaminants. No pipe shall be used which has corroded beyond Grade C of BS 7079-A1 (EN ISO 8501-1).

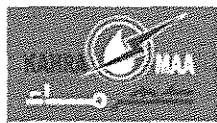


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Surfaces shall be prepared to Sa2.5 quality as defined in BS 7079-A1. This shall also apply where surface preparation is not defined.
- Galvanized steel shall be degreased by scrubbing with a warm detergent solution (2% Teepol or equivalent) followed by water washing, followed by treatment with a mordant solution (British Rail 'T-wash' or equivalent), followed by water washing once the surface has turned black. Any areas where the surface does not turn black shall be re-cleaned and re-treated.
- As soon as the priming coat has dried, an extra stripe coat of paint shall be applied to all edges, corners, crevices, bolt heads, welds and any similar areas, using the same paint as for the primer but in a contrasting shade.
- The dry film thickness shall be measured after each coat has dried using any of the methods of BS EN ISO 2808 for measurement.
- The adhesion of the paint scheme shall be measured using the method of BS EN ISO 2409, carried out on representative areas chosen to be non-obtrusive in the final condition. Areas not achieving classification 2 of that standard shall be cleaned to bare metal and repainted.
- Where a finish is specified for plastic, copper or other non ferrous metals the preparation, primer and finish shall be entirely to the manufacturer's recommendations. A minimum period of 10 years to first maintenance shall be applicable.
- Damaged painted surfaces and test areas shall be repaired and made good to the requirements of the original specification.
- The requirements of BS 799-5 for painting of oil tanks also apply.

1.40 Paints For On-Site and Off-Site Application

- Paints shall be manufactured by an approved firm and delivered to the place of painting in sealed containers labeled with the following information:
 1. Type of paint
 2. Brand name
 3. Intended use
 4. Manufacturers batch reference
- Primers and all other paints shall have good adhesion, good covering power, rust-inhibiting and grain filling properties.
- Gloss finishing paint shall be machine finish paint having a high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.
- Paints shall be used in strict accordance with the manufacturer's instructions.
- Metal surfaces of components shall be thoroughly cleaned, removing all mill scale, weld scale and corrosion by mechanical means, and final degreasing.
- Primers, undercoats and finishing coats shall all be obtained from one manufacturer, even if part of the painting application is done off-site. Successive layers of paint shall be of different shades.



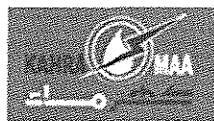
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Wherever possible, paint finishes applied by the component manufacturer shall be sprayed and those applied on site shall be brushed. Each coat of paint shall be evenly applied to obliterate the colour of the previous coat.
- Splashing, spotting or staining of other work on-site shall be made good by the Mechanical Sub-Contractor at his expense. Damage to off-site painted work shall be made good to the Engineer's satisfaction or the component replaced.
- Work described as painted shall be given one coat of primer and two coats of gloss machine finish paint.
- Work described as primed shall be given one coat of primer.
- Unless otherwise stated within these documents, all mild steel pipework shall be painted with one coat of primer.
- Aluminium based paints are not to be used in the vicinity of flammable liquids or flammable gases.

1.41 Application Tables for Paintwork

- Minimum Standards:

Ref.	Material	Location	Preparation	Primer	Build and Finish Coats*	Notes
1	Steel & iron	Buried in ground	Blast clean	EZP 40µm	EZP 150µm EZP 150µm	[1]
2	Steel & iron	Outside building, exposed	Blast clean	EZP 50µm	EMIO 100µm AUR 50µm AUR 50µm	
3	Steel & iron	Outside building, sheltered	Blast clean	EZP 50µm	AKU 40µm AKG 40µm	
4	Steel & iron	Within building, dry	Factory blast clean	AZP 30µm		[2]



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Ref.	Material	Location	Preparation	Primer	Build and Finish Coats*	Notes
5	Steel & iron	Within building, dry	Manual clean	EZP 50µm	AKU 40µm AKG 40µm	[3]
6	Steel & iron	Within building, dry	Blast clean	EZP 50µm	AKU 40µm AKG 40µm	[4]
7	Steel & iron	Within building, surface condensation possible	Blast clean	AZP 30µm	AKU 40µm	[2]
8	Galvanized steel	All locations	Degrease	Etch prime	AKU 40µm AKG 40µm	[4]

Notes:

[1] Bitumen backed PVC tape overlapped by 50% alternative system for pipes.

[2] Prime unprepared areas and repairs with EZP 50µm.

[3] Use for only for system colour coding.

[4] Use only when decorative finish is required.

* Minimum dry film thickness.

• Abbreviations:

EZP – Epoxy zinc phosphate

EMIO – Epoxy micaceous iron oxide

AUR – Acrylic urethane

AKU – Alkyd undercoat

AKG – Alkyd gloss

AZP – Acrylic zinc phosphate.



7.3.3 23 0513 - Common Motor Requirements for HVAC Equipment

GENERAL

1.1 SUMMARY

- This section includes general requirements for single-phase and three-phase induction motors for use on AC power systems up to 600 V.
- Related Sections:
 1. Section 23 0500 – Common Work Results for HVAC
 2. Section 26 2726 – Wiring Devices
 3. Section 26 2913 – Enclosed Motor Controllers
 4. Section 26 2923 – Variable Frequency Motor Controllers

1.2 REFERENCES

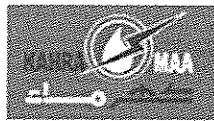
- BS EN 60034-16-1:2011 Rotating electrical machines. Excitation systems for synchronous machines.
- BS 5000-11:1973 Specification for rotating electrical machines of particular types or for particular applications. Small-power electric motors and generators
- BS EN 50347:2001 General purpose three-phase induction motors having standard dimensions and outputs.
- ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc.; 1990 (R2000).
- IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; Institute of Electrical and Electronic Engineers; 2004.
- NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2006.
- NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.
- BS 2048 – Dimensions for fractional horse-power motors
- BS 4999 – Winding Terminations

1.3 General Requirements

- A factory authorized service and parts organization shall be located within Qatar.
- Provide the name and address of the factory authorized service and parts organization nearest to the project location at the time of the bid/material submission.

1.4 SUBMITTALS

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 1. For each type and rating of motor, include performance, electrical ratings, operating characteristics, shipping and operating weights.
 2. Wiring diagrams with electrical characteristics and connection requirements.
 3. Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
 4. Indicate setting, mechanical connections, lubrication, and wiring instructions.



Qatar General Electricity & Water Corporation

Tender NO. GTC 626/2014

Construction of Mega Reservoir PRPSs

(Packages A, B, C, D & E)

5. Include instructions for safe operating procedures
 6. Point-wise compliance statement to the specifications duty signed by the manufacturer / manufacturer's authorized representative and by the Contractor.
 7. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
 8. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
 9. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats
- 1.5 QUALITY ASSURANCE**
- Conform to NFPA 70.
 - Provide certificate of compliance from authority having jurisdiction indicating approval of high efficiency motors.
 - Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

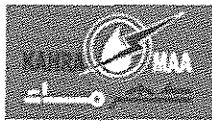
PRODUCTS

1.6 MANUFACTURERS

- Materials and products proposed by the Contractor shall be compliant with the Specification. All material submittals shall be approved by the Engineer prior to procurement.
- Refer the Approved Suppliers List in the "General Requirements and Scope of Works".

1.7 GENERAL REQUIREMENTS

- Electrical Service: Refer to Section 26 2726 "Wiring Devices".
- Construction:
 1. Open drip-proof type except where specifically noted otherwise.
 2. Design for continuous operation in 50 degrees C and 100% RH environment.
 3. Motor insulation to be Class B or F with design for temperature rise in accordance with BS 5000 and BS EN 60034
 4. Use motors with class H insulation when used to drive LTHW / DHW pumps
- Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- Wiring Terminations:
 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to BS 7671, threaded for conduit.
 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.
- Select maximum continuous rating (MCR) such that
 1. Driven machinery operates at correct speed or speeds at approved design duty
 2. When running continuously at design rated duty the temperature of the motor parts are within the limits defined in BS EN 60034-1



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

3. When provided with excess motor current (over-load) protection of thermal over current release type, ensure operation is within tolerances of tripping as per BS EN 60034-1
 - Starters:
Motors shall be suitable for starting equipment in accordance with the following unless otherwise specified:
 - a. Up to and including 5.5 kW – Direct On line
 - b. Over 5.5 kW – Star Delta
 - Unless otherwise specified, all electrically driven equipment shall be supplied complete with electric motors, together with all components to couple the drive. The components to couple the drive shall be constructed and rated for the duty and for any transient surges imposed by the method of starting the motor
 - Slide Rails
Fit motors on slide rails or other suitable means of adjustment to facilitate correct alignment and belt tension where applicable
 - Plinths
Provide all necessary coordination and information required for the construction
 - Motor Ratings: General
Ratings of all motors mentioned in the specifications and drawings are indicative only and contractor shall ensure adequacy of the output ratings with the requirement. For all pumps and fans the contractor shall carry out the system pressure drop calculations based on the approved layouts, obtain approval to the calculations from the engineer and propose the KW rating of the motor he proposes to use. Such approval shall be obtained prior to procurement of motors. Necessary coordination shall also be carried out to ensure compatibility with electrical power distribution components. Enclosures to be IP55 for all motors serving AHUs and pumps
- 1.8 Motor ratings - up to and including 0.75 kw**
- Single or 3 Phase, totally enclosed, fan cooled. Contractor to ensure motor is suitable for duty and torque requirements of driven machine
- 1.9 Motor ratings – Above 0.75 kw up to and including 4 kw**
- Three phase squirrel cage induction type, totally enclosed, fan cooled. To be to BS EN 50347:2001 and BS EN 60034-6 IP44 – IC 01.1411
- 1.10 Motor ratings – Above 4 kw squirrel cage smoke spill**
- Three phase squirrel cage induction type, for smoke spill applications. To be to BS EN 50347:2001 and BS EN 60034-6 IP55 cooling as applicable
- 1.11 Motor ratings – Above 4 kw squirrel cage Energy Efficient Design**
- Three phase squirrel cage induction type, totally enclosed, energy efficient design, fan cooled. To be to BS EN 50347:2001 and BS EN 60034-6 IP55 – IC 01.1411
- 1.12 Over temperature protection thermistors**
- Fit positive temperature coefficient thermistors to BS EN 50347:2001. Provide minimum of 3 PTC thermistors in each motor with 2 ends terminated in motor terminal box clearly and permanently marked.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. For motors rated between 30kW and 75kW provide a single thermistor in each phase
 2. For motors rated above 75kW provide two thermistors in each phase
- Provide control unit to BS EN 50347:2001 to motors fitted with thermistors. Interconnect control unit with thermistors and starter to trip starter when one or more of the thermistors detect overheating except in the case of fire pumps where overheating detectors shall sound alarm only and indicate at the fire alarm panel. Operation of the sensing device shall cause pilot light to be illuminated on the motor starter panels. A reset button on the starter must be reset before the motor can be restarted. Motors equipped with temperature sensing devices shall be guaranteed for one year against burnouts due to overheating resulting from bearing seizures, locked rotor, blocked ventilation, single phasing and voltage unbalance.
- 1.13 Indirect drives – toothed belts**
- Belts: Use toothed wedge belts to BS 3790. Provide at least two matched belts for any drive of anti-static type and rated to transmit full machine power with one belt removed
 - Pulleys: Construct pulleys from approved materials and statically balance. Lock close limit bores by keys fitting into machinery shaft keyway
 - Pulleys to be adjusted prior to hand over to give alignment and correct belt tension
- 1.14 Indirect drives – flat belts**
- Belts: Use flat belts to BS 3790. Provide at least two matched belts for any drive of anti-static type and rated to transmit full machine power with one belt removed
 - Pulleys: Construct pulleys from approved materials and statically balance. Lock close limit bores by keys fitting into machinery shaft keyway
 - Pulleys to be adjusted prior to hand over to give alignment and correct belt tension
- 1.15 Direct coupled drives**
- Use and extended motor shaft coupled to the machine or a flexible coupling connecting drive and driven shafts incorporating suitable arrangements for aligning the two shafts
 - Mount motors on a substantial mild steel bed plate fixed to machine casing
 - Where flexible couplings (short or long) are used to connect the driven equipment on a common base frame. The alignment shall be further checked on site after installation by a certified specialist with appropriate tools (laser or dial guage)
 - Manufacturers tolerance shall be strictly complied to and results submitted to the engineer for approval
- 1.16 Motor Enclosures**
- Unless otherwise specified, the types of motor enclosure shall be in accordance with BS 4999-105 and as follows:
 1. Fans with dripping motors outside the air stream – drip proof to IP 54
 2. Supply air fans with driving motors in the air stream – totally enclosed with fan cooling to IP 54.
 3. Extract air fans with driving motors in the air stream – Suitable for Group II gases.
 4. Motors fitted externally shall be weatherproofed to IP65.
 5. Motors operating in moisture-laden air shall be suitably protected to IP 53.
- 1.17 Guards**



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Totally protect drives and couplings. Fit purpose made guards around all exposed or otherwise accessible drive shafts, pulleys, V belts or couplings
- Ensure guards comply with National or Local safety codes, Acts and By laws and incorporate the following features:
 1. Construction to BS 5304 and generally of galvanized steel wire mesh
 2. Stiffening within the guards to ensure rigidity and freedom from vibration
 3. Allowance for prime mover adjustment during belt tensioning procedures
 4. Temporary access to all shafts for use of Tachometer

1.18 APPLICATIONS

- Single phase motors for shaft mounted fans and centrifugal pumps: Split phase type.
- Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.
- Motors located in outdoors, in wet air streams downstream of sprayed coil dehumidifiers, in draw through cooling towers, and in humidifiers: Totally enclosed weatherproof epoxy-treated type.
- Motors located outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-sealed type.

EXECUTION

1.19 DELIVERY, STORAGE, AND HANDLING

- Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering.
- Do not install motors in their final locations until the facilities are permanently weather tight.

1.20 COORDINATION

- Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
 1. Motor controllers.
 2. Torque, speed, and horsepower requirements of the load.
 3. Ratings and characteristics of supply circuit and required control sequence.
 4. Ambient and environmental conditions of installation location.
- Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

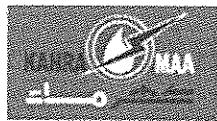
1.21 WARRANTY

- Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace motors that fail in materials or workmanship within the specified warranty period.

Warranty Period: five years from date of Substantial Completion.

1.22 INSTALLATION

- Install in accordance with manufacturer's instructions.
- Install securely on firm foundation. Mount ball bearing motors with shaft in any position.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Check line voltage and phase and ensure agreement with nameplate.

7.3.4 23 0516 - Expansion Fittings and Loops for HVAC Piping

General

1.1 Summary

- This section includes:
 1. Flexible pipe connectors.
 2. Expansion joints and compensators.
 3. Pipe loops, offsets, and swing joints.
 4. Pipe expansion and contraction devices.

1.2 Related Sections:

1. Section 23 2113 - Hydronic Piping.
2. Section 23 2300 - Refrigerant Piping.

1.3 References

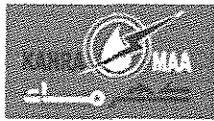
- BS 21 - Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads
- Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
- ASTM A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2004.
- EJMA (STDS) - EJMA Standards; Expansion Joint Manufacturers Association; 2003.

1.4 General Requirements

- Where expansion and contraction cannot be accommodated by the selected pipework routing the contractor is to provide pipe loops or suitable proprietary devices
- Design and verification of all items related to pipework thermal expansion and thrust shall be solely the responsibility of the contractor inclusive of all calculations, selections and associated drawings.

1.5 Submittals

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 - Note: British (BS) or European (BS EN) Standards may be proposed by the contractor for components defined within this section provided detailed equivalence statement provided as part of the technical submittal
 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions meter and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.



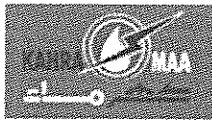
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
 3. Design Data: Indicate selection calculations.
 4. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
 5. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
 6. Maintenance Data: Include adjustment instructions.
- Product Data:

PRODUCTS

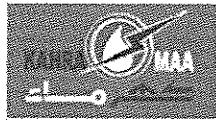
1.6 Packed Expansion Joints

- Slip-Joint Packed Expansion Joints:
 1. Standard: ASTM F 1007.
 2. Material: Carbon steel with asbestos-free PTFE packing.
 3. Design:
 - a. With internal guide and injection device for repacking under pressure. Include drip connection if used for steam piping.
 - b. Slips shall be machined from seamless pipe, Schedule 80 for sizes up to and including 400 mm, and Schedule 60 for sizes 450 mm through 600 mm. Slips shall be ground and polished to obtain a surface finish of 16 RMS prior to plating. Slips shall be plated with a dual chrome plate process consisting of 1 mil minimum of industrial hard chrome over 1 mil minimum of crack free hard chrome.
 - c. Packing surface area in contact with the sliding slip shall be equal to at least fifteen (15) times the expansion joints nominal pipe size.
 - d. The internal end of all slips shall be provided with stainless steel outward limit stops to prevent disengagement of the slip from the stuffing box (at full design pressure) in the event of an anchor failure.
 - e. The injectable packing shall be self lubricating flake graphite contained by three (3) rings of self lubricating graphite packing at each end of the stuffing box. The packing cylinders shall be a minimum of 50 mm in diameter, be welded in place, and shall have internal acme threads and be furnished with mating aluminum bronze plungers.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- f. Internal and external guide surfaces in contact with the sliding slip shall be furnished with low friction non-metallic inserts (for applications up to 260°C).
 - g. Total traverse of the expansion joint shall be 25 mm greater than the nominal traverse. Expansion joints shall be shipped, unless otherwise indicated, with 25 mm pre-compression to allow for 25 mm extension and the nominal traverse in compression.
 - 4. Configuration: Single joint class unless otherwise indicated.
 - 5. End Connections: Flanged or weld ends to match piping system.
- Packless Expansion Joints
 - A. Metal, Expansion-Compensator Packless Expansion Joints:
 - 1. Configuration for Copper Tubing: Two-ply, phosphor-bronze bellows with copper pipe ends.
 - a. End Connections for Copper Tubing DN 50 and Smaller: Solder joint or threaded.
 - b. End Connections for Copper Tubing DN 65 to DN 100: Threaded.
 - 2. Configuration for Steel Piping: Two-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.
 - a. End Connections for Steel Pipe DN 50 and Smaller: Threaded.
 - b. End Connections for Steel Pipe DN 65 to DN 100: Flanged.
 - B. Metal-Bellows Packless Expansion Joints:
 - 1. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
 - 2. Type: Circular, corrugated bellows with external tie rods.
 - 3. Minimum Pressure Rating: 1200 kPa unless otherwise indicated.
 - 4. Design:
 - a. Expansion bellows shall be manufactured by an approved firm. Performance, materials of construction and type of ends shall be completely compatible the pipeline in which they are inserted. Those for installation in copper services shall have stainless steel flanges.
 - b. Bellows shall be installed with great care and must not be twisted during installation. Where welded joints are to be made, heat must not be allowed to affect the bellows materials. Pre-stressing (cold draw) shall be taken up during installation in accordance with the manufacturers recommendations.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014**

**Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- c. Flange compensators shall be pulled up diagonally across the flange by means of long bolts, after joints are made the long bolts shall be removed diagonally one at a time and replaced with standard bolts, nuts and washers.
 - d. If temporary installation bars or similar are provided by the manufacturer these must be removed.
 - e. Bellows which may be damaged during the pipeline hydrostatic pressure testing must be replaced for the test by a spacer piece.
 - f. Bellows for chilled water service shall be of the single wall convoluted stainless steel type with internal sleeve. Ends shall be screwed or welded up to 50mm size and flanged above 50mm size.
5. Configuration: Single joint class unless otherwise indicated.
 6. Expansion Joints for Copper Tubing: Single-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing DN 50 and Smaller: Solder joint.
 - b. End Connections for Copper Tubing DN 65 to DN 100: Solder joint
 - c. End Connections for Copper Tubing DN 125 and Larger: Flanged.
 7. Expansion Joints for Steel Piping: Single-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
 - a. End Connections for Steel Pipe DN 50 and Smaller: Threaded.
 - b. End Connections for Steel Pipe DN 65 and Larger: Flanged.

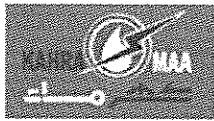
1.7 Alignment Guides And Anchors

• Alignment Guides:

1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

• Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
- a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

1.8 Flexible Pipe Connectors - Steel Piping

- Inner Hose: Carbon Steel.
- Exterior Sleeve: Single braided stainless steel.
- Pressure Rating: 862kPa and 232 °C.
- Joint: Flanged.
- Size: Use pipe sized units.

1.9 Expansion Joints - Stainless Steel Bellows And Victaulic Couplings.

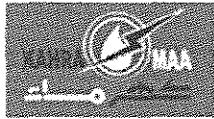
- Pressure Rating: Stainless steel bellows shall be rated for 862 kPa and 204 °C and shall only be used for pipe sizes less than 150mm diameter. Pipes over 150mm diameter having higher pressure than 15bars shall be provided with Victaulic couplings.
- Joint: Flanged.
- Size: Use pipe sized units.
- Application: Steel piping 75mm and under.

1.10 Expansion Joints - Steel With Packed Sliding Sleeve

- Working Pressure and Temperature: Class 150.
- Joint: Flanged OR Welded.
- Size: Use pipe sized units.

1.11 Building Expansion And Settlement Joints

- Two number flexibly jointed couplings shall be installed within all pipelines that cross building construction/movement joints to accommodate the building movement and/or settlement whether such joints are detailed on the drawings or not.
- The first coupling shall be located immediately before and the second immediately after the pipe crosses the building joint. The pipe between these couplings shall be arranged and installed in a manner that will accommodate the maximum building settlement and/or movement without fracture, distortion or damage of pipework or joint failure occurring.
- The Contractor shall submit fully detailed drawings indicating their proposals for these joints to the Engineer for acceptance.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- The Contractor shall, prior to installing these joints, obtain from the Engineer confirmation of the maximum degree of settlement and/or building movement to be accommodated.
- The Contractor shall, if required, expose, remove and relay all pipework and joints that may be required or deemed necessary by the Engineer should any pipework or couplings be installed prior to receiving the Engineer's acceptance and confirmation of the aforementioned all works shall be carried out at the contractor's own expense.
- Type and Traverse:
 1. Expansion joints shall be rated for minimum 21 Bar, 260°C, unless otherwise indicated, and shall be of the type indicated (single – with or without base, or double with base). For pressures above 21 Bar use pressure on the system as minimum.
 2. Machine and bevel ends of the expansion joints for welding to the various pipe wall thicknesses specified, unless otherwise indicated.
 3. Cycle and Force Testing: The sliding slip of each expansion joint shall be hydraulically cycled three (3) times through its rated traverse after the expansion
 4. Joint to be fully packed to verify free movement of the slip through the guides. Record the forces required to move the slip and certify that the forces are within the limits of the manufacturer's published friction force data.
 5. Performance: Provide a list of five (5) installations which have had the manufacturers expansion joints in successful operation for five (5) years at service conditions equal to or exceeding the conditions required for this Project.
- Insulation Blankets:
 1. Provide an insulation blanket supplied by the expansion joint manufacturer to ensure proper fit and to provide single source responsibility. Insulation blanket shall be removable/reusable type, designed to cover the expansion joint stuffing box and sliding slip. The blanket shall overlap the field installed insulation by a minimum of 100 mm at both the mating pipe and expansion joint body ends. Insulation thickness on the mating pipe is specified in Section 23 0719.

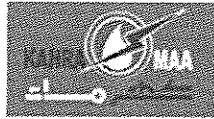
1.12 Accessories

- Stainless Steel Pipe: ASTM A269.
- Pipe Alignment Guides:
 1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 25 mm thick insulation, minimum 75 mm travel.

Execution

1.13 Extra Materials

Supply two sets of packing for each packed expansion joint.



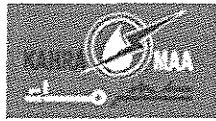
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1.14 Warranty

Special Warranty: Submit for Employer's documentation. Furnish 5 year written warranty in form stipulated by Employer, signed by the Contractor and Installer, agreeing to repair or replace packed slip type expansion joints which fail as a result of defects in materials or workmanship. Upon notification of such defects, within the warranty period, make necessary repairs or replacement at the convenience of the Employer.

1.15 Installation

- The contractor shall carry out a stress analysis and review of the piping system by the employment of a specialist in this field of work. The contractor shall coordinate and ensure the all associated element of the stress analysis conducted is reviewed and agreed on by a structural engineer of record to verify the design intent and any impact on the structure to be considered. All associated works and agreements to be carried out between the structural engineering and contractor. The contract shall be responsible for all aspect of this work. Refer to item 1.3 for submittal and processes.
- Install in accordance with manufacturer's instructions.
- Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards or as per agreed equivalent BS / BS EN Standard
- Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- Attach guides to pipe and secure guides to building structure.
- Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- Anchor Attachments:
 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- Use grout to form flat bearing surfaces for guides and anchors attached to concrete.



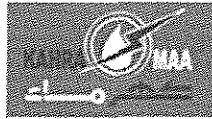
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014

Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Anchor pipe to building structure as required. See specification 23 0548. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
- Provision to accommodate thermal movements shall be made by changes in direction of the pipework, by loops or by special expansion joints, as appropriate for the pipework jointing method. Loops and changes in direction shall not be used for this purpose on grooved joints, press-fit or push-fit systems.
- Supports and guides shall be arranged to ensure that movement is taken up as intended.
- Expansion joints may be axial or articulated and have screwed or flanged ends as appropriate. Internal liners shall be incorporated if required, manufactured from corrosion-resistant steel, or other approved material appropriate to the duty, and designed to withstand the test pressure of the system. The joints shall be capable of not less than 2000 complete cycles of movement over the designed working range.
- Where pipework is required to be pre-stressed, the extent of the cold pull shall be limited and recorded.
- Joints intended for angular movements shall be provided with tie rods or hinges to take end thrust.
- Expansion joints shall be provided with external protection against damage and be installed so that they are not subjected to stresses other than those for which designed. Installation shall ensure joints are in the free position at a temperature midway between the high and low limits of normal service.
- Expansion joints shall be installed in accordance with the manufacturer's recommendations. On completion of installation and before the system is operated the manufacturer shall confirm that the installation is in accordance with his requirements. Guides shall be rigidly secured and allow freedom of movement for pipe expansion without excessive clearance. Lubrication points shall be provided where necessary.
- Measures shall be taken to prevent the movement of pipework causing damage to thermal insulation.
- Offsets shall be formed by using welded bends shop-fabricated with flanged ends, the whole assembly being annealed after manufacture to remove any stresses due to welding. When installing offsets at least 50% cold draw shall be applied.
- Branch connections from mains shall allow the thermal movement of the main without putting strain on the branch. Where this cannot be achieved, the pipeline shall be anchored in suitable places and a purpose-made expansion bellows shall be inserted in the pipeline between anchors.
- A pipeline guide shall be fitted within two pipe diameters of the moving end of an expansion unit, with a second guide a further 15 to 20 pipe diameters distant from the first.

7.3.5 23 0517 - Sleeves and sleeve seals for HVAC Piping

General



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1.1 Summary

- Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

- Related Sections

1. 23 2113 - Hydronic Piping

1.2 General Requirements

Enclose pipes passing through building elements (walls, floors, partitions etc) concentrically within purpose made sleeves. Fit masking plates where visible pipes pass through building elements including false ceilings of occupied rooms.

1.3 Submittals

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 1. Point wise compliance statement with this specification for all products
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats

PRODUCTS

1.4 Sleeves

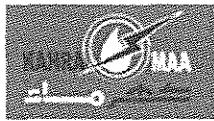
- Materials
- Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- Galvanized-Steel-Sheet Sleeves: 0.6-mm minimum thickness; round tube closed with welded longitudinal joint.

1.5 Sleeve-Seal Systems

- Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

1.6 Sleeves Through Fire Barriers

- Provide fire stopping for pipes penetrating fire barriers utilizing proprietary fire sleeves fully coated internally with intumescent sheet in line with local Authority Having Jurisdiction requirements provide only one type for each similar application.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. Silicone Fire stopping Elastomeric Fire stopping: Singl/Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Fire stopping Compounds: Single/Multiple component foam compound.
3. Formulated Fire stopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and
6. silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
7. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface
8. heat gain.
9. Firestop Pillows: Formed mineral fiber pillows.

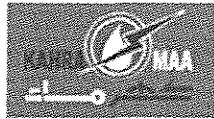
1.7 Grout

- Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- Characteristics: Nonshrink; recommended for interior and exterior applications.
- Design Mix: 34.5-MPa, 28-day compressive strength.
- Packaging: Premixed and factory packaged.

EXECUTION

1.8 Sleeve Installation

- Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 25mm annular clear space between piping and concrete slabs and walls.
- Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 50mm above finished floor level.
- 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- Install sleeves for pipes passing through interior partitions.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 6.4mm annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- Sleeves which are contained in walls, ceilings or floors which are fire barriers shall be additionally packed with a non-combustible material for the entire length to form a fire/smoke stop of the required fire rating.
- The material shall be subject to approval of the Engineer and must comply with local Civil Defence Regulations.
- Petroleum based expanding foam products shall not be used.
- The ends of sleeves packed with material shall have a suitable fire resistant mastic applied to seal the fibres and present a neat appearance.
- Sleeves for UPVC pipes shall contain an intumescence material to BS 476.

1.9 Sleeve-Seal-System Installation

- Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

1.10 Sleeve ad Sleeve-Seal Schedule

- Use sleeves and sleeve seals for the following piping-penetration applications:
 1. Exterior Concrete Walls above Grade:
 - b. Piping Smaller Than DN 150: Galvanized-steel-pipe sleeves
 - c. Piping DN 150 Galvanized-steel-pipe sleeves.
 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller than DN 150 [Galvanized-steel-pipe sleeves with sleeve-seal system].



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- 1.) Select sleeve size to allow for 25mm annular clear space between piping and sleeve for installing sleeve-seal system.
- b. Piping DN 150 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1.) Select sleeve size to allow for 25mm annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than DN 150 Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1.) Select sleeve size to allow for 25mm annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping DN 150 Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1.) Select sleeve size to allow for 25mm annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
 - a. Piping Smaller Than DN 150 Galvanized-steel-pipe sleeves
 - b. Piping DN 150 and Larger: Galvanized-steel-pipe sleeves
5. Interior Partitions:
 - a. Piping Smaller Than DN 150 Galvanized-steel-pipe sleeves.
 - b. Piping DN 150 and Larger.

7.3.6 23 0519 - Meters and Gauges

General

1.1 Summary

- This section includes:

1. Water temperature gauges/thermometers
2. Pressure/altitude gauges
3. Temperature and pressure test points
4. Digital Temperature Meter
5. Chilled Water or Condenser Water flow meters and Kw/Hr Meters

- Related Sections:

1. Section 23 2113 – Hydronic Piping



Qatar General Electricity & Water Corporation

Tender NO. GTC 626/2014

Construction of Mega Reservoir PRPSs

(Packages A, B, C, D & E)

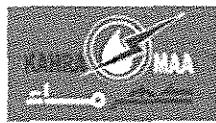
2. Section 23 0943 – Analog control equipment
3. Section 23 0923 – Direct-Digital Control Equipment
4. Section 23 0993 – BMS Sequence of Operations for HVAC Controls

1.2 References

- BS 5235 Specification for dial-type expansion thermometers; 1975
- BS EN 837 - Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
- BS 759 - Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers. Specification for valves, mountings and fittings
- BS EN 13190 Dial thermometers

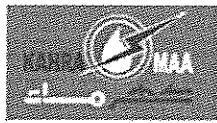
1.3 General Requirements

- As a minimum water temperature gauges/thermometers shall be installed at the following positions in addition to any other particular position stated elsewhere or indicated on the drawing:
 1. On flow and return connections to heating and chilled water coils except on individual fan coil units and induction type terminal units.
 2. On flow and return chilled and condenser water connections to water chillers.
 3. On the inlet and discharge connections to cooling towers.
 4. On the cold feed connection to the HWS cylinders.
 5. On the main HWS secondary flow and return connections to HWS cylinders.
 6. On the flow and return connections to each heating boiler.
 7. On the main common flow header from the water chillers and heating boilers.
 8. On the primary flow and return connections to each HWS cylinder.
 9. On branch return connections to the main return chilled water and heating headers.
 10. On the flue connection to each boiler
 11. On all connections to water plate heat exchangers
- As a minimum pressure gauges and gauge cocks shall be fitted to indicate system pressures/heads at the following positions in addition to any other particular position stated elsewhere or indicated on the drawings:
 1. On chilled water connections to each water chiller.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

2. On condenser water connections to each water chiller.
 3. Pressure differential gauges across the suction and discharge connection of every circulating pump.
 4. On the discharge of every spray pump.
 5. On flow connections to cooling towers.
 6. On the primary heating connections to the HWS cylinders.
 7. On the inlet and outlet connection to pressure reducing valves.
 8. On the inlet and outlet connections to strainers (32 mm and above).
 9. On all inlet and outlet connections of water plate heat exchangers
- As a minimum differential pressure gauges shall be applied to across:
 1. Chilled water evaporators to each water chiller.
 2. Condenser water connections to each water chiller.
 3. Across the suction and discharge connection of every circulating pump.
 - As a minimum test plugs shall be installed at the following positions in addition to any other particular position stated elsewhere or indicated on the drawings:
 1. On the flow and return connections to each terminal heat transfer unit i.e. across each coil, evaporator, condenser, heat exchanger etc.
 2. On each port of every automatic valve.
 3. On flow and return connections to each heating and cooling coil.
 4. On the suction and discharge of each circulating or transfer pump.
 5. On the inlet and outlet connections to strainers (32 mm and below).
 6. On the flow and return of each branch line.
 - As a minimum Kw/hr energy meters comprising flow meter and supply / return temperature sensors shall be provided in the following locations:
 1. At the discharge of the Primary CHW pumps
 2. At each main branch on the CHW and LTHW network as indicated on the drawings, schedules, specifications or BMS system
 - As a minimum water meters shall be provided in the following areas for individual domestic water metering for monitoring and management purposes:
 1. Main incoming water supply (check meter against local authority meter)
 2. Domestic hot water supply



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

3. Boiler make up to feed tank
 4. Water Features
 5. TSE sub meters on Landscape System
 6. Any other area indicated on the drawings, schedules or in these specifications
- As a minimum gas meters shall be provided in the following areas:
 1. Main line from LPG tanks
 2. Any other area indicated on the drawings, schedules or in these specifications

1.4 Submittals

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 1. Operating Range
 2. Total Range
 3. Accuracy
 4. BMS interfaces
- Project Record Documents: Record actual locations of components and instrumentation.
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats.

1.5 Environmental Requirements

- Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

Products

1.6 TEMPERATURE GAUGES/ THERMOMETERS

- Temperature ranges for Gauges / Thermometers are to be as follows
 1. Domestic Hot Water: 0 to 100°C with 1°C scale divisions
 2. Domestic Cold Water: 0 to 500°C with 1°C scale divisions
 3. Chilled Water: -25°C to 25°C
 4. Low Temperature Hot Water: 0 to 100°C with 1°C scale divisions
- Accuracy to be +/- 1 percent of range span
- Temperature gauges/thermometers shall be 100 mm diameter gas filled type acting through mechanical linkage to BS EN 13190



- Matt black case and polished chrome bezel and glass face. Horizontal or vertical rigid stem to suit the particular application, black indicating pointer with red hand set and graduated in °C with the range equal to twice the normal operating temperature.
- Pointer movement to be clockwise for increase in temperature
- Where gauges are externally located they shall be of weather resistant construction.

1.7 Thermometer Wells

- Fitting with protective well for installation in threaded pipe fitting to hold test thermometer
 1. Material: Brass for use in copper pipework
 2. Material: Stainless Steel for use in steel piping
 3. Expansion neck length to be provided as required. Nominal thickness of 50mm but not less than thickness of insulation.
 4. Insertion length to extend 1/3 of pipe diameter
 5. Cap to be threaded with chain permanently attached to socket
 6. Heat transfer fluid to be oil or graphite

1.8 Static Pressure Guages

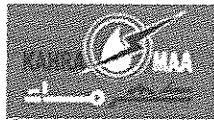
- Accuracy to be +/- 1 percent of range span
- Pressure guages shall be 100 mm diameter gas filled, bourdon tube type to BS 837-1
- Matt black case and polished chrome bezel and glass face. Horizontal or vertical rigid stem to suit the particular application, black indicating pointer with red hand set and graduated in kPa with the range equal to twice the normal operating pressure with normal operation indicated as the mid-point of the scale
- Where gauges are externally located they shall be of weather resistant construction.
- Where pressure gauges are fitted on boilers and pressure vessels clearly mark with operating and maximum permissible working heads in accordance with BS 759
- Connect to pipelines via matched guage cocks and cock connectors

1.9 Pressure Differential Gauges

- Manufactured in accordance with BS EN 837-1 from 316L stainless steel where in contact with the water.
- Direct mounting of two independent bottom inlet Bourdon tube type linked to a single pinion gear driving an adjustable red pointer which shall have a bi-directional differential range
- 90 mm diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

1.10 Temperature / Pressure Test Plugs

- Nickel-plated, brass-body test plugs in DN15 fitting are to be provided
- Length to be as required to extend beyond insulation and cladding
- Pressure rated to 3450kPa minimum



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014

Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Core insert to be self sealing valve suitable for insertion of 3mm OD probe from dial type thermometer or pressure gauge
- Core material for Air, Water, Gas from -7°C to +93°C to be chlorosulfonated polyethylene synthetic rubber or neoprene
- Test plug to be gasketed and threaded with retention chain or strap

1.11 Energy Meters

- General
- The contractor shall provide a fully working installation including all necessary hardware, devices, software, engineering, commissioning, integration, networking and training etc. The system shall facilitate remote monitoring of all energy meters via a PC based system and be complete with printing facility for the automatic billing system. The Kw/Hr meter system may be connected via an independent MBus network or connected directly to the BMS
- The flow meter / Kw/Hr meter units shall be complete with one inline ultrasonic sensor, two matching insertion type temperature sensors and isolated analogue outputs for supply / return temperature 4 – 20 ma or 0-10 vdc. Unit shall be field calibrated and shall be provided with necessary communication modules etc. for interface with BMS or central station network for remote reading.
- Material
 1. Integrator top: SAN
 2. PCB casing: ABS
 3. Connection unit and bracket: PP
 4. Gaskets: Sarlink 3150B
 5. Flow meter to be Ultrasonic Type.
 6. Temperature Sensors – Pt 500 with 10 m of cabling.
- Approvals
 1. All meters shall be certified for use either in the USA or Europe for use by district energy utility providers.
 2. The meter output shall be certified for use in billing.
 3. Complies with test: OIML R75, EN1434, DS2340, PTB.
- Performance
 1. Accuracy: +/- (0.15+2/ΔT)%
 2. Range: 1 °C – 40 °C
 3. Flow Calculation: 30s intervals
 4. Back up battery 20 year life



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

5. Power supply 220-240V AC, 50 Hz, 1 ph.

6. Backlit LCD display

• **Display Features**

1. Accumulated thermal energy: MWh
2. Accumulated water flow: m³
3. Actual thermal power: kW
4. Actual water flow: l/h
5. Supply temperature: °C
6. Return temperature: °C
7. Peak thermal power: kWP
8. Peak water flow: l/h P
9. Hour Counter: HRS
10. Factory calibrated RS-232 data communication including inlet temp, outlet temp, volumetric flow, calculated energy, and delta temp

1.12

Transient Time Ultrasonic Chilled Water Meters:

The Contractor shall provide transient time ultrasonic chilled water metering assemblies, sized for the manufacturer's minimum rated flow at minimum building load without exceeding maximum allowable velocity at full building load. Maximum flow rate shall be pumped rate plus 20%. Temperature shall be sensed by platinum RTD's inserted in vertical separable thermometer wells. Data from a flow sensor and temperature sensor shall be input into a software driven programmable meter which shall calculate and display a read out of power (tons) and energy (ton hours) and shall furnish a remote output signal for input into the Building Automation System. The meter manufacturer shall furnish initial set-up and calibration of the metering assembly.

EXECUTION

1.13 Installation

- Install in full accordance with manufacturer's instructions.
- Install pressure gauges in piping tee with gauge cock at the most readable position. Select gauges with bottom side or rear inlet as appropriate
- Install snubbers on all pressure gauges installed in close proximity of pump discharge.
- Provide red set hands to indicate normal or critical pressure in gauges subjected to variable pressures.
- Use remote reading type pressure gauges with armoured capillary tubes, when installed above 2 Ms from FFL.
- Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valve bypass with globe valve for liquid service meters.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Provide one pressure Gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to Gauge.
- Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 60 mm for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- Install thermometers in air duct systems on flanges.
- Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 0943. Where thermometers are provided on local panels, duct or pipe mounted thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
- Locate duct mounted thermometers minimum 3 m downstream of mixing dampers, coils, or other devices causing air turbulence.
- Coil and conceal excess capillary on remote element instruments.
- Provide instruments with scale ranges selected according to service with largest appropriate scale.
- Install Gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- Adjust Gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- Locate test plugs adjacent thermometers and thermometer sockets.

7.3.7 23 0523 - General-Duty Valves for HVAC Piping

General

1.1 Summary

- Section Includes:

1. Chain wheel valves
2. Commissioning Valve Sets
3. Automatic Balancing Valves
4. Differential Pressure Control Valves
5. Pressure Independent Control Valves
6. 2 Port Modulating Control Valves
7. Orifice Plates
8. Ball Valves
9. Gate Valves
10. Butterfly Valves



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

11. Safety and Relief Valves
12. Drain Valves
13. Automatic Air Eliminators
14. Strainers
15. Test Points
16. Swing Check Valves

- Related Sections:

1. Section 23 0516 – Expansion Fittings and Loops for HVAC Piping
2. Section 23 0553 – Identification for HVAC Piping and Equipment
3. Section 23 0719 – HVAC Piping Insulation
4. Section 23 2114 – Hydronic Specialties
5. Section 23 2500 – HVAC Water Treatment

1.2 Referred Documents

- BS 21 Specification for pipe threads for tubes and fittings where pressure – tight joints are made on the threads (metric dimensions)
- BS EN 593 Industrial valves. Metallic butterfly valves
- BS 759 Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers. Specification for valves, mountings and fittings.
- BS 1042 Measurement of fluid flow in closed conduits.
- BS1212-2 Float operated valves. Specification for diaphragm type float operated valves (copper alloy body) (excluding floats)
- BS 2767 Specification for manually operated copper alloy valves for radiators
- BS 2879 Specification for draining taps (screw-down pattern)
- BS EN 1092 Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories. PN designated.
- BS EN 1171 Industrial valves. Cast iron gate valves
- BS EN 13789 Industrial valves. Cast iron globe valves
- BS EN 12288 Industrial valves. Copper alloy gate valves
- BS 5158 Specification for cast iron plug valves
- BS 5163 Valves for waterworks purposes
- BS EN ISO 4126-1 Safety devices for protection against excessive pressure. Safety valves

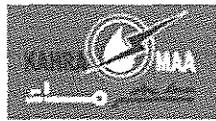


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- BS 7350 Specification for double regulating globe valves and flow measurement devices for heating and chilled water systems
- BS EN 215 Thermostatic radiator valves. Requirements and test methods
- BS EN 1092 Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated.
- ASTM 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc- Coated, Welded and Seamless
- BS 476 Fire tests on building materials and structures
- BS EN 10088 Stainless steels
- BS EN ISO 228-1 Pipe threads where pressure-tight joints are not made on the threads. Dimensions, tolerances and designation

1.3 General Requirements

- Valves of a single type are to be sourced from a single manufacturer and supplier
- Valves, cocks, air vents and pipework accessories shall be provided where indicated on the drawings and at all positions necessary for the proper working, regulation, control and maintenance of the installation with the approval of the Engineer.
- Valves shall be provided on all pipework wherever necessary to achieve proper isolation and regulation of the whole systems. They shall be installed to isolate and balance every section of the pipework network including but not limited to the following locations, whether indicated on the design drawings or not:
 1. To isolate each item of equipment including heat transfer terminal units, fan coil units, air handling units, plate heat exchangers, De-aerators, dosing systems, pressurisation sets, pumps etc.
 2. To regulate and balance the flow through each item of equipment including heat transfer terminal units, fan coil and control valves etc.
 3. To isolate every section of the pipework network including sub-branch mains, sub-circuits and to multi-connections to heat transfer terminal units. They shall also be provided to isolate each floor and each riser.
 4. To regulate and balance the flow through every section of the pipework network including sub-branch mains, sub-circuits, and to multi-connections to heat transfer terminal units
 5. To isolate, regulate and balance the flow to any item of equipment supplied by or, to be connected to the systems, by others (Should the equipment or plant not be connected up prior to balancing, temporary bypass connections and a regulating valve shall be installed to achieve balancing)
 6. To isolate, and allow the removal of all control valves, flow meters, BTU meters, strainers, and other similar pipeline ancillaries.
 7. To isolate each float operated valve or pressure reducing valve.

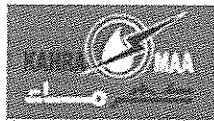


**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

8. To isolate immediately inside the building incoming utility services Isolating, regulating and orifice valves shall be provided generally as scheduled below and elsewhere as indicated on the drawings and schedules.
 9. Inlet and outlet connections to each refrigeration machine evaporator and condenser, inlet, outlet, make-up and balance pipe connections to each cooling tower, heat exchanger.
- Drain cocks shall be supplied and fitted where indicated on the drawings and in the Specification and at the low points on all water systems to ensure complete drainage.
 - Automatic Air vents shall be supplied and fitted where indicated on the drawings and in the Specification and at all high points on all water systems to ensure complete air removal
 - Provide 25mm drain valves with threaded ends for hose connections at drain points, at main shutoff valves, low points of piping systems, bases of vertical risers, and at equipment.
 - Provide renewable bronze seat rings and bronze spindles for cast iron body valves.
 - Provide chain operated sheaves and chains for all valves which are more than 2.5m above the floor in Mechanical Equipment Rooms.
 - Furnish and install other valves, check valves, cocks, etc., as required for the complete and proper valving of the entire installation.

1.4 SUBMITTALS

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 1. Pointwise Compliance statement
 2. Valve Selection calculations
 3. Body material
 4. Valve design
 5. Pressure and temperature classification
 6. End connection details
 7. Seating Materials
 8. Trim materials and arrangement
 9. Dimensions and required clearances
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Products

1.5 General Requirements For Valves

- Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- Valve Sizes: Same as upstream piping unless otherwise indicated.
- Valve Actuator Types:
 1. Gear Actuator: For quarter-turn valves DN 200 and larger.
 2. Handwheel: For valves other than quarter-turn types.
 3. Handlever: For quarter-turn valves DN 150 and smaller except plug valves.
 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- Valves in Insulated Piping: With 50mm stem extensions and the following features:
 1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.
- Valve-End Connections:
 1. Flanged: With flanges according to BS EN 1092.
 2. Threaded: With threads according to BS EN ISO 228

1.6 Chainwheels

- Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to butterfly valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

1.7 COMMISSIONING VALVE SETS

- General Requirements
 1. The commissioning stations specified hereinafter and/or shown on the drawings are a flow measurement device close coupled to the variable



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

orifice double regulating valve on the return (i.e. single valve commissioning).

2. Where, as an alternative, commissioning stations of the remote type are selected, include for all necessary works associated with their required location and compliance with the manufacturers recommendations (i.e. two valve commissioning).
3. The variable orifice double regulating valve forming part of the flow measurement devices are to be selected for particular application such that the flow rates are achieved with the valve position more than 25% open. Valve signal strength to be between 4-10 kPa
4. Accuracy of flow rate derived from pressure readings to be +/- 5%
5. The minimum pressure differential signal should not be less than 3 kPa to provide good accuracy of flow measurements
6. The Contractor should note that the commissioning station will not necessarily be of full line size and he shall allow for providing reducers immediately adjacent to these valves as necessary.
7. Contractor shall include for the provision of an electronic portable test manometer kit suitable for measuring differential pressures across the orifice valves. Accurate flow differential pressures shall be provided to the Contractor at the commissioning stage of the project. This test equipment shall be issued to the Client upon completion of the works. Instruction in the use of this equipment shall be included.

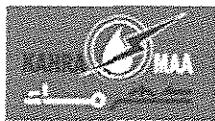
• DN10 – DN50

1. Application: CHW and LTHW Balancing
2. Type: Variable orifice Oblique or Y Pattern, Non rising stem with numerical indicator
3. Functionality:
 - a. Balancing
 - b. Pre-setting
 - c. Measuring
 - d. Shut-off
 - e. Draining (optional)
4. Pressure Class: PN 20 (or as required)
5. Temperature Range: -20°C to 120°C
6. Materials



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- a. Body: Bronze or DZR Copper Alloy to BS5154
- b. Trim: Manufacturers Recommended
- c. Handwheel: Polyamide
- DN65 – DN150
 - 1. Application: CHW and LTHW Balancing
 - 2. Type: Variable Orifice Oblique or Y Pattern, Non rising stem with numerical indicator
 - 3. Functionality:
 - a. Balancing
 - b. Pre-setting
 - c. Measuring
 - d. Shut-off
 - 4. Pressure Class: PN 16 (or as required)
 - 5. Temperature Range: -100°C to 120°C
 - 6. Materials
 - a. Body: Cast iron EN-GJL-250 (GG 25)
 - b. Trim: Manufacturers Recommended
 - c. Handwheel: Polyamide
- DN200 – DN400
 - 1. Application: CHW and LTHW Balancing
 - 2. Type: Variable Orifice Oblique or Y Pattern, Non rising stem with numerical indicator
 - 3. Functionality:
 - a. Balancing
 - b. Pre-setting
 - c. Measuring
 - d. Shut-off
 - 4. Pressure Class: PN 16 (or as required)
 - 5. Temperature Range: -20°C to 120°C



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

6. Materials

- a. Body: Ductile iron EN-GJS-400-15
- b. Trim: Manufacturers Recommended
- c. Handwheel: Aluminum

1.8 Automatic Balancing Valves

- General Requirements
 1. Factory set removable cartridge to ensure stated flow rate under all pressure conditions
 2. Where ABVs are provided in combination with modulating control valve contractor to demonstrate that the ABV will move to fully open position within first 10% of modulating valves stroke
 3. Accuracy of ABVs to be demonstrably within +/-5% of true flow rate
- DN20 – DN400
 1. Application: CHW and LTHW Flow automatic balancing
 2. Type: Cartridge or combination valve
 3. Functionality:
 - a. Automatic Balancing
 - b. Shut off (optional)
 4. Pressure Class: PN 16 (or as required)
 5. Temperature Range: -20°C to 120°C
 6. Materials:
 - a. Fixed orifice: Ductile iron or DZR
 - b. Flow cartridge: Brass
 - c. Seals: EDPM
 - d. Ball valve: Brass (optional)
 - e. Hand lever: Steel with PVC sleeve (optional)

1.9 Differential Pressure Control Valves (Dpcv)

- General Requirements
 1. Self-acting, adjustable, differential pressure control valve designed to absorb unwanted head pressure and maintaining downstream pressure.



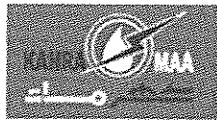
**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

2. The valve should have integral spring and diaphragm arrangement for differential pressure control.
 3. To be supplied with companion valve or valves for shut off, flow measurement and connection of capillary tube
 4. Contractor to select DPCVs based on flow rate, calculated downstream pressure range and maximum anticipated differential pressure. Calculations to be submitted to the engineer for approval prior to procurement
 5. Shut off valve to be provided for the capillary pipe of DPCV sizes DN65 and above
- DN 15 – DN 50
 1. Application: CHW and LTHW Flow Differential Pressure Control
 2. Type: Self acting, Adjustable Dynamic DP Control Valve
 3. Functionality:
 - a. Automatic Balancing
 - b. Differential pressure control
 - c. Adjustable differential pressure
 - d. Flow measurement
 - e. Shut off
 4. Pressure Class: PN 16
 5. Maximum Differential Pressure: 250 kPa
 6. Setting Range: as required
 7. Temperature Range: -20°C to 120°C
 8. Materials:
 - a. Body: Bronze or DZR Copper Alloy
 - b. Bonnet: Bronze or DZR Copper Alloy
 - c. Chamber: Bronze or DZR Copper Alloy
 - d. Diaphragm: Rubber EDPM or manufacturer recommended
 - e. Spring: Stainless steel
 - f. Adjuster: Nylon or Polyamide



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- g. Capillary Tube: manufacturers recommended
- DN 65 and above
 - 1. Application: CHW and LTHW Flow Differential Pressure Control
 - 2. Type: Self-acting, Adjustable Dynamic DP Control Valve
 - 3. Functionality:
 - a. Automatic Balancing
 - b. Differential pressure control
 - c. Adjustable differential pressure
 - d. Flow measurement
 - e. Shut off
 - 4. Pressure Class: PN 16
 - 5. Maximum Differential Pressure: 350 kPa
 - 6. Setting Range: as required
 - 7. Temperature Range: -10°C to 120°C
 - 8. Materials:
 - a. Body: Cast iron to EN-GJL-250 (GG 25)
 - b. Bonnet: Bronze or DZR Copper Alloy
 - c. Chamber: Bronze or DZR Copper Alloy
 - d. Diaphragm: Rubber EDPM or manufacturer recommended
 - e. Spring: Stainless steel
 - f. Adjuster: Nylon or Polyamide
 - g. Capillary Tube: manufacturers recommended
- DN 15 – DN 50
 - 1. Application: CHW and LTHW Flow Differential Pressure Control
 - 2. Type: Self acting, Adjustable Dynamic DP Control Valve
 - 3. Functionality:
 - a. Automatic Balancing
 - b. Differential pressure control



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- c. Adjustable differential pressure
- 4. Pressure Class: PN 25
- 5. Maximum Differential Pressure: 1600 kPa
- 6. Setting Range: as required
- 7. Temperature Range: -10°C to 120°C
- 8. Materials:
 - a. Body: Ductile iron EN-GJS-400
 - b. Diaphragm & gaskets: EDPM
 - c. Spring: Stainless steel
 - d. Adjustment ring: Ryton PPS
 - e. Capillary Tube: manufacturers recommended
 - f. Surface treatment: Electrophoretic painting
 - g. Flanges: According to EN-1092-2:1997, type 16.
- DN 65 – DN 150
 - 1. Application: CHW and LTHW Flow Differential Pressure Control
 - 2. Type: Self acting, Adjustable Dynamic DP Control Valve
 - 3. Functionality:
 - a. Automatic Balancing
 - b. Differential pressure control
 - c. Adjustable differential pressure
 - 4. Pressure Class: PN 25
 - 5. Maximum Differential Pressure: 1600 kPa
 - 6. Setting Range: as required
 - 7. Temperature Range: -10°C to 120°C
 - 8. Materials:
 - a. Body: Ductile iron EN-GJS-400
 - b. Diaphragm & gaskets: EDPM



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- c. Spring: Stainless steel
- d. Adjustment ring: R St 37-2 steel for DN65-125
- e. Capillary Tube: manufacturers recommended
- f. Surface treatment: Electrophoretic painting
- g. Flanges: According to EN-1092-2:1997, type 21
- DN 200
 - 1. Application: CHW and LTHW Flow Differential Pressure Control
 - 2. Type: Self acting, Adjustable Dynamic DP Control Valve
 - 3. Functionality:
 - a. Automatic Balancing
 - b. Differential pressure control
 - c. Adjustable differential pressure
 - 4. Pressure Class: PN 25
 - 5. Maximum Differential Pressure: 1600 kPa
 - 6. Setting Range: as required
 - 7. Temperature Range: -10°C to 120°C
 - 8. Materials:
 - a. Body: Ductile iron EN-GJS-400
 - b. Diaphragm: EDPM
 - c. Valve seat: Stainless steel
 - d. Valve plug: Stainless steel with EPDM insert
 - e. Capillary Tube: manufacturers recommended
 - f. Surface treatment: Duasolid painting
 - g. Flanges: According to EN-1092-2:1997, type 21

1.10 Pressure Independent Control Valves (Picv)

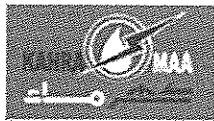
- General Requirements

- 1. The pressure independent control valves shall contain a differential control and temperature control element.



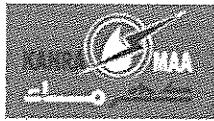
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

2. The differential pressure control valve shall provide accurate and stable differential pressure control over the full range of system pressures ensuring maximized valve authority at the control valve.
 3. The valve shall be a dynamic type that shall enable it to automatically keep a constant differential pressure across the internal controlling orifice of the valve. Consequently pressure drop fluctuations across the valve shall not effect the set flow.
 4. The control signals input and feedback shall automatically adapt to the pre-set range of the valve.
 5. The valve shall also have a maximum pre-set adjustable flow rate limit.
 6. The valve shall have test points for flow measurement using Kv methodology. If the PICV cannot provide flow rate measurement using Kv methodology, the contractor is to provide an orifice plate along with each PICV
 7. The valve should have EQM characteristics
 8. Accuracy of ABVs to be demonstrably within +/- 5% of true flow rate
 9. The valve should have rangeability ≥ 100
- DN 15 to DN 50
 1. Application: CHW and LTHW Differential pressure control and flow modulation
 2. Type: Self acting, Adjustable Dynamic DP Control Valve with modulating control valve and actuator
 3. Functionality:
 - a. Automatic Balancing
 - b. Differential pressure control
 - c. Modulating flow control
 - d. Adjustable differential pressure
 - e. Flow measurement using kV method
 - f. Shut off
 4. Pressure Class: PN 16
 5. Maximum Differential Pressure: 350 kPa
 6. Setting Range: as required



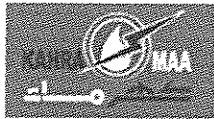
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7. Temperature Range: -20°C to 120°C
8. Materials:
 - a. Body: Bronze or DZR Alloy
 - b. Bonnet: Bronze or DZR Copper Alloy
 - c. Diaphragm: Rubber EDPM or manufacturer recommended
 - d. Spring: Stainless steel
 - e. Adjuster: Nylon or Polyamide
9. Actuator:
 - a. Rated to IP 54
 - b. Actuator shall be driven by a 24VDC motor, and shall accept 2-10v VDCV, 4-20mA, pulse width modulation electronic signal and shall include a resistor to facilitate any of these signals.
 - c. Actuator shall be capable of providing 4-20mA or 2-10v DC feedback signal to the BMS control system.
 - d. External readout of current valve position and maximum valve position setting shall be available.
- DN 65 to DN 150
 1. Application: CHW and LTHW Differential pressure control and flow modulation
 2. Type: Self acting, Adjustable Dynamic DP Control Valve with modulating control valve and actuator
 3. Functionality:
 - a. Automatic Balancing
 - b. Differential pressure control
 - c. Modulating flow control
 - d. Adjustable differential pressure
 - e. Flow measurement using kV method
 - f. Shut off
 4. Pressure Class: PN 16 (or as required)
 5. Maximum Differential Pressure: 500 kPa



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

6. Setting Range: as required
7. Temperature Range: -20°C to 120°C
8. Materials:
 - a. Body: Ductile Iron EN-GJS-400
 - b. Bonnet: Bronze or DZR Copper Alloy
 - c. Diaphragm: Rubber EDPM or manufacturer recommended
 - d. Spring: Stainless steel
 - e. Adjuster: Nylon or Polyamide
9. Actuator:
 - a. Rated to IP 54
 - b. Actuator shall be driven by a 24VDC motor, and shall accept 2-10v VDCV, 4-20mA, pulse width modulation electronic signal and shall include a resistor to facilitate any of these signals.
 - c. Actuator shall be capable of providing 4-20mA or 2-10v DC feedback signal to the BMS control system.
 - d. External readout of current valve position and maximum valve position setting shall be available.
- DN 15 to DN 125
 1. Application: CHW and LTHW Differential pressure control and flow modulation
 2. Type: Self acting, Adjustable Dynamic DP Control Valve with modulating control valve and actuator
 3. Functionality:
 - a. Automatic Balancing
 - b. Differential pressure control
 - c. Modulating flow control
 - d. Flow measurement
 - e. Shut off
 4. Pressure Class: PN 16 (or as required)
 5. Maximum Differential Pressure: 1600 kPa



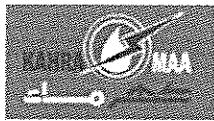
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

6. Setting Range: as required
7. Temperature Range: -10°C to 120°C
8. Materials:
 - a. Body: Ductile Iron EN-GJS-400
 - b. Diaphragms & gaskets: EDPM
 - c. Valve Plug: EPDM / Stainless steel
 - d. Adjuster: Nylon or Polyamide
9. Actuator:
 - a. Rated to IP 54
 - b. Actuator shall be driven by a 24VDC motor, and shall accept 0-10v VDCV.
 - c. Actuator shall be capable of providing 0-10v DC feedback signal to the BMS control system.
 - d. External readout of current valve position and maximum valve position setting shall be available.

1.11 2 Port Modulating Control Valves

• General Requirements

1. All modulating control valves to be infinitely adjustable equal percentage type valves with matched actuator.
 2. EQM characteristic of the valve should be independent from the valve presetting
 3. Contractor to select control valves to ensure a minimum valve authority of 0.25 under all part load conditions
 4. Simple line size valve selection will not be acceptable and the contractor is to allow for all necessary pipe fittings associated with changing pipe size
 5. Selection calculations stamped by the valve manufacturer or hydronic specialist to be provided as part of the technical submittal
 6. The valve should have the capacity for manual, leak-tight shut off without the actuator attached for maintenance purposes
- DN 15 to DN 50
1. Application: CHW and LTHW actuated flow modulation
 2. Type: Equal Percentage at all presetting and fully modulating actuated control valve

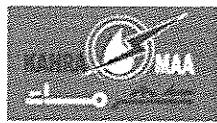


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

3. Functionality:
 - a. Modulating flow control
 - b. Shut off
4. Pressure Class: PN 16 (or as required)
5. Temperature Range: -20°C to 120°C
6. Range ability: 100:1
7. Materials:
 - a. Body: Bronze or DZR Copper Alloy (DN15-50) and Ductile iron EN-GJS-400-15 (DN65-150)
 - b. Plug: Bronze or DZR Copper Alloy (DN15-50) and Stainless steel (DN 65-150)
 - c. Stem: Stainless Steel
 - d. Stem sealing: EPDM O-rings
8. Actuator:
 - a. Rated to IP 54
 - b. Actuator shall be driven by a 24VDC motor, and shall accept 2-10v VDCV, 4-20mA, pulse width modulation electronic signal and shall include a resistor to facilitate any of these signals.
 - c. Actuator shall be capable of providing 4-20mA or 2-10v DC feedback signal to the BMS control system.
 - d. External readout of current valve position and maximum valve position setting shall be available.

1.12 Orifice Plates

- General Requirements
 1. Stem to be selected to protrude past proposed insulation and cladding
 2. Unless otherwise stated by manufacturer installation to allow for 10 pipe diameters before and 5 pipe diameters after Orifice Plate
- DN20 – DN900
 1. Application: CHW and LTHW Flow verification
 2. Type: Fixed flow measuring orifice with self-sealed measuring points
 3. Functionality:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

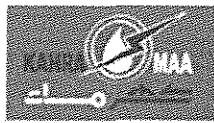
- a. Flow measurement
- 4. Pressure Class: PN 16 (or as required)
- 5. Temperature Range: -20°C to 120°C
- 6. Materials:
 - a. Fixed orifice: Stainless Steel
 - b. Measuring Points: Bronze or DZR Copper Alloy
 - c. Seals: EDPM

1.13 Ball Valves

- General Requirements
 - 1. Utilized on LTHW and CHW between DN 10 and DN 25
 - 2. Quarter turn hand lever type, full bore aperture
- DN 10 to DN 25
 - 1. Application: LTHW / CHW Isolation
 - 2. Type: Hand lever, Flange or Threaded as Required
 - 3. Functionality:
 - a. Shut Off
 - 4. Pressure Class: PN 25 (or as required)
 - 5. Temperature Range: -10°C to 135°C
 - 6. Materials:
 - a. Body: DZR Copper Alloy
 - b. Ball: DZR Copper Alloy
 - c. Trim: Manufacturers recommended
 - d. Hand Lever: Steel with PVC Sleeve

1.14 Gate Valves

- General Requirements
 - 1. Utilized on LTHW and CHW between DN 30 and DN 400 to BS EN 1171
 - 2. Stem to be non-rising type
- DN 10 to DN 50
 - 1. Application: LTHW / CHW Isolation



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

2. Type: Handwheel, Flange or Threaded as Required
 3. Functionality:
 - a. Shut Off
 4. Pressure Class: PN 16 (or as required)
 5. Temperature Range: -10°C to 135°C
 6. Materials:
 - a. Body: Bronze
 - b. Trim: Manufacturers recommended
 - c. Hand Wheel: Aluminium.
- DN 65 to DN 400
 1. Application: LTHW / CHW Isolation
 2. Type: Handwheel, Flanged connections
 3. Functionality:
 - a. Shut Off
 4. Pressure Class: PN 16 (or as required)
 5. Temperature Range: -10°C to 135°C
 6. Materials:
 - a. Body: Cast Iron to BS EN 1561
 - b. Bonnet: Cast Iron to BS EN 1561
 - c. Disc: Cast Iron to BS EN 1561
 - d. Stem: Stainless Steel to BS 970
 - e. Hand wheel: Cast Iron to BS EN 1561
 - f. Trim: Manufacturers standard
 - g. Finish: Manufacturers standard

1.15 Butterfly Valves

- General Requirements

1. Utilized on LTHW and CHW between over DN 65 to BS EN 593
2. Lever operated up to DN 150



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- 3. Gear operated above DN 150
- 4. Butterfly valves may be provided in lieu of gate valves in sizes 150mm or larger, subject to review by the Engineer.
- DN 65 and above
 - 1. Application: LTHW / CHW Isolation
 - 2. Type: Lever or gear operated, Flanged
 - 3. Functionality:
 - a. Shut Off
 - 4. Pressure Class: PN 16 (or as required)
 - 5. Temperature Range: -10°C to 135°C
 - 6. Materials:
 - a. Body: Cast iron to BS EN 1563
 - b. Shaft: Stainless Steel
 - c. Disc: Bronze
 - d. Bushes: PTFE

1.16 Safety And Relief Valves

- General Requirements

- 1. Safety and relief valves shall be to BS EN ISO 4126-1
- 2. To be totally enclosed spring-loaded type with padlock.
- 3. Suitable for the operating conditions of the system.
- 4. Safety valves shall be manufactured by an approved firm from materials suitable for the scheduled operating conditions. If the manufacturer recommends the use of special pipeline connections, these shall be supplied.
- 5. The valve shall be designed to open at the scheduled limit of pressure. The valve shall deal effectively with small excesses and shall quickly relieve dangerous conditions in the pipeline.
- 6. Valve to open proportionally to increases in pressure over the set level
- 7. The valve seat shall give a positive seal at all conditions of operating temperature and pressure up to the scheduled limit points.
- 8. The working parts of the valve shall be effectively screened from the contents of the pipeline by means of diaphragms. Pressure adjustment



Qatar General Electricity & Water Corporation

Tender NO. GTC 626/2014

Construction of Mega Reservoir PRPSs

(Packages A, B, C, D & E)

shall be locked and sealed by the manufacturer. An easily operating test lever shall be fitted and the operator shall be effectively protected from scalding during the testing operation.

9. A full bore copper pipeline shall be taken from the valve discharge outlet to a suitable discharge point. This extension pipe shall be hard-soldered throughout and properly clipped to the building fabric.

- All sizes

1. Application: Excess pressure relief
2. Type: Spring release pressure relief valve diaphragm protected working components
3. Functionality:
 - a. Automatic pressure relief
4. Pressure Class: PN 16 (or as required)
5. Set Pressure: As required
6. Temperature Range: -10°C to 190°C
7. Materials:
 - a. Body: Bronze
 - b. Diaphragm: EDPM
 - c. Spring: Steel

1.17 Drain Valves

- General Requirements

1. Drain valves shall be provided at:
 - a. The bottom of every riser.
 - b. Outlets of equipment on the equipment side of isolating valves.
 - c. All low points of pipework.
 - d. Intervals not exceeding 100m.
 - e. As defined on the contract drawings
2. To be provided complete with hose union connector
3. Drain valves sizes shall be line size up to DN40 and DN50 for larger line sizes.

- DN 10 – DN 50



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. Application: System draining and sediment removal
2. Type: screwed end, solid wedge disc, inside screw, non-rising stem, and screwed-in bonnet lock-shield type gate valves
3. Functionality:
 - a. System draining and sediment removal
4. Pressure Class: PN 16 (or as required)
5. Set Pressure: As required
6. Temperature Range: -10°C to 190°C
7. Materials:
 - a. Body: Bronze
 - b. Stem: Brass
 - c. Bonnet: Brass
 - d. Disc Holder: Brass

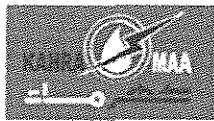
1.18 Automatic Air Eliminators

• General Requirements

1. Automatic air relief valves shall be provided at the top of all risers and all other high points to prevent air lock. Wherever possible, piping shall be graded to permit natural venting and draining to a minimum number of points in the system.
2. Strainers over 100 mm shall be complete with an adequate size of blow-down connection and drain cock and shall have a discharge pipe which shall run to the nearest gully.
3. Strainer baskets to be removable via cap without necessitating the removal of the strainer body from the pipeline

• All sizes

1. Application: Automatic release of air at system high points
2. Type: Float action operated
3. Functionality:
 - a. Air removal
 - b. System drain vacuum breaker
4. Pressure Class: PN 16 (or as required)



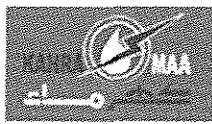
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

5. Set Pressure: As required
6. Temperature Range: -10°C to 190°C
7. Materials:
 - a. Body: Bronze or DZR alloy
 - b. Float: polypropylene
 - c. Release: polypropylene

1.19 Pipeline Strainers

• General Requirements

1. Strainers generally of 'Y' pattern shall be provided to protect:
 - a. Automatic control valves.
 - b. Pressure reducing valves.
 - c. Meters.
 - d. Other sensitive fittings or circuits, as indicated.
 2. Strainer screens shall have free-area of perforation at least 250% of pipe bore
- DN 10 to DN 50
1. Application: Removal of particulates from LTHW and CHW systems
 2. Type: Y pattern basket with threaded cap
 3. Functionality:
 - a. Inline dirt removal
 4. Pressure Class: PN 16 (or as required)
 5. Temperature Range: -10°C to 120°C
 6. Basket Perforations: 0.7-0.9mm
 7. Materials:
 - a. Body: Bronze or DZR alloy
 - b. Screen: Stainless steel
- DN 65 to DN 400
1. Application: Removal of particulates from LTHW and CHW systems
 2. Type: Y pattern basket bolted end cover



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

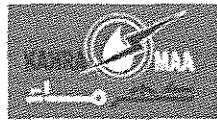
3. Functionality:
 - a. Inline dirt removal
4. Pressure Class: PN 16 (or as required)
5. Temperature Range: -10°C to 120°C
6. Basket Perforations: 1.5-1.8mm
7. Materials:
 - a. Body: cast-iron to BS EN 1561
 - b. Screen: Stainless steel

1.20 BINDER TEST POINTS

- General Requirements
 1. Stem to be selected to protrude past proposed insulation and cladding
- All sizes
 1. Application: LTHW / CHW Temperature and Pressure probe test points with retained cap
 2. Type: Self Sealing test point
 3. Functionality:
 - a. Probe test point
 4. Pressure Class: PN 16 (or as required)
 5. Temperature Range: -10°C to 135°C
 6. Materials:
 - a. Body, cap and retaining ring: Brass.
 - b. Cap seal: Neoprene Rubber.
 - c. Retaining strap: Ethylene Propylene Rubber.
 - d. Core: Ethylene Propylene Rubber.

1.21 Swing Check Valves

- General Requirements
 1. Entirely automatic operation swing or Oblique pattern check valve
 2. Check valves permit flow in one direction only, and close automatically if flow reverses.
 3. Check valves to be WRAS and BSI approved



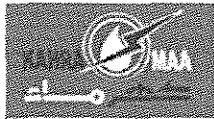
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

4. System pump check valves to include spring closer
- DN 10 to DN 50
 1. Application: LTHW / CHW flow reversal protection
 2. Type: Swing check valve with threaded connectors
 3. Functionality:
 - a. Flow reversal protection
 4. Pressure Class: PN 25 (or as required)
 5. Temperature Range: -10°C to 120C
 6. Materials:
 - a. Body: Bronze or DZR
 - b. Hinge: Stainless Steel
 - c. Disc: Brass or Bronze
- DN 65 and above
 1. Application: LTHW / CHW flow reversal protection
 2. Type: Swing check valve with flanged connectors
 3. Functionality:
 - a. Flow reversal protection
 4. Pressure Class: PN 25 (or as required)
 5. Temperature Range: -10°C to 120C
 6. Materials:
 - a. Body: Cast Iron
 - b. Hinge: Stainless Steel
 - c. Disc: Brass or Bronze

Execution

1.22 Examination

- Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Examine threads on valve and mating pipe for form and cleanliness.
- Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- Do not attempt to repair defective valves; replace with new valves.

1.23 Valve Installation

- Install valves in strict accordance with manufacturer's recommendations with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- All valves shall be installed only in the upright vertical or horizontal positions unless specifically otherwise required by the drawings.
- All valves shall be installed in accessible locations to facilitate easy removal for repair or replacement. Install with operating clearance for handle and stem.
- Install isolation valves on equipment so that valve and piping do not interfere with equipment removal or maintenance. Install unions or flanges on equipment side of valves.
- Install butterfly valves in horizontal piping with stem in the horizontal position so that bottom of disk lifts in the direction of flow. Install butterfly valves in vertical piping at pumps with stem perpendicular to pump shaft.
- Locate valves for easy access and provide separate support where necessary.
- Install valves in horizontal piping with stem at or above center of pipe.
- Install valves in position to allow full stem movement.
- Install chainwheels on operators for butterfly, gate and globe valves DN 100 and larger and more than 2400mm above floor. Extend chains to 1520mm above finished floor.
- Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

1.24 Adjusting

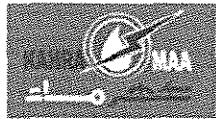
Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

1.25 Asbestos Materials In Valves

- To ensure that all valves, stopcocks, etc, contain no asbestos the following sentence should be included on all orders:
 1. "All gaskets, fire seals and packing shall be manufactured from asbestos free materials."
 2. "Submit valve, stopcock, etc, manufacturer's confirmation that all materials used are asbestos free."

1.26 Measuring Interference

- In order to minimise spurious turbulence in the flow thorough flow measurement devices such as:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. Orifice plates or rings
 2. Flow measurement valves
 3. Flow measurement fixed orifice double regulating valves
 4. Flow measurement variable orifice double regulating valves
- Ensure that the installation provides a minimum of 10 diameters of straight pipe, of the same nominal bore as the device or valve, upstream and at least 5 diameters of straight pipe downstream clear of any disturbing influences such as bends, tees, valves, vessels, etc.
 - Ensure that all regulating and orifice valves will give a measurable reading on a manometer when passing the design flow rates, and will include for reducers where valves are not line size. Submit a schedule of valves and their pressure losses to the Engineer for acceptance

7.3.8 23 0529 - Hangers and Supports for HVAC Piping and Equipment

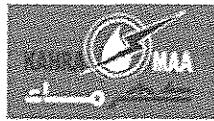
General

1.1 SUMMARY

- Section Includes:
 1. Metal pipe hangers and supports.
 2. Trapeze pipe hangers.
 3. Thermal-hanger shield inserts.
 4. Fastener systems.
- Related Sections
 1. 23 0500 - Common Work Results for HVAC
 2. 23 0516 - Expansion fittings and loops for HVAC piping
 3. 23 2113 - Hydronic Piping
 4. 23 2213 - Steam and condensate heating piping
 5. 23 3000 - Refrigerant piping
 6. 23 3113 - Metal Ducts
 7. 23 3116 - Nonmetallic ducts

1.2 References

1. BS 4429 Rigging Screws and Turnbuckles for General Engineering, Lifting Purposes and Pipe Hanger Appliances (AMD 5875) June 30, 1989-Amd 1;



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

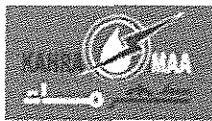
2. BS 5950-1:2000 - Structural use of steelwork in building. Code of practice for design. Rolled and welded sections
3. BS 7668:2004 - Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification
4. BS EN 1090-1:2009+A1:2011 - Execution of steel structures and aluminium structures. Requirements for conformity assessment of structural components
5. Local Power Supply Authority Regulations.

1.3 Submittals

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 1. Rated capacities
 2. Detailed assembly drawings
 3. Dimensions
 4. Weights
 5. Method of field assembly
 6. Components
- Product Data: Catalogue sheets, specifications and installation instructions.
- Point-wise compliance statement to the specifications duty signed by the manufacturer / manufacturer's authorized representative and by the Contractor.
- Load and thrust calculations for all piped service installations
- The Contractor shall follow to the submittal procedures outlined in the "General Requirements and Scope of Works".

1.4 General Requirements

- Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- Pipework supports are to be arranged so that no undue stress is imposed upon the pipes.
- Ensure that all materials used for pipework supports are compatible with the pipeline materials.
- Pipework supports shall not exceed the maximum intervals stated elsewhere.
- Pipe and duct supports shall be resistant to corrosion. All external supports shall as a minimum be galvanized. Supports exposed to extreme conditions such as coastal application or in the vicinity of cooling towers shall in addition be provided with suitable epoxy coatings. All internal supports shall also be galvanized.
- Additional supports shall be provided for equipment such as valves, strainers and ancillaries so that minimum stress is imposed on the pipework and the weight is not



Qatar General Electricity & Water Corporation Tender NO. GTC 626/2014

Construction of Mega Reservoir PRPSs (Packages A, B, C, D & E)

taken by the pipework. The support arrangement shall allow safe operation and removal of the component.

- All brackets and supports shall allow free movement of the pipes due to expansion and contraction with special regard to prevention of damage to any thermal insulation and vapour barrier.
- Where multiple pipe runs of differing bores are supported from a common point, use support spacing of pipe requiring the closest spacing with adequate provision for the unequal movement due to expansion and contraction. Supports shall also be provided at bends where there is a run of pipework 1 metre or more both sides of the bend.
- Cantilever type supports from walls will not be allowed except for single pipes of diameters up to 50 mm.
- Static point loadings transferred to the structure which cannot be accommodated by the structural fixings shall be spread over a larger area by means of additional brackets and/or additional load spreading primary steelwork.
- The installer will be responsible for marking out the exact positions where pipe brackets are to be built in and for checking the accuracy, levels and alignment of supports after building in by others.
- For vertical support spacing check total self-weight and pressure loading against manufacturer's recommendations when using mechanical joints or end load capable flexible couplings. Ensure adequate support when using non-end load capable flexible couplings.
- Obtain approval for all fixings to structural concrete or structural steelwork and loads imposed on the structure. Shot fired fixings shall not be used or any reinforcement drilled through.

1.5 Quality Assurance

- Manufacturer's Qualifications:
 1. Company specializing in manufacturing Products specified in this Section with minimum three years' experience.
 2. Manufacturer is ISO 9001:2000 certified.

- Undertake installation and procure materials in accordance to BS 6946.

1.6 Delivery, Storage And Handling

- Material delivered to jobsite shall be stored in original packaging per manufacturer's requirements.

Products

1.7 Manufacturers

- Materials and products proposed by the Contractor shall be compliant with the Specification. All material submittals shall be approved by the Engineer prior to procurement.
- Refer the Approved Suppliers List in the "General Requirements and Scope of Works".

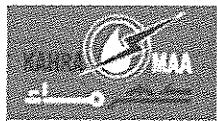
1.8 Support, Anchorage, And Attachment Components

- Steel Slotted Support Systems:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. Comply with BS 6946:1988 - Specification for metal channel cable support systems for electrical installations
 2. Minimum material channel yield strength shall be 170N/mm.sq unless otherwise stated.
 3. Brackets, support hardware and accessories shall have a minimum yield strength of 170N/mm.sq unless otherwise stated.
 4. Maximum length of channel shall be no greater than 6m.
 5. Minimum material thickness on all components shall be no less than 2.5mm.
 6. Channel dimensions shall be selected in accordance with manufacturers guidance and be suitable for the applicable load criteria.
- Nonmetallic Slotted Support Systems:
 1. Structural-grade, factory-formed, glass-fiber-resin channels and angles with (14-mm diameter holes at a maximum of 200 mm, in at least 1 surface.
 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 4. Channel dimensions shall be selected in accordance with manufacturers guidance and be suitable for the applicable load criteria.
- 1.9 Metal Pipe Hangers And Supports**
- Carbon-Steel Pipe Hangers and Supports:
 1. To BS 3974 or equivalent
 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 - Stainless-Steel Pipe Hangers and Supports:
 1. To BS 3974 or equivalent
 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

1.10 Trapeze Pipe Hangers

- Provide trapeze hangers where several pipes can be installed parallel and at the same level, and fabricate from structural steel shapes. Use roller chairs or pipe-roll stands where provision for expansion is required:
 1. Spacing shall not be farther than the closest interval required for any size pipe supported thereby, or as necessary to prevent damage or failure to the structure.
 2. Where there is doubt of the structural capacity for concentrated loads necessary structural calculations shall be carried out and the load distributed sufficiently.
 3. Supporting rods over 450 mm long shall be braced at every fourth hanger with diagonal bracing attached to the structure.
 4. The Contractor shall select support distances such that the precast structure is not subjected to excessive point loads. The contractor will be required to submit calculations to demonstrate that the proposed loads can be safely supported from the structure.

1.11 THERMAL-HANGER SHIELD INSERTS

- Insulation-Insert Material for Cold Piping: BS 3958 cellular glass with 688-kPa minimum compressive strength and vapor barrier.
- Insulation-Insert Material for Hot Piping: Water-repellent treated, BS 3958 calcium silicate with 688-kPa minimum compressive strength.
- For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- Insert Length: Extend 50mm beyond sheet metal shield for piping operating below ambient air temperature.

1.12 Fastener Systems

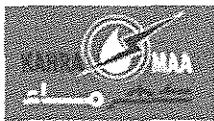
- Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Subject to structural engineer analyses.
- Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1.13 Equipment Supports

- Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

1.14 Miscellaneous Materials

- Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 34.5MPa, 28-day compressive strength.

Execution

- 1.15 Hanger And Support Installation (Subject To Structural Engineer Requirements)**
- Provide hangers at each change in direction on both sides of each valve and on both sides of cast iron pipe fittings.
 - Regardless of the type of construction (i.e., concrete, concrete-deck-steel or other variations) take particular care to support all main lines and all large and heavy pipes in an approved manner, including the furnishing and installation of supplementary steel, if required. Supplementary steel sections are to be mill-rolled.
 - Set all inserts for all pipes in ample time to allow concrete work to be performed on scheduled time.
 - Do not hang piping from other piping. Support of hangers by means of vertical expansion bolts is not permitted.
 - Support all lines of copper tubing individually by approved type hangers not more than 2m apart, or as shown on the drawings. Use hangers especially designed for copper tubing and of exact outside diameter of tubing. On hangers for covered tubing, use broad straps fitting outside of covering.
 - Hangers used for cold piping will support the pipe without piercing the insulation. Use insulation shields to protect the insulation on cold pipes. Weld insulation protection saddles to insulated hot pipes, or any piping subject to axial movement, at roller supports. Space between pipe and saddle to be filled with insulation.
 - For piping 100mm and larger, support the elbows of the piping adjacent to the pumps with steel base elbow supports from the inertia base which pump is on to prevent loading heavy weights of piping on pump casing. Where inertia base is not provided, base elbows to be supported on floor with 25mm neoprene pad.
 - All pipes supports shall be of such design and type to allow for the removal of any pipe section without the necessity of disconnecting other adjacent pipes.
 - In all plant and pump rooms discharge pipework from pumps, and all pipework where vibration could be transmitted to the building structure, shall be supported with brackets having a tough rubber lining in contact between the bracket and the pipe shall have anti-vibration hangers/supports.
 - The space between pipe sleeves and the pipe or insulation shall be completely backfilled with materials having the same fire resistant rating as the walls and floors by the Contractor. Should multi-services or more than one single pipe be laid through box-out, the space between the individual pipe sleeves shall be sealed off. The space between the pipe sleeves and the service pipes shall be back-filled.
 - Details of pipes through walls and floors shall be approval by the Engineer before installation.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

1.16 Metal Fabrications

- Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- Field Welding: Comply with BS 4515 procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

1.17 Adjusting

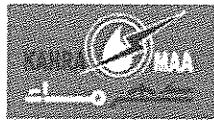
- Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- Trim excess length of continuous-thread hanger and support rods to 40mm.

1.18 Painting

- Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 0.05mm.
 2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

1.19 Hanger And Support Schedule

- Hydronic Piping
 1. Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.
 2. Hangers for Cold Pipe Sizes 50 mm and Larger: Carbon steel, adjustable, clevis.
 3. Hangers for Hot Pipe Sizes 50 to 100 mm: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 150mm & Larger: Adjustable steel yoke, cast iron roll, double hanger
 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.



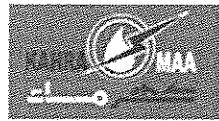
Qatar General Electricity & Water Corporation

Tender NO. GTC 626/2014

Construction of Mega Reservoir PRPSs

(Packages A, B, C, D & E)

6. Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
 7. Wall Support for Pipe Sizes 76 mm and Smaller: Cast iron hooks.
 8. Wall Support for Pipe Sizes 100 mm and Larger: Welded steel bracket and wrought steel clamp.
 9. Wall Support for Hot Pipe Sizes 150 mm and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
 10. Vertical Support: Steel riser clamp.
 11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 12. Floor Support for Hot Pipe Sizes 100 mm and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes 150 mm and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- General Requirements - steam & condensate Piping
 1. Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.
 2. Hangers for Pipe Sizes 50 to 100 mm: Carbon steel, adjustable, clevis.
 3. Hangers for Pipe Sizes 150 mm and Larger: Adjustable steel yoke, cast iron roll, double hanger.
 4. Multiple or Trapeze Hangers for Pipe Sizes 100 mm and Smaller: Steel channels with welded spacers and hanger rods.
 5. Multiple or Trapeze Hangers for Pipe Sizes 150 mm and Larger: Steel channels with welded spacers and hanger rods; cast-iron roll and stand.
 6. Wall Support for Pipe Sizes 70 mm and Smaller: Cast iron hooks.
 7. Wall Support for Pipe Sizes 100 to 125 mm : Welded steel bracket and wrought steel clamp.
 8. Wall Support for Pipe Sizes 150 mm and Larger: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll.
 9. Vertical Support: Steel riser clamp.
 10. Floor Support for Pipe Sizes 100 mm and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

11. Floor Support for Pipe Sizes 150 mm and Larger: Adjustable cast iron roll and stand steel screws, and concrete pier or steel support

• Steel Pipework Spacing

Pipe Bore (nominal)	Maximum Support Spacing		
	Bare	Insulated	Vertical Pipework
up to 15	1.8	1.8	2.4
20	2.4	2.4	3.0
25	2.4	2.4	3.0
32	2.7	2.4	3.0
40	3.0	2.4	3.6
50	3.0	2.4	3.6
65	3.7	3.0	4.6
80	3.7	3.0	4.6
100	3.7	3.0	4.6
125	3.7	3.0	5.4
150	4.5	4.5	5.4
200	5.0	5.0	6.0
250	5.0	5.0	6.0
300	6.1	6.1	9.0
350	9.5	7.0	9.0
400	9.5	7.5	9.5
450	10.0	8.0	10.0
500	11.0	9.0	11.0

7.3.9 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment

General

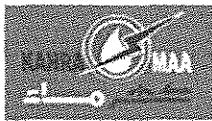
1.1 SUMMARY

- This section includes:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. Inertia bases
 2. Vibration isolators
 3. Vibration isolation spring mountings
 4. Vibration control hangers
 5. Vibration isolation pads
 6. Equipment vibration isolation bases
 7. Flexible connectors
 8. Seismic restraints
 9. Thrust restraints
 10. Isolation pipe anchors / guides
 11. Equipment isolator requirements
 12. Piping isolator requirements
 13. Stress Analysis
- Related Documents:
 1. 23 0500 - Common Work Results for HVAC
 2. 23 0529 - Hangers and Supports for HVAC Piping and Equipment
 3. 23 2113 - Hydronic Piping
 4. 23 2123 - Hydronic Pumps
 5. 23 3413 - Axial HVAC Fans
 6. 23 3416 - Centrifugal HVAC Fans
 7. 23 6416 - Centrifugal Water Chillers
 8. 23 7400 - Central Station Air Handling Units and Outside Air Handling Units
- 1.2 References**
- BS 5228-1:1997 – Noise and vibration control on construction and open sites. Code of practice for basic information and procedures for noise and vibration control.
 - BS ISO 10816-3:2009 – Mechanical vibration. Evaluation of machine vibration by measurements on non-rotating parts. Industrial machines with nominal power above 15 kW and nominal speeds between 120 r/min and 15000 r/min when measured in situ
 - BS EN ISO 354 - Acoustics. Measurement of sound absorption in a reverberation room



Qatar General Electricity & Water Corporation Tender NO. GTC 626/2014

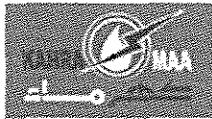
Construction of Mega Reservoir PRPSs (Packages A, B, C, D & E)

- BS EN 61672- Electroacoustics. Sound level meters. Specifications
- BS EN ISO 11820 - Measurements on silencers in situ
- BS EN ISO 7235 - Laboratory measurement procedures for ducted silencers and air terminal units. Insertion loss, flow noise and total pressure loss
- Qatar Construction Specification (QCS 2010).

1.3 Submittals

- Product Data: Provide schedule of vibration isolator type with location and load on each. Furnish a material list with technical data documenting the primary function, quality, and performance of each system to be used in the Work, and other primary characteristics required by the Contract Documents.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate seismic control measures. Furnish shop drawings for the fabrication and installation of the Work. Prepare details at not less than 1:50 minimum scale. Show conditions for the following.
 1. Base constructions, dimensions, structural member sizes, anchor bolts, seismic restraints, support point locations, maximum loading at each location, and piping riser details showing main support of riser, intermediate supports and guiding.
 2. Show items of equipment or piping to be isolated, the isolator type and model number selected, isolator loading and deflection curves, seismic restraints, and references to specific drawings showing base and construction where applicable.
 3. Suspension, isolation at penetrations, and support guides for busbar.
- Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.
- Calculations: Submit for Consultant's information. Calculations shall be prepared and sealed by a suitably qualified Engineer or specialist supplier / manufacturer and shall show compliance with the systems being installed. Furnish engineering calculations showing the design criteria, including, but not limited to, the following items.
 1. Point loadings.
 2. Wall and column attachments.
 3. Embedment's for supporting major items or plant or busbar.
 4. Stresses and forces on mountings and hangers from expansion and contraction of busbar.
- Quality Control Testing and Inspection Reports: Submit for Consultant's information. Furnish report for the specified Field Quality Control inspections.
- Record Documents: Submit for Employer's documentation. Furnish record drawings annotated with the changes made during installation of the Work so as to be a complete set of "as installed" plans.

1.4 Quality Assurance



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Contractor's Quality Control Responsibilities: Contractor is solely responsible for quality control of the Work.
- Qualified Installer: Isolator manufacturer's personnel shall train the Installer in the use of materials and equipment to be employed in the Work. Installer shall verify the completeness of the isolation requirements, and the correctness and overall suitability of the equipment. Vibration isolation manufacturer's representative shall directly supervise the installation of vibration isolation units, and associated hangers and bases.
- Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of the authorities having jurisdiction. Obtain necessary approvals from all such authorities.
- Plant and equipment shall be selected and installed to ensure that the vibration level in the spaces served, in any adjacent buildings and within plant rooms does not exceed the specified criteria. Where vibration criteria are not given for standard rooms and spaces, then appropriate values given in Table 5, Appendix A of BS 6472 shall apply.

1.5 Delivery, Storage, And Handling

General: Deliver and store materials in manufacturer's original packaging labeled to show name, brand, type, and grade. Store materials in protected dry location off ground in accordance with manufacturer's instructions. Do not open packaging nor remove labels until time for installation.

1.6 Project / Site Conditions

Weather Conditions: Do not proceed with the Work during inclement weather nor when weather forecasts are unfavorable, unless the Work will proceed in accordance with the manufacturer's requirements and instructions and any agreements or restrictions of the Preconstruction Conference.

1.7 Maintenance

Maintenance and Operating Manuals: Furnish complete manuals describing the materials, devices and procedures to be followed in operating, cleaning and maintaining the Work. Include manufacturers' brochures and parts lists describing the actual materials used in the Work, including isolators and other major components. Assemble manuals for component parts into single binders identified for each system.

Products

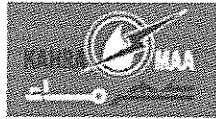
1.8 Manufacturers

- Materials and products proposed by the Contractor shall be compliant with the Specification. All material submittals shall be approved by the Engineer prior to procurement.
- Refer the Approved Suppliers List in the "General Requirements and Scope of Works".

1.9 Inertia Bases

- Structural Bases:

1. Construction: Welded structural steel with gusseted brackets, to support equipment and motor, with motor slide rails.
2. Design: Steel frame equipment bases shall comprise an all welded steel framework of sufficient rigidity to provide adequate support for the equipment and adequately stiff to prevent resonances at operating frequencies of the supported equipment. Cross framing



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

shall be incorporated to provide adequate strength and stiffness. The steel frame base shall incorporate isolator mounting brackets and supported by spring isolator mounts appropriate to the plant type and the standard of isolation required.

- Concrete Inertia Bases:

1. Construction: Structural steel channel perimeter frame, with gusseted brackets and anchor bolts, reinforcing; concrete filled.
2. Design: Concrete bases shall be formed from an all welded steel pouring framework and a frame depth of approximately 1/12 of the longest dimension of the base, with a minimum of 150 mm and no greater than 300 mm.
3. The bottom of the frame shall be blanked off and concrete (2300 kg/m³ unless otherwise stated) poured in over the steel reinforcing bars. The reinforcing shall consist of 13 mm diameter bars welded on 150 mm centres running cross-batch positioned 35 mm above the bottom of the base or as specified by the Structural Engineer. The inertia base shall be sufficiently large to provide support for all parts of the equipment base, including any components which overhang the equipment base such as suction and discharge elbows on centrifugal pumps.
4. Mass: Minimum of 1.5 times weight of isolated equipment.
5. Connecting Point: Reinforced to connect isolators and snubbers to base.
6. Concrete: Minimum 20 MPa concrete.

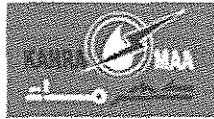
1.10 Vibration Isolators

- Open Spring Isolators:

1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
2. Spring Mounts: Provide with leveling devices, minimum 6 mm thick neoprene sound pads, and zinc chromate plated hardware.
3. Sound Pads: Size for minimum deflection of 1.2 mm; meet requirements for neoprene pad isolators.
4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.

- Closed Spring Isolators:

1. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.

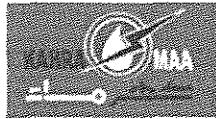


**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 7 mm clearance.
- 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- Spring Hanger:
 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 2. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
 3. Misalignment: Capable of 20 degree hanger rod misalignment.
 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- Neoprene Pad Isolators:
 1. Rubber or neoprene waffle pads.
 - a. Thickness: Minimum 13 mm.
 - b. Maximum Loading: 345 kPa.
 - c. Rib Height: Maximum 0.7 times width.
 2. Configuration: Single layer.
 3. Configuration: 13 mm thick waffle pads bonded each side of 6 mm thick steel plate.
- Roof Mounting Curb: 350 mm high with rigid steel lower section containing adjustable spring pockets with restrained spring isolators, steel upper section to support rooftop equipment, and continuous elastomeric membrane extending from upper section for counter flashing over roofing. Provide acoustical package consisting of interior perimeter angles and cross members to support up to two layers of gypsum board.

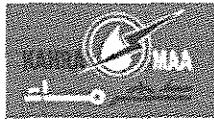
1.11 System Description

- Vibration and Seismic Control Design Requirements: Mount rotating and reciprocating equipment on vibration isolators. Isolation manufacturer shall determine mounting sizes and deflection, and seismic restraints based on the lowest operating RPM of the rotating equipment. The Contract Documents detail the minimum project requirements. The Contractor shall employ the services of an Acoustical Consultant to review equipment, piping, ductwork and conduit sound, vibration and seismic control requirements and any additional improvements necessary to achieve the required design criteria for mechanical, electrical, plumbing and fire protection work shall be provided without additional cost to the Employer.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Internally Isolated Equipment: Substitution of "Internally Isolated" equipment in lieu of the isolation specified must be reviewed for individual equipment units by the Acoustical Consultant, and shall provide the same isolation efficiency and deflection as required by the Contract Documents.
- Load Deflection Verification: Provide vibration isolators with either known undeflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection under load can be verified to determine that the load is within the proper range of the device and that the correct degree of vibration isolation is provided according to the design.
- Seismic Requirements: Provide seismic restraints for rigidly and resiliently supported equipment in accordance with code requirements. Use designs in accordance with SMACNA guidelines for seismic restraints for equipment, ductwork and piping, except for fire protection piping. Restraints shall prevent permanent displacement in any direction caused by lateral motion, overturning or uplift.
- Isolated Equipment: If required to be seismically restrained, equipment shall withstand the applicable seismic force criteria, including its internal design, components and frame; and provide suitable structural elements to which restraining attachments may be fastened.
- Flexibly Supported Equipment, Piping and Ductwork: Provide restraints as indicated or as otherwise required by the local jurisdiction. Locate restraints to allow normal operation of systems without transmitting vibrations to building structure. Normal operation includes static condition, start-up, normal running and shut-down. Allow maximum of 6.0 mm between restraint and restrained device.
- Base Mounted Equipment: Provide a minimum of 4 restraints for each piece of equipment, separate from vibration isolators.
- Piping, Ductwork and Suspended Equipment: Locate restraints in accordance with SMACNA requirements. Construct restraint as indicated and as required. Steel cables, installed slack, may be used.
- Mountings shall be provided with hold down or restraining features to prevent changes to the equipment disposition by virtue of weight changes and/or the inclusion of damping features where operation of the equipment requires the reduction of excessive movement, even allowing for the provision of inertia bases etc.
- All mountings shall provide the static deflection under the equipment weight, indicated in the relevant schedule. The selection of specific mountings should account for any eccentric load distribution, dynamic reactions, so the preferred deflections are achieved on all mountings under the equipment in the operational mode.
- It is the supplier's responsibility to ensure that all mountings offered to the Contract meet the specification and are suitable for the loads, operating and environmental conditions which prevail.
- All resilient hangers shall be of a two-element design with helical springs and noise isolation blocks of neoprene rubber or glass fibre.
- The elements shall be mounted within an open steel bracket with pre-drilled and some pre-tapped holes to permit fixing and the location of hanger rods.
- The spring location should facilitate at least 15% vertical misalignment.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

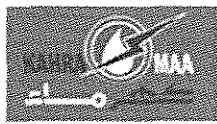
- Enclosed spring mountings shall be included for specific applications listed in the appropriate schedule. The mounting may include one or more helical springs located in a base plate. The mounting furniture shall include a telescopic top and bottom housing, incorporating built-in levelling adjustment, resilient guides to the two housings. The mounting may include adjustable dampers and shall have a ribbed rubber neoprene sound pad.
- The use of neoprene and other synthetic rubber and glass fibre anti-vibration mountings is acceptable where the performance requirements are of a lower orders and as specified in the relevant schedule. The materials and their design should render them impervious to the contamination from oils and attaching chemicals and be rot and vermin proof.
- The static deflections of the mounting shall be limited to 12mm, and in the case of rubber in compression mounts to 10% compression.
- Individual plant manufacturers shall submit details of their preferred equipment and/or supplier.

1.12 Vibration And Seismic Control Performance Requirements:

- Isolation Efficiency: Provide quantity and loading of isolation units required for scheduled deflection and not less than 90% isolation efficiency in Basement areas and not less than 95% isolation efficiency in upper level areas, except where otherwise indicated, and based on the lowest operating RPM of the rotating equipment.
- Load/Deflection Curves: Provide isolators which operate in the linear portion of their load versus deflection curve, with curves linear over a deflection range of not less than 50% above design deflection.
- Ratio of Lateral to Vertical Stiffness: Not less than 0.9 nor greater than 1.5.
- Theoretical Vertical Natural Frequency: Not more than 10% of the design objectives for the equipment as a whole, for each support point, based upon load per isolator and isolator stiffness.
- Neoprene Mounting Shore Hardness: 40 to 65, after minimum aging of 20 days or corresponding oven-aging.
- Supplementary Steel: Size supplementary steel for maximum deflection of 2.0 mm at center span.
- Seismic Force Criteria: Isolators for purchased and fabricated equipment shall accept external forces of "0.5 g" load in any direction for rigidly and resiliently supported equipment, piping, and ductwork without failure and permanent displacement. Isolators for life safety equipment such as fire pumps, sprinkler piping, emergency generators, and machinery, shall accept external forces up to "1.0 g" load in any direction without permanent displacement.

1.13 Vibration Isolation Spring Mountings

- Type A, Free Standing Spring Isolation Mounts: Minimum diameter of 0.8 of the loaded operating height and horizontal spring stiffness of 1.1 times rated vertical spring stiffness. Where exposed to corrosive environment, provide corrosion resistance consisting of neoprene coated springs, cadmium plated hardware, and hot dip galvanizing for all other parts. Provide minimum rated deflection as indicated, with 50% additional travel to solid. Provide leveling device. Minimum 6 mm thick neoprene acoustical base pad on underside, unless designated otherwise. Design and install so that ends of springs remain



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

parallel. Non-resonant with equipment forcing frequencies or support structure natural frequencies.

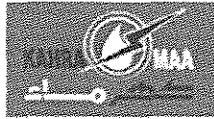
- Type B, Vertically Restrained Spring Isolation Mounts: Minimum diameter of 0.8 of the loaded operating height and horizontal spring stiffness of 1.1 times rated vertical spring stiffness. Where exposed to corrosive environment, provide corrosion resistance consisting of neoprene coated springs, cadmium plated hardware, and hot dip galvanizing for all other parts. Provide minimum rated deflection as indicated, with 50% additional travel to solid. Provide leveling device. Minimum 6 mm thick neoprene acoustical base pad on underside, unless designated otherwise. Design and install so that ends of springs remain parallel. Non-resonant with equipment forcing frequencies or support structure natural frequencies. Provide built-in resilient vertical limit stops. Tapped holes in top plate for bolting to equipment. Capable of supporting equipment at a fixed elevation during equipment erection.

1.14 Vibration Control Hangers

- Type C, Spring Hanger Rod Isolators: Spring element seated on a steel washer within a neoprene washer. Steel retainer box encasing the spring and neoprene washer. Minimum 13 mm clearance between retainer box and spring hanger rod. Minimum 30 degrees allowable rod misalignment. Where operating weight differs from installed weight provide built-in adjustable limit stops to prevent equipment from rising when weight is removed. Stops shall not be in contact during normal operation.
- Type D, Elastomeric Hanger Rod Isolators: Moulded neoprene element compounded to not greater than 70 durometer, with minimum tensile strength of 138 Bar, minimum elongation of 300%, and maximum compression set at 25% of original deflection. Steel retainer box encasing neoprene mounting. Clearance between mounting hanger rod and steel retainer box.
- Type E, Combination Spring/Elastomeric Hanger Rod Isolators: Spring and neoprene isolator elements in a steel retainer box. Minimum 13 mm clearance between retainer box and spring/elastomeric element rod. Minimum 30 degrees allowable rod misalignment.
 1. Spring Element: Spring element seated on a steel washer within a neoprene washer. Where operating weight differs from installed weight provide built-in adjustable limit stops to prevent equipment from rising when weight is removed. Stops shall not be in contact during normal operation.
 2. Elastomeric Element: Moulded neoprene element compounded to not greater than 70 durometer, with minimum tensile strength of 138 Bar, minimum elongation of 300%, and maximum compression set at 25% of original deflection.

1.15 Vibration Isolation Pads

- Type F, Neoprene Isolator Pad: Bolt holes for bolting to equipment base. Bottom steel plates for bolting to sub-base as required. Unit type design moulded in oil-resistant neoprene, compounded to not greater than 70 durometer, with minimum tensile strength of 138 Bar, minimum elongation of 300%, and maximum compression set at 25% of original deflection.
- Type G, Neoprene and Steel Layered Isolator Pad: 8.0 mm minimum thickness. 3.45 Bar maximum loading. Ribbed or waffled design. 1.5 mm deflection per pad thickness. 1.5 mm galvanized steel plate between multiple layers of pad thicknesses. Suitable bearing plate to distribute load.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Type H, Neoprene and Canvas Duck Isolator Pad: Laminated canvas duck and neoprene. Maximum loading of 69 Bar. Suitable bearing plate to distribute load. Minimum 50 mm thickness.

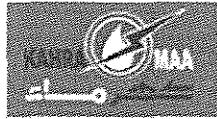
1.16 Equipment Vibration Isolation Bases

- Type B-1, Integral Structural Steel Equipment Base: Reinforce base to prevent base flexure at start-up and misalignment of drive and driven units. Provide motor slide rails for centrifugal fan bases. Drill base for drive and driven unit mounting template.
- Type B-2, Concrete Inertia Equipment Base: Provide concrete inertia base formed in a structural steel perimeter base. Reinforce to prevent flexure, misalignment of drive and driven unit or stress transferral to equipment. Provide motor slide rails, pump base elbow supports, height saving brackets, equipment bolting provisions and isolators as required by the application.
- Where appropriate steel rails may be applied to the equipment to provide the facility of attaching suitable anti-vibration mountings and/or improving equipment stability. The rails should include height savings brackets and be sufficiently stiff to maintain the equipment stiffness integrity.
- Inertia bases may be applied where appropriate and shall be adequate in their design and stiffness to provide adequate support of the equipment.
- The base shall have a depth of at least equivalent to 10% of the longest plan dimension of the equipment and be at least 150mm deep.
- A minimum of 25mm clearance shall be achieved between inertia base underside and the floor by adjustment of the levelling facility on the vibration isolation mount.
- The underside of the base will be sheeted and suitably reinforced with concrete to a density of 2300 Kg/m³ minimum introduced. The inertia base size should be sufficient to provide support for all integral parts of the equipment and also any overhanging parts of the equipment and components, such as inlet and discharge manifolds and primary elbows etc.
- Inertia Base Thickness:

Motor Size (kW) 3.7 to 11.2	Minimum Thickness 150 mm
15 to 37.3	200 mm
45 to 56	250 mm
74 to 187	300 mm
224 to 373	450 mm

1.17 Vibration Isolation Pipe Couplings

- Vibration isolation pipe couplings shall be manufactured by one of the scheduled firms. Performance, materials of construction and type of ends shall be completely compatible with the pipeline in which they are inserted.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Flexible synthetic rubber pipe couplings shall be used in all equipment as indicated on the drawings or on the equipment schedules. They shall be manufactured using chlorobutyl for the rubber membrane, rated up to 105°C. The rubber sphere membrane shall be designed to ensure even distribution of all internal pressure force effects. Connections shall be manufactured with floating metal flanges designed such that they have a recess to lock the connectors raised rubber face.
- Tied flexible couplings shall be used. Tie rods where fitted between the oval flanges shall include rubber top hat washers to minimize the transfer of acoustic energy.
- Fairing pieces, restraining bands and strengthening rings shall be provided if required for the scheduled pipeline conditions. For connecting to pipelines which are not scheduled as flange jointed, suitable mating flanges shall be supplied and joined to the pipeline by the scheduled method.
- Vibration isolation pipe couplings shall be effective in preventing vibration from rotating and reciprocating machines causing sympathetic vibration in distribution pipelines.
- Couplings shall be installed with great care and must not be twisted, stretched, compressed or pulled out of line during installation. Flange bolts shall be installed with their heads on the flexible coupling side of the flanged joint.
- The coupling must not carry any weight from the equipment or pipelines to which it is attached.
- Couplings which may be damaged during pipeline hydrostatic pressure testing must be replaced for the test by a spacer piece.
- Test pressures shall be rated at 1.5 x working pressure. After installation of tied connections, the tie rod nuts shall be checked to ensure 1mm clearance is maintained over the steel washers.
- Suppliers shall be required to submit details of certification applicable to their products for the application proposed and they shall include at least Lloyds Register certification.

1.18 Flexible Connectors

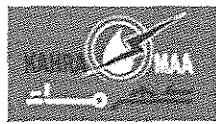
Type FC-1, Neoprene Flexible Connector: Provide neoprene flexible connectors, with straight connectors having two spheres and elbow connectors having a single sphere forming the corner of the joint, pressure rated for 10 Bar at 104°C. For connectors 300 mm and larger, use control cables with end fittings isolated from anchor plates by means of 13 mm bridge bearing. Provide neoprene washer bushings.

1.19 Seismic Restraints

- Type I, Spring Seismic Restraining With Snubber: Spring seismic restraints complying with general characteristics of spring isolators, incorporating snubbing restraint in all directions, and capable of supporting equipment at a fixed elevation during equipment erection.
- Type II, Corner Or Side Limit Stop Seismic Restraining: Corner or side seismic restraints made of plate, structural members or square metal tubing in a welded assembly, incorporating minimum 15 mm thick resilient pad limit stops.
- Type III, Metal Cable Seismic Restraining: Metal cable type with approved end fastening devices to equipment and structure.

1.20 Thrust Restraints

Diagonal Thrust Restraining: Use Type C hanger with the same deflection as specified for spring mountings. Design the spring element so it can be pre-set



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

for thrust and adjusted to allow for a maximum of 6 mm movement at start and stop. Attach diagonal restraints at the centerline of thrust restraint.

1.21 Isolation Pipe Anchors / Guides

General: Provide isolation pipe anchors / guides consisting of 2 telescoping steel tubes separated by minimum 12.5 mm thick heavy duty neoprene and duck or neoprene isolation material. Do not exceed 35 Bar load on isolation material.

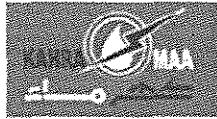
1.22 Stress Analysis

The contractor shall carry out a stress analysis and review of the piping system by the employment of a specialist sub-consultant in this field of work. The contractor shall coordinate and ensure that all associated elements of the stress analysis conducted is reviewed and agreed on by a structural engineer of record to verify the design intent and any impact on the structure to be considered. All associated works and agreements to be carried out between the structural engineering and contractor. The contract shall be responsible for all aspect of this work. Refer to item 1.3 for submittal and processes.

Execution

1.23 Installation

- Install in accordance with manufacturer's instructions. Vibration isolators must not cause any change of position of equipment or piping resulting in piping stresses or misalignment
- Bases:
 1. Set steel bases for 25 mm clearance between housekeeping pad and base.
 2. Set concrete inertia bases for 50 mm clearance between housekeeping pad and base.
 3. Adjust equipment level.
- On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.
- Short Circuiting:
 1. Do not make rigid connections between equipment and building structure that degrade noise and vibration isolation systems.
 2. Do not install equipment, piping, and conduit which make rigid contact with the structure and would degrade noise and vibration isolation systems, including but not limited to slabs, beams, columns, studs and walls.
- Supplementary Steel: Provide structural quality supplementary steel as required for support and attachment of isolators.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Coordination with Other Trades: Coordinate the Work to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce or compromise the vibration isolation.
- Inspections and Approvals: Obtain prior inspection and approval by authorities having jurisdiction before covering or enclosing the Work.
- Isolator Locations and Spacing: Provide as follows.
 1. Close to building structure.
 2. Between building structure and supplementary steel if required.
 3. Suspend isolators from rigid and massive support points.

1.24 Equipment Isolator Requirements

- General: Isolate mechanical equipment from the building structure by means of noise and vibration isolators.
- Housekeeping Pads: Mount floor mounted equipment on 100 mm and 150 mm high concrete housekeeping pads as indicated, over complete floor area of equipment. Mount vibration isolating devices and related inertia blocks on concrete pad. Provide seismic restraint anchor plates flush with top of housekeeping pad
- Fan and Motor Assemblies: Support on a single structural steel frame.
- Isolated Machinery: Support by structural steel frame or concrete inertia base. Install isolators without raising the machinery and frame assembly.
- Roof Mounted Equipment: Mount curb mounted roof top equipment on vibration isolation bases that fit over the existing roof curb and under the isolated equipment.
- Isolation Mounting Deflections: As indicated on the Drawings or as required.
- Brackets: Provide brackets to accommodate isolators. Use the vertical position and size of the bracket specified by the isolator manufacturer.
- Operating Clearances:
 1. Between Equipment Frame or Rigid Steel Base Frame and Housekeeping Pad or Floor: 25 mm minimum.
 2. Between Concrete Inertia Base and Housekeeping Pad or Floor: 50 mm minimum.
- Temporary Blocks or Shims: Place equipment structural steel or concrete inertia base in position and support temporarily by blocks or shims prior to installation of machinery or isolators.
- Transferring Loads: After installation is complete and under full operational load, adjust isolator so that the load is transferred from the blocks to the isolator. After isolators are properly adjusted, remove blocks or shims which shall be barely free.
- Seismic Restraints: Position corner or side seismic restraints with equipment operating for proper operating clearance and weld or bolt seismic restraint to seismic anchor plates in housekeeping pad.

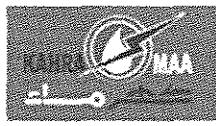


**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- Electrical Connections: Verify that electrical circuit connections to isolated equipment are looped, allowing free motion of isolated equipment.
- Equipment Motion: Verify that installed isolator and mounting systems permit equipment motion in all directions. Adjust or provide resilient thrust restraints to flexibly limit equipment start-up lateral motion to 6 mm.
- Isolation Short Circuits: Prior to start-up, clean out foreign matter between bases and equipment. Verify that there are no isolation short circuits in the base, seismic restraints or isolators.

1.25 Piping Isolator Requirements

- General: Includes all piping isolation requirements, except fire standpipe systems which are not isolated.
 1. Isolate piping outside shafts in the following locations.
 - a. All piping in mechanical equipment rooms, but not less than 15 m or 100 pipe diameters if greater than 15 m of connection to rotating equipment and pressure reducing stations, whichever is greater. For mechanical rooms adjacent to the upper portion of the ballroom and on the mechanical floors in the tower adjacent to residential floors, all piping shall be isolated.
 - b. Piping where exposed on roof and connected to rotating equipment.
 - c. All piping within 15 m or 100 pipe diameters if greater than 15 m of connection to rotating equipment and pressure reducing stations.
 - d. All piping in pump rooms adjacent to residential spaces or other noise sensitive spaces where an NC rating of 35 or lower is required by the Contract Documents.
 2. Install isolators with the hanger box attached to, or hung as close as possible to, the structure.
 3. Suspend isolators from substantial structural members, not from slab diaphragm unless otherwise noted.
 4. Align hanger rods to clear hanger box. For piping inside the emergency generator room, and other areas as indicated, mount piping on isolators and support rods extending between the acoustical ceiling panels wherever possible and attach isolator rods to the structure above the acoustical ceilings. Refer to the architectural drawings for acoustical ceiling locations and layouts and coordinate isolator and suspension rod locations. At each point where an isolator rod passes through the acoustical ceiling, wrap the entire circumference of the rod with a resilient wrapping or clamp system to prevent the transmission of vibration to the acoustical ceiling panels. All piping and conduit shall be isolated from the structure using Type E isolators with 50 mm minimum static deflection, or equivalent. All isolated ceiling penetrations shall be flexible and airtight.
- HVAC Water Systems Isolation: Isolate HVAC piping and vertical risers 32 mm and larger from the building structure by means of noise and vibration isolation guides and supports.



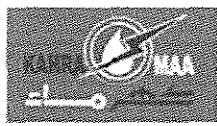
**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

1. Suspended Horizontal Piping Isolation:
 - a. 32 mm through 50 mm: Type D isolator with minimum 6 mm static deflection.
 - b. Larger than 50 mm: Type C isolator with minimum 38 mm static deflection.
 - c. In Mechanical Equipment Rooms: For all piping in mechanical equipment rooms, use Type E isolators with 25 mm minimum static deflection; however, if the rotating equipment to which the piping is connected has more than 25 mm deflection, than the piping isolator deflection shall be increased to match the deflection used on the piece of rotating equipment to which it is connected. Provide 50 mm minimum static deflection vibration isolators for all piping on mechanical floors located below occupied space.
2. Floor Supported Horizontal Piping Isolation: Type A isolator, with minimum static deflection of 25 mm or same deflection as isolated equipment to which pipe connects, whichever is greater.
3. Shaft Piping Isolation: Support water piping in shafts and floor supports entering shafts with Type G pads in 2 layers, or Type H pads, depending on piping loads and support point space conditions within shafts. Guide and anchor piping in shafts with isolation pipe anchors / guides incorporating Type H pads to prevent direct contact of piping with building structure. Isolator manufacturer shall design and select appropriate isolation for shaft piping.
4. Seismic Restraints: Provide seismic restraint for piping in equipment rooms, on roof, in shafts, and in ceilings of occupied spaces.
 - a. Sway Bracing: Restraine resiliently mounted piping with Type III seismic restraint cable sway bracing. Use 2 neoprene elements, Type G or H, to accommodate tension and compression forces.
 - b. Spacing: Locate seismic restraints in accordance with hanger spacing specified.
5. Flexible Connections: Provide flexible connectors at pump suction and discharge, riser takeoffs, cooling and heating coils, and elsewhere to accommodate thermal expansion and misalignment.
 - a. Compressor Discharge: Install Type FC-2 flexible stainless steel metal pipe connectors in two planes 90 degrees to each other in discharge piping from compressors.

1.26

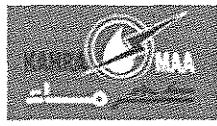
Adjusting

Upon completion of the Work repair surfaces that have been permanently stained, marred, or otherwise damaged. Replace Work which is damaged or cannot be adequately cleaned as directed. Correct defective Work at no additional cost.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- 1.27 Cleaning**
Upon completion of the Work, remove unused materials, debris, containers and equipment from the project site. In addition to the initial cleaning procedure required, and not more than 2 days before occupancy by the Employer, clean the Work as recommended by the manufacturer.
- 1.28 Protection**
Protect the Work during the construction period so that it will be without any indication of use or damage at the time of acceptance.
- 1.29 Field Quality Control**
Inspect isolated equipment after installation and submit report. Include static deflections. On completion of installation of noise, seismic, and vibration control devices, the representative of the isolation materials manufacturer shall inspect the completed system, accompanied by the Acoustical Consultant, and report in writing, installation errors, improperly selected isolation devices, and other faults that could affect system performance. Submit a report to the Consultant from the manufacturer's representative and the Contractor on the installation and the steps taken to eliminate deficiencies and to properly complete the Work.
- 1.30 Measurement**
- Measurements shall be made to demonstrate that the requirements of the specification are met.
 - Noise level measurements shall be made with sound level measuring equipment conforming to BS EN 61672-1 Class 1, with an octave band filter set to BS EN 61260 (IEC 61260). Equipment calibration shall be checked before and after any series of tests.
 - Noise criteria specified shall be met when the building is fully furnished and equipped, and rooms and other enclosed spaces are unoccupied and only the building services are operating and at their highest likely noise level.
 - Sound pressure levels of internal noise fields shall be determined from measurements taken from five (minimum) randomly chosen points in the area under test.
 - Measurements shall be taken (whenever possible) with the microphone in free space at least 1.5 metres from the floor, walls or other large sound reflecting surfaces within the room. In small compartments, where this requirement cannot be complied with, the details of the measurement positions shall be included in the test data. If otherwise not specified, the microphone shall be located at a point not less than 2 metres from any 'small' identified sound emitting surface or point (e.g. grilles, diffusers, ducts, etc). For 'large' surfaces (e.g. louvres, etc) the measurement distance should not be less than 3 metres (unless restricted by the site conditions, in which case the details of the measurement position shall be included with the test data).
 - Sound pressure levels of external noise fields shall be determined from measurements taken at locations identified in the specification and the resulting octave band sound pressure levels shall be compared with the specified levels.
 - Vibration levels shall be measured at locations identified in the specification, when the building is fully equipped and only the building services are operating, to confirm compliance with the criteria.
 - Vibration transducers used for building vibration measurements shall be accelerometers with a 'flat' response between the design operational limits. The sensitivity of the



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

accelerometer to vibrations in the design direction of measurement shall be at least 20 times the sensitivity in perpendicular directions.

- Vibration equipment used for surveys of electric motors and equipment shall be to BS 4675-2, (ISO 2954) and BS 4999-142, except that accelerometers instead of velocity transducers may be used when making comparisons of building and machine vibrations.

1.31 Schedules

- Pipe Isolation Schedule.

1. 25 mm Pipe Size: Isolate 120 diameters from equipment.
2. 50 mm Pipe Size: Isolate 90 diameters from equipment.
3. 80 mm Pipe Size: Isolate 80 diameters from equipment.
4. 100 mm Pipe Size: Isolate 75 diameters from equipment.
5. 150 mm Pipe Size: Isolate 60 diameters from equipment.
6. 200 mm Pipe Size: Isolate 60 diameters from equipment.

7.3.10 23 0553 - Identification for HVAC Piping and Equipment

General

1.1 Summary

- This section includes:

1. Nameplates
2. Tags
3. Stencils
4. Pipe Markers

- Related sections

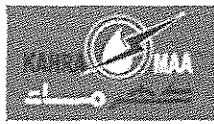
1. 23 2113 - Hydronic Piping
2. 23 3113 - Metal Ducts
3. 23 3116 - Non Metallic Ducts

1.2 References

- BS 1710: Specification for identification of pipelines and services
- BS 4800: Schedule of paint colours for building purposes
- BS 5499: Safety Signs and colours

1.3 Submittals

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
 2. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
 3. Provide manufacturers catalog literature for each product required.
 4. Indicate special procedures, and installation.
 5. Record actual locations of tagged valves.
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats

Products

1.4 Nameplates

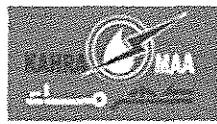
- Description: Laminated three-layer plastic with engraved letters.
 1. Letter Color: White.
 2. Letter Height: 6 mm
 3. Background Color: Black.

1.5 TAGS

- Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 40 mm diameter.
- Metal Tags: Brass with stamped letters; tag size minimum 40 mm diameter with smooth edges. Secured to valve with brass S-hook, and numbered consecutively, noted as follows for the applicable service.
- Chart: Typewritten letter size list in anodized aluminum frame STENCILS
- Stencils: With clean cut symbols and letters of following size:
 1. 40-50 mm Outside Diameter of Insulation or Pipe: 8 inch 200 mm long color field, 20 mm high letters.
 2. 65-150 mm Outside Diameter of Insulation or Pipe 300 mm long color field, 30 mm high letters.
 3. 200-250 mm Outside Diameter of Insulation or Pipe: 24 inch 600 mm long color field, 65 mm high letters.
 4. Ductwork and Equipment: 65 mm high letters.

1.6 Services Identification

- Color: Conform to BS 4800
- Pipework and ductwork shall be identified by colour bands 150mm. wide or colour triangles of at least 150mm/side. The bands or triangles shall be applied at termination points, junctions, entries and exits of plantrooms, walls and ducts, and control points to readily identify the service, but spacing shall not exceed 4.0 metres.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1.7 Pipework Identification

- Color: Conform to BS 4800
- In addition to the colour bands specified above all pipework shall be legibly marked with black or white letters to indicate the type of service and the direction of flow, identified as follows:

1.	High temperature hot water	HTHW
2.	Medium temperature hot water	MTHW
3.	Low temperature hot water	LTHW
4.	Chilled water	CHW
5.	Condenser water	CONDW
6.	Steam	Steam
7.	Condensate	Condensate
8.	Domestic hot water service	HWS
9.	Potable water	MWS
10.	Cold water down service	CWDS

- Pipes shall have the letters 'F' and 'R' added to indicate flow and return respectively as well as directional arrows.

1.8 Ductwork Identification

- Color: Conform to BS 4800
- The size of the symbol will depend on the size of the duct and the viewing distance but the minimum size should not be less than 150mm. length per side. One apex of the triangle shall point in the direction of airflow.
- In addition to the colour triangles specified above all ductwork shall be legibly marked with black or white letters to indicate the type of service, identified as follows:

1.	Supply air	SAD
2.	Return air	RAD
3.	Fresh air	FAD
4.	Exhaust air	EAD
5.	Kitchen Exhaust	KED

- The colour banding and triangles shall be manufactured from self adhesive cellulose tape, laminated with a layer of transparent ethyl cellulose tape. All labels shall be UV resistant.

1.9 Identification of Plant



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Each item of plant and equipment shall be labeled with a traffolyte or metal label indicating its unique reference code as used in the operating and maintenance documentation.
- The plant numbering system shall be agreed with the Engineer prior to the commencement of the Works.
- The plant numbering system shall be fully compatible with any existing numbering system.
- All items of plant and equipment shall be provided with a manufacturer's nameplate indicating the plant type, reference, serial number, year of manufacturer, performance and electrical data.
- Pressure vessels which have been hydraulically tested at the manufacturer's works shall indicate the test pressure, working pressure and date of test.

1.10 Asset Register

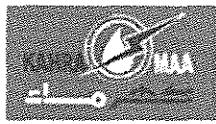
The contractor shall provide an asset register of all plant and equipment in electronic (Microsoft Excel) of all plant and equipment. The register shall include the technical particulars of the plant and the description shall match the plant labels provided on site.

1.11 Ceiling Tacks

- Description: Steel with 20 mm diameter color coded head.
- Color code as follows:
 1. Yellow: HVAC equipment
 2. Red: Fire dampers/smoke dampers
 3. Blue: Heating/cooling valves

1.12 Warning Signs And Labels

- Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, [1/16 1.6 mm thick, and having predrilled holes for attachment hardware.
- Letter Color: Black
- Background Color: Yellow
- Maximum Temperature: Able to withstand temperatures up to 71deg C.
- Minimum Label Size: Length and width vary for required label content, but not less than 2-64 by 19 mm.
- Minimum Letter Size: 6.4 mm for name of units if viewing distance is less than 600mm, 13mm for viewing distances up to 1830mm, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- Fasteners: Stainless-steel rivets.
- Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- Label Content: Include caution and warning information, plus emergency notification instructions.



Execution

1.13 Preparation

Degrease and clean surfaces to receive adhesive for identification materials.

1.14 Equipment Label Installation

- Install or permanently fasten labels on each major item of mechanical equipment.
- Locate equipment labels where accessible and visible.

1.15 Installation

- Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- Install tags with corrosion resistant chain.
- Apply stencil painting in accordance with the specification
- Install plastic pipe markers in accordance with manufacturer's instructions.
- Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- Install underground plastic pipe markers 150 to 200 mm below finished grade, directly above buried pipe.
- Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- Identify control panels and major control components outside panels with plastic nameplates.
- Identify thermostats relating to terminal boxes or valves with nameplates.
- Identify valves in main and branch piping with tags.
- Identify air terminal units and radiator valves with numbered tags.
- Tag automatic controls, instruments, and relays. Key to control schematic.
- Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 20 mm diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet 6 m on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

7.3.11 23 0593 - Testing, Adjusting and Balancing for HVAC

General



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1.1 Summary

- This section includes:

1. Testing, adjustment, and balancing of air systems.
2. Testing, adjustment, and balancing of hydronic systems.
3. Measurement of final operating condition of HVAC systems.
4. Sound measurement of equipment operating conditions.
5. Commissioning activities.
6. Welding Inspection
7. Pressure testing piping systems

- Related Sections:

1. 23 0130 - HVAC Air Duct Cleaning.
2. 23 2500 - HVAC Water Treatment
3. 23 0800 - Commissioning of HVAC

1.2 References

- CIBSE current Commissioning Codes

1. Series A Air Distribution Systems - High and Low Velocity
2. Series B Boiler Plant
3. Series C Automatic Control Systems
4. Series R Refrigeration Systems
5. Series W Water Distribution Systems

- BSRIA Current Application Guides

1. AG 3/89.3 Commissioning of air systems
2. AG 2/89.2 The commissioning of water systems in buildings
3. AG 1/91 Commissioning of VAV systems in buildings
4. AG 1/2001 Pre-commission cleaning of pipework services

- HVCA (Heating and Ventilating Contractor's Association) Current Standards

1. HVCA DW 144 Specification for sheet metal ductwork
2. HVCA DW 143 A practical guide to ductwork leakage testing



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- BS EN 12056 Gravity drainage systems inside buildings
- BS 5306 Fire extinguishing installations and equipment on premises
- BS 6880-3 Code of Practice for low temperature hot water heating systems of output greater than 45kW. Installation, commissioning and maintenance.
- BS 6700 Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages
- BS EN 12327 Gas supply systems. Pressure testing, commissioning and decommissioning procedures. Functional requirements
- The Institution of Gas Engineers IGE/UP/4 Commissioning of gas-fired plant on industrial and commercial
- SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.3 Submittals

Refer to Section 23 800 - COMMISSIONING OF HVAC Administrative requirements and procedures for commissioning HVAC systems.

Products

1.4 Test Equipment

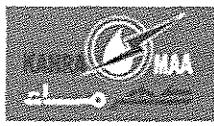
- Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of the client
- Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to the client; such equipment, tools, and instruments are to become the property of the client.

Execution

1.5 General Requirements

- Perform total system balance in accordance with one of the following:

1. CIBSE current Commissioning Codes
 - a. Series A Air Distribution Systems - High and Low Velocity
 - b. Series B Boiler Plant
 - c. Series C Automatic Control Systems
 - d. Series R Refrigeration Systems
 - e. Series W Water Distribution Systems
2. BSRIA Application Guides
 - a. AG 3/89.3 Commissioning of air systems



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- b. AG 2/89.2 The commissioning of water systems in buildings
- c. AG 1/91 Commissioning of VAV systems in buildings
- d. AG 1/2001 Pre-commission cleaning of pipework services
- 3. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
- 4. DW 144 and 143 Specification for Sheet Metal Ductwork
- Maintain at least one copy of the standard to be used at project site at all times.
- Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- At the time of tender the contractor shall declare the commissioning specialist and provide the following:
 1. Complete company profile including recent projects
 2. References
 3. Preliminary commissioning programme and "method of working"
- The engineer reserves the right to reject any company considered unacceptable
- The object of the witnessing stage is to enable the Engineer to establish a level of confidence in the commissioning results being presented. The extent and proportion of results to be witnessed by the Engineer will be at the discretion of the Engineer.
- The Engineer will only witness test proceedings confirm recorded results and determine if the specified requirements have been satisfied.
- If the tests fail to demonstrate that the plant and equipment are properly installed and functioning correctly, the cause of the failure shall be investigated. Should the failure be due to incorrect or faulty work then without delay, carry out such remedial measures and adjustments as may be necessary and repeat the commissioning and testing procedure to the satisfaction of the Engineer. If faults are not rectified to the satisfaction of the Engineer, the Engineer may exercise the right to demand removal of that particular part of the installation and replaced with new at no expense to contract or delay to the programme.
- Where it is not possible at the particular time of commissioning and testing for full load conditions to be obtained or simulated, undertake to repeat such operations of full load or a simulation thereof at a time when this can be achieved as agreed with the Engineer.
- The Works shall be fully tested, commissioned and be fully operational prior to witnessing and inspection by the Engineer.
- Where portions of the work are required to be commissioned and tested separately, then upon final completion, demonstrate to the Engineer that all the several portions are capable of proper simultaneous operation in accordance with the requirements of the specification.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- In cases where the construction programme is such that the commissioning, testing, balancing, adjustment, needs to be undertaken in an area of the building taken over and occupied by the Employer, then take all necessary precautions against and be responsible for any damage caused whilst working in such areas for that purpose.
- All certification documents shall be submitted to the Engineer for examination before any system is offered for final acceptance.
- Provide a written statement to the Engineer confirming that each installation has been correctly tested and commissioned and that the performance requirements can be achieved.
- The contractor is responsible for ensuring that all HVAC systems are suitably tested, commissioned and set to work. These systems include, but are not limited to:
 1. Fire Pumps
 2. Electric Water Coolers
 3. Plumbing Pumps
 4. HVAC Pumps
 5. Centrifugal Water Chillers
 6. Induced Draft Cooling Tower
 7. Computer Room Air Conditioning Units
 8. Air Coils
 9. Induction Units
 10. Fan Coils
 11. Air Handling Units
 12. Fans
 13. Air Filters
 14. Air Terminal Units
 15. Air Inlets and Outlets
 16. Controls Compressor
 17. Chilled Water pumps
 18. Condenser Water pumps

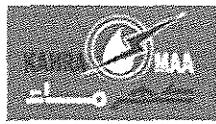
1.6 Preparation

- Hold a pre-balancing meeting at least one week prior to starting TAB work.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
 - Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to facilitate spot checks during testing.
 - Provide additional balancing devices as required.
 - Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 1. All pipework and ductwork systems have been cleaned, flushed, treated and or pressure tested as required in complete compliance with the requirements of this specification
 2. Systems are started and operating in a safe and normal condition.
 3. Temperature control systems are installed complete and operable.
 4. Proper thermal overload protection is in place for electrical equipment.
 5. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 6. Duct systems are clean of debris.
 - Fans are rotating correctly.
 1. Fire and volume dampers are in place and open.
 2. Air coil fins are cleaned and combed.
 3. Access doors are closed and duct end caps are in place.
 4. Air outlets are installed and connected.
 5. Duct system leakage is minimized.
 6. Hydronic systems are flushed, filled, and vented.
 7. Pumps are rotating correctly.
 8. Proper strainer baskets are clean and in place.
 9. Service and balance valves are open.
 - Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
 - Beginning of work means acceptance of existing conditions.
- 1.7 Ductwork Air Leakage Testing**
- Unless otherwise stated for medium and low pressure ducts, the Engineer shall select at random a maximum of 10% of the duct system to be tested for air



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

leakage. Tests shall be to the pressures recommended in DW 144 for the classification of the selected ductwork.

- All high pressure ducts shall be air leakage tested.
- Air leakage tested in accordance with DW 144 and procedures as DW 143 unless otherwise indicated.
- Tests shall be to the pressures recommended in DW 144 for the classification of the selected ductwork.
- Tests shall be carried out as the works proceed and prior to the application of insulation.
- In the event of test failure of the randomly selected section, the Engineer shall have the right to select two further sections at random for testing. Where successive failures are identified there shall be the right to require the installer to apply remedial attention to the complete ductwork system and carry re-testing at no cost to the contract.
- The installer shall provide documented evidence of the calculations used to arrive at the allowable loss for the section to be tested and the results of the test shall be witnessed and signed.

1.8 Welding Inspection

- Visual Inspection: Perform in accordance with ASME Codes. Cut out and test defective welds. If the percentage of defective welds is excessive, cut out and test additional welds as directed by Consultant.
- Radiographic Inspection: In addition to the tests required because of poor appearance of welds, make radiographic inspections of welded joints selected at random by the Consultant in accordance with ASTM E94, "Standard Guide for Radiographic Testing". Perform one inspection as follows.
 1. 50 mm pipe: 1 X-Ray for each 100 finished joints
 2. 65 mm pipe: 1 X-Ray for each 75 finished joints
 3. 80 mm pipe: 1 X-Ray for each 64 finished joints
 4. 100 mm pipe: 1 X-Ray for each 50 finished joints
 5. 150 mm pipe: 1 X-Ray for each 32 finished joints
 6. 200 mm pipe: 1 X-Ray for each 28 finished joints
 7. 250 mm pipe: 1 X-Ray for each 20 finished joints
 8. 300 mm pipe: 1 X-Ray for each 17 finished joints
 9. 350 mm pipe: 1 X-Ray for each 14 finished joints
 10. 400 mm pipe: 1 X-Ray for each 13 finished joints
 11. 450 mm pipe: 1 X-Ray for each 12 finished joints
 12. 500 mm pipe: 1 X-Ray for each 10 finished joints
 13. 550 mm pipe: 1 X-Ray for each 8 finished joints



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

14. 600 mm pipe: 1 X-Ray for each 6 finished joints

1.9 Pressure Testing Piping Systems

- After portions of the mechanical work are completed and operable, perform pressure testing in line with the agreed commissioning codes or as noted below in the presence of the Consultant's and Employer's representatives.
 1. Subject piping and connections to a hydrostatic or pneumatic pressure test prior to painting, installation of insulation and concealment within the building. Subject to a hydrostatic or pneumatic test pressure of not less than 1-1/2 times the operating pressure, and not less than 3.45 Bar minimum. Hold required pressure for a period of not less than 24 hours unless otherwise noted.
 2. Individual sections of piping may be tested separately. Retest piping sections reworked after testing.
 3. Rigidly support steam piping carried on spring hangers during hydrostatic pressure test.
 4. Repair, rework, replace and retest defective material and workmanship found during the tests.

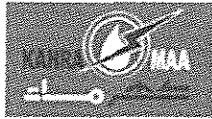
1.10 Refrigerant Pipework Pressure Testing

- After portions of the mechanical work are completed and operable, perform pressure testing in line with the agreed commissioning codes or as noted below in the presence of the Consultant's and Employer's representatives.
- Refrigeration equipment shall have a strength pressure test and a leakage pressure test after manufacture. Tests on the refrigerant side shall be made in accordance with BS EN 378. The leakage pressure test shall be applied to the refrigerant system after all piping has been fitted and shall be in addition to the strength pressure test on each unit at completion of manufacture.
- After the pipework has been completed it shall be purged with nitrogen to remove extraneous materials from the system and prior to sealing of insulation joints. It shall then be pressure tested to the following pressure or alternative test pressure agreed with the Engineer prior to the work being carried out. During this process due care shall be taken to ensure that any components that have a pressure test limitation are suitably isolated.

1. Refrigerant Test Pressure

2. Pressure test period 24 hours

- Initial and final readings shall be noted, advised to the Engineer, and recorded in the Commissioning Report.
- Following the pressure testing, the system content of test nitrogen shall be released to atmosphere and the complete installation triple evacuated, the final stage being over a minimum period of 24 hours without any loss, the outdoor units shall then be connected. Final Torr readings shall be taken with the vacuum pump switch off and isolated. Each independent refrigeration circuit shall be separately tested.
- Prior to evacuation, all valves within the system must be fully opened except the compressor service valves which should remain closed.

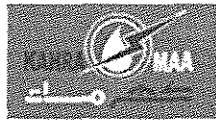


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- The compressor should not be operated during the evacuation process.
- Triple evacuation procedure is to be adopted as follows:
 1. Evacuate each system to a pressure (absolute) of 1500 microns (1.5 Torr), then break the vacuum to a pressure of 14 kN/m² with the selected refrigerant for the system.
 2. Repeat the above procedure.
 3. Open the compressor suction and discharge valves and evacuate to a pressure (absolute) of 500 microns (0.5 Torr).
 4. The vacuum pump should be left running continuously for a period of 2-3 hours.
 5. At a vacuum of 500 microns (0.5 Torr) the vacuum pump should be switched off. Close the pump isolation valve. Observe the pressure of the system. If there is a slow and continuous rise of more than 2% then the process must be repeated as this is an indication of an air leak in the system. The presence of free water in the system will be indicated by a rise in pressure accompanied by a levelling until a constant value is maintained.
 6. When the system has been satisfactorily evacuated, (i.e. the system maintains a vacuum of 500 microns, (0.5 Torr) and the pressure rise is less than 2%), the vacuum should be broken with refrigerant vapour as soon as possible and the system pressure increased to above atmospheric to reduce any possible likelihood of moisture ingress (0.35 bar).
 7. Independent pressure and leakage tests shall be carried out on each refrigerant circuit where a common evaporator is used in conjunction with number of compressors in independent refrigerant circuits.

1.11 Air System Procedure

- The air systems are to be balanced in line with the requirements of the agreed commissioning code, including all pre-commissioning activities and noting the following requirements
 1. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
 2. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
 3. Measure air quantities at air inlets and outlets.
 4. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
 5. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Volume control to be by duct internal devices such as dampers and splitters.

6. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
7. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
8. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
9. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
10. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
11. Where modulating dampers are provided, take measurements and balance at extreme conditions.
12. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
13. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

1.12 Water System Procedure

- The air systems are to be balanced in line with the requirements of the agreed commissioning code and noting the following requirements
 1. Adjust water systems to provide required or design quantities.
 2. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
 3. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
 4. Effect system balance with automatic control valves fully open to heat transfer elements.
 5. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

6. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

1.13 Automatic Controls System Procedure

- The BMS is to be tested in line with the requirements of the agreed commissioning code, including all pre-commissioning activities and noting the following requirements. Refer Section 23 5100 - Building Management System for detailed procedure
- Pre-functional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submittal.
- Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with the contract documents.
- Using a skilled technician, who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.

1.14 Refrigeration System Procedure

- Procedures for refrigeration systems shall be in accordance with the requirements of the agreed commissioning code and manufacturer's instructions for the following:
 1. Use and handling of refrigerants
 2. Pressure and leak testing
 3. Evacuation and dehydration
 4. Charging and lubrication
 5. Preliminary checks
 6. Setting to work and adjusting
 7. Apparatus and instruments
- In the presence of the Engineer show the correct operation of the refrigeration equipment, that is: air on/off d.b. and w.b. temperatures for the cooling coil for steps of control together with suction and discharge temperatures/pressures on the refrigerant side and chilled water flow and return temperatures (which ever applies), all recorded against the prevailing ambient conditions and recorded room conditions.
- Air cooled condensers and water cooling towers shall be demonstrated to show that correct refrigerant condensing temperatures and water on/off temperatures can be achieved against outdoor d.b. and w.b. air temperatures respectively.

1.15 Acoustics Testing Procedure

- Unless otherwise stated, sound pressure levels shall be measured in all spaces containing supply or extract terminals, all plantrooms, all rooms immediately adjacent to plantrooms and all rooms located above or below plantrooms.
- The results shall incorporate a spectrum band analysis made at octave band centre frequencies from 63 Hz to 8k Hz. Results shall be both tabulated and plotted on NR curves.



Qatar General Electricity & Water Corporation Tender NO. GTC 626/2014

Construction of Mega Reservoir PRPSs (Packages A, B, C, D & E)

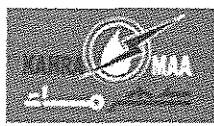
- All plant such as fans, chillers, pumps, boilers etc shall be tested to ensure their acoustic performance is within the respective manufacturer's stated data at the time of order and results submitted to the Engineer.
- Noise readings shall be taken at the site boundaries and adjacent facades to demonstrate the acoustic performance of the systems complies with the noise levels stated elsewhere.
- Locations for noise readings shall be agreed with the Engineer prior to measurements being undertaken.
- Measuring of environmental noise shall be in accordance with BS 4142 and the local authority guidelines.
- All measurements undertaken to demonstrate compliance with the specification shall be performed using sound measuring equipment conforming to BS EN 61672 and other relevant standards.
- Calibration certification for all measuring equipment shall be submitted to the Engineer prior to measurements being undertaken.
- Duplicate records of all such shall be provided to the Engineer within 3 days of testing and copies included in the operating and maintenance documentation. All records shall be signed by a competent person and witnessed. Results shall be submitted to the Engineer for examination before any system is offered for final acceptance.
- Any witnessing or independent checking by the Engineer shall be carried out solely at the discretion of the Engineer as considered necessary.
- All necessary apparatus, measuring equipment, instruments, and meters required for acoustic testing of the Works shall be provided by the installer at no additional cost.

1.16 Installation Tolerances

- Commissioning tolerances to be in line with the agreed commissioning code recommendations or as follows (contractor to allow for the most stringent):
- Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- Hydronic Systems: Adjust to within plus or minus 5 percent of design.

1.17 Authority Witnessing And Testing

- As part of the commissioning procedure the installer shall arrange for all necessary checks and witnessing where required by the relevant Local Authority, Statutory Authorities, etc.
- Such witnessed tests and signed certificates of acceptance shall be obtained from, but not limited to, the following:-
 1. Local Civil Defense for fire and gas systems
 2. Local Municipality Environmental Health Officer
 3. Local Municipality Drainage Inspector



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

4. Local District Cooling Provider
 5. Local Water Authority
 6. Local Electricity Authority
 7. Local Telecoms provider
 8. Local Police
- The installer shall be prepared to carry out similar tests at the end of the defect liability period if the Engineer deems it necessary to prove that the plant and installation are still functioning in accordance with the requirements of the specification. The installer shall allow for this item at the time of tender.

7.3.12 23 0713 - Ductwork Insulation

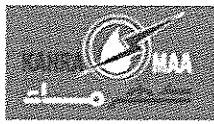
General

1.1 Summary

- This section includes:
 1. Duct insulation
 2. Duct Liner
 3. Insulation jackets
 4. Acoustic
- Related Sections:
 1. Section 23 0553 – Identification for HVAC Piping and Equipment.
 2. Section 23 3113 – Metal Ducts
 3. Section 23 3116 – Non-metal Ducts
 4. Section 22 1005 - Plumbing Piping
 5. Section 23 2113 - Hydronic Piping

1.2 References

- BS 476 - Fire tests on building materials and structures
 1. Part 4: Non-combustibility test for materials
 2. Part 6: Method of test for fire propagation for products
 3. Part 7: Method of test to determine the classification of the surface spread of flame of products
 4. Part 11: Method for assessing the heat emission from building materials



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

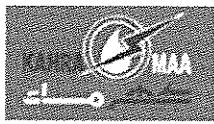
5. Part 12: Method of test for the ignitability of products by direct flame impingement

- BS 2972 - Methods of test for inorganic thermal insulating materials
- BS 3533 - Glossary of Thermal Insulation Terms.
- BS 3927 - Specification for Rigid Phenolic Foam (PF) for Thermal Insulation in the form of slabs and Profiled Sections.
- BS 3958 - Thermal Insulating Materials
- Part 3: Metal mesh faced man-made mineral fibre mattresses.
- Part 4: Bonded pre-formed man-made mineral wool pipe section.
- Part 5: Specification for bonded man-made mineral wool slabs.
- BS 4735 - Laboratory method of test for assessment of horizontal burning characteristics of specimens no larger than 150mm x 50mm x 12mm (nominal) of cellular plastics a small frame.
- BS 5422 - Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range, -40°C to +700°C
- BS 874 - Methods for determining thermal insulating properties with definitions of thermal insulating terms
- BS EN ISO 5659-2 - Plastics. Smoke generation. Determination of optical density by a single chamber test.
- BS 5970 - Code of Practice for thermal insulation of pipework and equipment (in the temperature range -100°C to + 870°C).
- BS EN 10220 - Seamless and welded steel tubes
- BS EN 10255 - Non alloy steel tubes suitable for welding and threading
- BS EN 10326 - Continuously hot dip coated strip and sheet of steel enclosures
- BS EN ISO 12241 - Thermal insulation for building equipment and industrial installations. Calculation rules.
- Local Authority regulations and standards.
- NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; 2003.
- ASTM E-84 - Test Method for surface Burning Characteristics of Building Materials.
- DW 144 - Ductwork Installation

1.3 General Requirements

- Thermal insulation shall be provided for the following functions:

1. Prevent the formation of condensation on pipework, ductwork or equipment



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- 2. To protect personnel from exposure to extremes of temperature
- 3. Conserve energy for both cooled and heated systems
- 4. Control process temperatures
- Ensure that all thermal insulation is made from materials with zero ozone depletion potential (CFC and HCFC free). Submit to the Engineer, prior to ordering, written confirmation from the insulation manufacturer(s) that the products to be installed are CFC and HCFC free.
- All insulation products shall maintain their thermal performance for a minimum of the plant design life.
- Submit to the Engineer, prior to ordering, details from the manufacturer(s) that define the life expectancy of the materials to be installed.
- Where two or more layers of dissimilar insulating material are used, submit to the Engineer the declared value of thermal conductivity for each layer under the appropriate temperature conditions. The thickness of each layer shall also be stated. Ensure that the interface temperature between the two materials does not exceed the limiting temperature for the material of the outer layer.
- Adequate precautions shall be taken against any hazard to health involved in the use of any cleaner, adhesive or material in connection with the application and handling of insulation material. The manufacturer of any such material shall be consulted in respect of safe handling and working. The Contractor shall ensure that all operatives, for whom he is directly indirectly responsible for, conform with the working practices for safe handling of hazardous materials as set out in the COSHH Regulations and the Safety Plan for the Contract prepared by the Contractor to the satisfaction of the Employer and the Engineer.

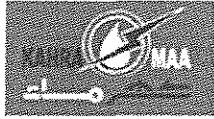
1.4 Submittals

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 1. Product description
 2. Thermal Characteristics
 3. Material list and thickness for each service and location
 4. Two representative samples
 5. Manufacturers installation procedure

- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats

1.5 Quality Assurance

- Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of documented experience.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- The installer shall be an insulating firm with at least 5 years of successful insulation experience on projects with pipe, duct and equipment insulations similar to that required for this project.

1.6 Delivery, Storage, And Protection

- Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 Environmental Requirements

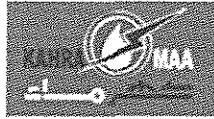
- Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

Maintain temperature during and after installation for minimum period of 24 hours.

Products

1.8 General Requirements

- All systems are to have been tested and approved by the Consultant prior to installation of insulation
- All thermal insulation shall be non-corrosive to the metal, water repellent and fire retardant.
- All insulating materials shall be proofed against rotting, mould, fungus growth and attack by vermin.
- Materials and their method of application shall not constitute a known risk to health during application or use.
- Thermal conductivity values shall be tested in accordance with BS 2972.
- The uses of galvanized or zinc coated insulation steel jacketing and accessories on or near austenitic stainless steel and austenitic nickel steel/alloy equipment and piping, is prohibited.
- Dissimilar metals and materials subject to galvanic corrosion shall not be installed in contact with one another.
- Where the complete assembly is liable to mechanical damage in use, the final finish shall be sufficiently strong to ensure that the insulation does not become exposed.
- Materials in contact shall be compatible and shall not cause corrosion or degradation under normal site conditions.
- Insulation materials and finishes shall be inherently proof against rotting, mould and fungal growth and attack by vermin, be non-hygroscopic and in all respect be suitable for continuous use throughout the operating temperatures and within the environment where installed.
- Materials shall be free from objectionable odour at the temperature at which they are to be used.
- The insulation shall be suitable for the specified conditions of use without the physical properties falling outside the tolerances allowed in the appropriate British Standard for the material.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Protect insulated stainless steel surfaces from the risk of stress corrosion in accordance with the recommendations of BS 5970.

1.9 Fire Performance

- All insulating materials are required to meet the stated Fire Performance of the Authority Having Jurisdiction and references to any standard in this specification to be confirmed by the contractor prior as part of the tender process
- The whole of the insulation work shall be carried out by an approved specialist insulation contractor. All allowances shall be included for arranging a specialist subcontractor accordingly and for informing the specialist subcontractor of all conditions relating to contract and for coordinating his works with the remainder of the Works.
- In addition to complying with the relevant standards, all insulating material shall be free from asbestos.
- The insulating material shall be acceptable only if they are equal to or better than the grades or classes of the fire resistance as follows:
 1. BS 4735, Class Q, for burning rate nil, and not producing melted droplets
 2. BS 476 Part 4, for non-combustible grade
 3. BS 476 Part 5, Class P, for not easily ignitable
 4. BS 476 Part 7, for fire propagation index of a maximum of 12.6
 5. BS 476 Part 7, Class 1, for surface spread of flame
 6. BS 476 Part 9, for production of emitted smoke shall not give more than 35% obstruction of the light beam.

- All insulation finishes and covering shall be classified as Class 1 surface spread when tested in accordance with BS 476, Part 7. They shall not in any way attack the insulation or the surface to which the insulation is being applied and shall be suitable for working temperatures.
- All adhesive, mastics, coatings, sealers and primers shall be classified as Class 1 surface spread when tested in accordance with BS 476, Part 7. They shall not in any way attack the insulation or the surface to which the insulation is being applied and shall be suitable for the working temperatures.

1.10 Vapor Barrier

1. On surfaces operating below ambient temperature a complete vapour barrier seal shall be provided.
2. The vapour barrier shall take the form of a coating or sheet material.
3. Vapour barriers shall be continuous and the integrity maintained. Where this is not possible, the vapour barrier shall be effectively sealed to the pipe to prevent any ingress of moisture or water vapour.
4. External vapour barriers shall be pre-applied or applied immediately after fitting the insulating material and before the fluid in the pipe, duct, or vessel is cooled.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

5. The function of an external vapour barrier shall not be compromised by its additional use for other purposes e.g. as a form of weather protection or as mechanical protection for the thermal insulation.
6. Where required separate layers in the form of coatings or sheet material shall be used for the individual purposes. Where such additional protection is required, the installer shall ensure that its application does not cause any damage to the vapour barrier during installation and is unlikely to cause damage in service.
7. The vapour barrier shall not reduce the fire performance of the system as installed below the limit specified as appropriate to the type of application.
8. The values for water vapour permeance of barriers shall be as BS 5422: 2001

1.11 Fiber glass insulation

- Insulation shall be rigid section of fiber glass insulation with a density of 64kg/cum, having a thermal conductivity factor of 0.034w/sqm./K. The minimum thickness shall be as indicated in the referred codes.
- All pipe insulation to be factory covered with reinforced aluminum foil/kraft paper laminate, the whole providing a Class I rating to BS 476 Part 7.
- Bends are to be insulated with pre-molded polyisocyanurate rigid closed cell foam meeting the same fire ratings as above but with aluminum foil applied separately on site.
- Tees, valves, strainers etc. are to be produced by the Contractor forming suitable metal boxes and pouring in-situ polyisocyanurate chemical system supplied by the pipe insulation manufacturer and in accordance with his instructions.
- E. High density pipe supports, 80kg/m³, are to be produced from the same chemical system and by the same manufacturer of the insulation PIPE INSULATION
- The manufacturer's installation recommendations shall be strictly adhered to.

1.12 Mineral wool insulation

- For all mineral wool insulation products, test evidence must be submitted to the CA for approval, prior to ordering, showing that the fibers from which the products are made are not classified as a possible human carcinogen, as detailed by European Directive 97/69/EC and the approved supply list of CHIP98.
- Mineral pipe insulation sections shall have a nominal density of not less than 120 kg/m³. Pre-formed pipe sections shall be resin bonded with a thermal conductivity not exceeding 0.038 W/mK at 50 °C mean temperature
- Mineral wool duct slab shall have a nominal density of not less than 45 kg/m³ with a thermal conductivity not exceeding 0.04 W/mK at 50 °C mean temperature.

1.13 Polyisocyanurate (Phenolic Foam) Duct Insulation

- All phenolic foam shall be CFC and HCFC free.
- Phenolic foam pipe and duct insulation shall have a thermal conductivity of not more than 0.018 W/mK at 10 °C mean temperature. (Fully aged values shall be in accordance with BS3927).

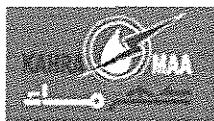


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Phenolic foam shall not be used on steam services or services operating above 100 °C.
- Where there is risk of corrosion being initiated by the pipework insulation a standard passivating bore coating shall be provided to reduce the risk. Any aluminium foil overlaps shall not be tucked in between the butt joints of the insulation sections.
- All phenolic pipe insulation shall be a nominal density of 35 kg/m³ for interior piping and 50kg/m³ for external pipework.
- The perpendicular compressive strength shall not be less than 150 kN/m² for pipe insulation and 100 kN/m² for duct insulation.
- All pipe insulation to be factory covered with reinforced aluminum foil/kraft paper laminate, the whole providing a Class I rating to BS 476 Part 7.
- Bends are to be insulated with pre-molded polyisocyanurate rigid closed cell foam meeting the same fire ratings as above but with aluminum foil applied separately on site.
- Tees, valves, strainers etc. are to be produced by the Contractor forming suitable metal boxes and pouring in-situ polyisocyanurate chemical system supplied by the pipe insulation manufacturer and in accordance with his instructions.
- High density pipe supports, 80kg/m³, are to be produced from the same chemical system and by the same manufacturer of the insulation
- The manufacturer's installation recommendations shall be strictly adhered to.

1.14 Closed Cell Insulation Elastomeric Foam

- Closed cell elastomeric rubber insulation or Cross Linked Polyfin foam shall be accepted as an alternative to Phenolic foam subject to the thickness proposed providing equal or better thermal resistance and vapour resistance to the specified thicknesses of Phenolic foam in the relevant codes
- These alternative insulation systems shall be complete with factory applied reinforced aluminium foil finish.
 1. Temperature Range: -100 °C + 105°C.
 2. Thermal Conductivity: <0.034 W/m.k at 0°C.
 3. Water Vapour Permeability: µ 7000 (DIN 52 615), 0.09 µgm/Nh BS 4370/2.
 4. Fire Rating: Class (UN 8457 – UNI 9174), Class 1 BS 476: Part 7: 1987/ Class 0 BS 476 part 6.
 5. Elastomeric Insulation must be FM approved.
 6. Density: 45 kg/m³ up to 65 kg/m³.
 7. Noise Reduction: 35 db (A) to the frequency of 500 Hz, European Standard EN 20140 – 10.
 8. Closed Cell Content: > 90%.
 9. Corrosion Risk: Assessment certified according DIN 1988/7.
 10. Ozone Resistance: ASTM-D-1171- No crack.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

11. Material shall be CFC free.

1.15 Acoustic Insulation

- Furnish all labour, materials, tools and equipment and perform all Services and operations necessary for the complete supply and Installation of batt/blanket insulation to areas indicated on the as specified.
- Batt / Blanket Acoustic Insulation:
 1. Mineral fiber semi-rigid insulation in batts or blankets manufactured from stable glass fibers bonded with thermosetting resins, with a flame-spread and maximum smoke-developed indices of 0 and 15, respectively.
 2. Density: 24 kg/m³.
 3. Thickness: 50 mm.(Refer 23 3319 for acoustic treatment)
- Adhesive:

As recommended by insulation manufacturer for specific application with demonstrated capacity to bond insulation securely to substrate indicated without damaging insulation and substrates.
- Accessories:

Fasteners and accessories required for the installation shall be as recommended by the manufacturer.

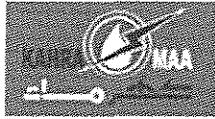
1.16 Jackets

- Internal Applications: Glass cloth Jacket: Glass cloth treated with dilute fire retardant lagging adhesive.
- For all external ductwork: Aluminum Jacket:
 1. Thickness: 0.40 mm sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 50 mm laps.
 4. Fittings 0.4 mm thick die shaped fitting covers with factory attached protective liner.
- Vapor Barrier Jacket:
 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. The values for water vapour permeance of barriers shall be as BS 5422: 2001
 3. Secure with pressure sensitive tape

Execution

1.17 Examination

- Verify that ducts have been tested before applying insulation materials.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- Verify that surfaces are clean, foreign material removed, and dry.
- Ensure that surfaces to receive insulation are clean, dry, and suitable to provide a complete and satisfactory installation.

1.18 Insulation Thickness

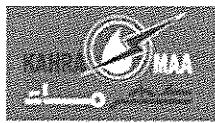
- The insulation thickness should be in accordance with the requirements of BS 5422 and calculated according to BS EN 10241
- If the thickness given in, or interpolated from, the tables in the British Standard or the specification do not correspond with available thickness, the nearest higher available thickness shall be used.
- In multi-layer applications, where material thickness is rounded up to suit available commercial thickness, the installer shall ensure by calculation (in accordance with the appropriate British Standard) that each interface temperature is below the maximum continuous operating temperature of the materials involved.

1.19 Installation

- Install in strict accordance with manufacturer's instructions.
- In order to ensure that the insulation applied is in all respects in accordance with the Specification, sections shall, as required by the Consultant, be cut from the finished insulation. The Contractor is as allow his price for the removal and replacement of two sections of each type of insulation. If however, defects sections shall be replaced at no cost to the Contract. If further defects are revealed then the Consultant shall have the right, when in his opinion it is necessary, to issue instructions for any part or the whole of the insulation to be removed and replaced. The replacement with new insulation shall be to the satisfaction of the Consultant and the cutting out and replacement shall be at no cost to the Contract.
- Particular attention shall be paid to the finished appearances of all thermal insulation which must present a neat and symmetrical appearance running true in the line with pipe layouts, etc. Any rough, irregular and badly finished surfaces shall be stripped down and re-insulated to the Consultant's satisfaction.
- All metal surfaces shall be thoroughly cleaned and treated with approved corrosion inhibitor before applying the insulation. Insulation can be applied directly to galvanized surfaces.
- Lead bearing inserts shall be provided at all supports to ensure that the insulation is not compressed or damaged. The inserts shall be treated hardwood or approved plastic.
- Mechanical fasteners shall be used when installing slab or roll insulation. The fasteners shall be the self-adhesive type and only fixed after cleaning to ensure proper adhesion.

1.20 Insulation Thickness

- The insulation thickness should be in accordance with the requirements of BS5422:2001 Table 10
- If the thickness given in, or interpolated from, the tables in the British Standard or the specification do not correspond with available thickness, the nearest higher available thickness shall be used.
- In multi-layer applications, where material thickness is rounded up to suit available commercial thickness, the installer shall ensure by calculation (in accordance with the



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

appropriate British Standard) that each interface temperature is below the maximum continuous operating temperature of the materials involved.

1.21 Aluminium Cladding

- Aluminium cladding shall be formed to fit tightly over the outer circumference of the insulation with longitudinal overlaps of not less than 40 mm the outer part of the overlap to be secured with self-tapping screws or rivets of the appropriate type at centres of not more than 150mm. All longitudinal joints shall be hidden from view as far as possible.
- Circumferential overlaps to be not less than 40 mm and secured with secured with self-tapping screws or rivets of the appropriate type, not less than four, equally spaced. One circumferential joint should be left free at maximum intervals of 5 metres to allow for expansion and contraction.
- All joints shall be so arranged as to shed liquids and shall be sealed with a suitable gun applied water resistant sealant.
- All bends and fittings shall be covered with matching aluminium sheet cladding tailored to fit the application but using specially segmented purpose made pieces, or mitered bends where applicable.
- All insulation termination points shall be trimmed with compatible aluminium coiled end capping pieces secured over the aluminium cladding with closed head pop rivets.
- All aluminium metal work shall be pre-formed, neatly and correctly installed, and manufactured to ensure a smooth, clean, uniform installation free from sharp and dangerous edges.

1.22 Insulation Schedule

- Ductwork Internal

Elastomeric foam with aluminium cladding where exposed to view (i.e. no false ceiling) or installed externally or in plant rooms

- Ductwork External

Elastomeric foam with aluminium cladding

- Ductwork AHU intake / discharge

Lined with 25mm of acoustic insulation (neoprene or vinyl coated fiberglass of 24 kg/m³ density)

- All insulation shall be provided with continuous vapour barrier.
- Elastomeric foam applied externally shall be complete with impregnated aluminium finish to protect it from UV during installation and before application of cladding.
- All external supports shall be galvanized steel.
- Contractor shall provide galvanized steel step-overs in all necessary locations to facilitate full access to all plant for maintenance and to help protect the insulation during construction. Step-overs shall be provided by the Contractor in the locations required by the Engineer and to the Engineers approval.



7.3.13 23 0716 - HVAC Equipment Insulation

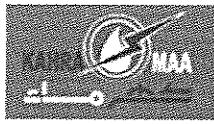
General

1.1 Summary

- This section includes:
 1. Equipment insulation
 2. Covering
- Related Sections:
 1. Section 09 - Finishes
 2. Section 23 0553 - Identification for HVAC Piping and Equipment.
 3. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.
 4. Section 23 2114 - Hydronic Specialties.
 5. Section 23 2300 - Refrigerant Piping: Placement of inserts.

1.2 References

- BS 476 - Fire tests on building materials and structures
 1. Part 4: Non-combustibility test for materials
 2. Part 6: Method of test for fire propagation for products
 3. Part 7: Method of test to determine the classification of the surface spread of flame of products
 4. Part 11: Method for assessing the heat emission from building materials
 5. Part 12: Method of test for the ignitability of products by direct flame impingement
- BS 2972 - Methods of test for inorganic thermal insulating materials
- C. BS 3533 - Glossary of Thermal Insulation Terms.
- D. BS 3927 - Specification for Rigid Phenolic Foam (PF) for Thermal Insulation in the form of slabs and Profiled Sections.
- E. BS 3958 - Thermal Insulating Materials
 1. Part 3: Metal mesh faced man-made mineral fibre mattresses.
 2. Part 4: Bonded pre-formed man-made mineral wool pipe section.
 3. Part 5: Specification for bonded man-made mineral wool slabs.

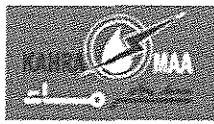


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- BS 4735 - Laboratory method of test for assessment of horizontal burning characteristics of specimens no larger than 150mm x 50mm x 12mm (nominal) of cellular plastics a small frame.
- BS 5422 - Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range, -40°C to +700°C
- BS 874 - Methods for determining thermal insulating properties with definitions of thermal insulating terms
- BS EN ISO 5659-2 - Plastics. Smoke generation. Determination of optical density by a single chamber test.
- BS 5970 - Code of Practice for thermal insulation of pipework and equipment (in the temperature range -100°C to + 870°C).
- BS EN 10220 - Seamless and welded steel tubes
- BS EN 10255 - Non alloy steel tubes suitable for welding and threading
- BS EN 10326 - Continuously hot dip coated strip and sheet of steel enclosures
- BS EN ISO 12241 - Thermal insulation for building equipment and industrial installations. Calculation rules.
- NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; 2003.
- ASTM E-84 - Test Method for surface Burning Characteristics of Building Materials.
- Local Authority regulations and standards

1.3 General Requirements

- The Contractor shall insulate all equipment above or below ambient temperature. Thermal insulation shall be provided for the following functions:
 1. Prevent the formation of condensation on pipework, ductwork or equipment
 2. To protect personnel from exposure to extremes of temperature
 3. Conserve energy for both cooled and heated systems
 4. Control process temperatures
- Ensure that all thermal insulation is made from materials with zero ozone depletion potential (CFC and HCFC free). Submit to the Engineer, prior to ordering, written confirmation from the insulation manufacturer(s) that the products to be installed are CFC and HCFC free.
- All insulation products shall maintain their thermal performance for a minimum of the plant design life.
- Submit to the Engineer, prior to ordering, details from the manufacturer(s) that define the life expectancy of the materials to be installed.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Where two or more layers of dissimilar insulating material are used, submit to the Engineer the declared value of thermal conductivity for each layer under the appropriate temperature conditions. The thickness of each layer shall also be stated. Ensure that the interface temperature between the two materials does not exceed the limiting temperature for the material of the outer layer.
- Adequate precautions shall be taken against any hazard to health involved in the use of any cleaner, adhesive or material in connection with the application and handling of insulation material. The manufacturer of any such material shall be consulted in respect of safe handling and working. The Contractor shall ensure that all operatives, for whom he is directly indirectly responsible for, conform with the working practices for safe handling of hazardous materials as set out in the COSHH Regulations and the Safety Plan for the Contract prepared by the Contractor to the satisfaction of the Employer and the Engineer.
- The Contractor shall insulate and finish the following services as a minimum:-
 1. Domestic Cold Water.
 2. Chilled water supply and return service.
 3. Condenser cooling water.
 4. Refrigeration suction lines.
 5. Condensate drainage lines.
 6. Domestic hot water services
 7. Refrigeration discharge line.
 8. All ductwork including smoke extract where adjacent to combustible materials.
 9. Chilled Water pumps
 10. Chilled water expansion tanks
 11. Hot Water Storage Calorifiers
 12. Chilled water buffer tanks
 13. Diesel exhaust flues.
- Fire Standards: Unless otherwise specified within the specifications, the following standards shall be adhered to:
 1. All thermal insulating materials shall have a Class O fire rating in accordance with Building Regulations, Part B (Fire safety). Tested in accordance with BS476 Part 4 or Parts 6 and 7.
 2. The finish of all thermal insulating materials shall comply with BS476 Part 7 Class 1 spread of flame.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

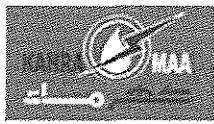
3. The insulating materials and finishes shall not produce smoke or toxic fumes when subject to fire (as British Standards). The Smoke Obscuration rating of insulating materials shall not be greater than 5% in accordance with BS EN ISO 5659-2.
4. All thermal insulation and its finished surfaces shall comply with the Fire Officers Requirements for the particular building, service, position, etc. It shall be responsibility of the Contractor to gain the Fire Officers approval for all the insulation material and finishes they propose to use, in compliance with this section of the Specification, before work is started.
5. All insulating materials shall be consistent and where the finish selected for a particular application may cause harm or pollute in any manner the areas in which they contained, this shall be brought to the attention of the Consultant and where appropriate the finish changed. The cost of any changes shall be borne by the Contractor.
6. In particular, mineral fibre insulation shall not be used in kitchen, food stores and other similar places where harm could result from its use.
7. The Contractor shall submit to the Consultant, for approval, samples of insulating materials and finishes at his request. Samples submitted may be sent to a selected laboratory for testing and report at the Contractors expense. Work undertaken without the Consultant's approval may be rejected. If rejected, the work shall be removed and replaced at the Contractor's expense.

1.4 Submittals

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 1. Product description
 2. Thermal Characteristics
 3. Material list and thickness for each service and location
 4. Two representative samples
 5. Manufacturers installation procedure
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats

1.5 Quality Assurance

- Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of documented experience.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- The installer shall be an insulating firm with at least 5 years of successful insulation experience on projects with pipe, duct and equipment insulations similar to that required for this project.
- All insulation materials and accessories for piping, ductwork and equipment shall meet the requirements of Qatar Construction Specification (QCS) All accessories and materials such as coatings, adhesive and sealer are to be shipped to the job in unopened containers as received from the manufacturer. These accessory materials are to be applied consistency and are not to be diluted in any form.

1.6 Delivery, Storage, And Protection

- Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

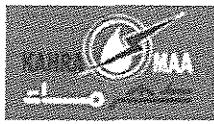
1.7 Environmental Requirements

- Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- Maintain temperature during and after installation for minimum period of 24 hours.

Products

1.8 General

- All systems are to have been tested and approved by the Consultant prior to installation of insulation
- All thermal insulation shall be non-corrosive to the metal, water repellent and fire retardant.
- All insulating materials shall be proofed against rotting, mould, fungus growth and attack by vermin.
- Materials and their method of application shall not constitute a known risk to health during application or use.
- Thermal conductivity values shall be tested in accordance with BS 2972.
- The uses of galvanized or zinc coated insulation steel jacketing and accessories on or near austenitic stainless steel and austenitic nickel steel/alloy equipment and piping, is prohibited.
- Dissimilar metals and materials subject to galvanic corrosion shall not be installed in contact with one another.
- Where the complete assembly is liable to mechanical damage in use, the final finish shall be sufficiently strong to ensure that the insulation does not become exposed.
- Materials in contact shall be compatible and shall not cause corrosion or degradation under normal site conditions.
- Insulation materials and finishes shall be inherently proof against rotting, mould and fungal growth and attack by vermin, be non-hygroscopic and in all respect be suitable for continuous use throughout the operating temperatures and within the environment where installed.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Materials shall be free from objectionable odour at the temperature at which they are to be used.
- The insulation shall be suitable for the specified conditions of use without the physical properties falling outside the tolerances allowed in the appropriate British Standard for the material.
- Protect insulated stainless steel surfaces from the risk of stress corrosion in accordance with the recommendations of BS 5970.

1.9 Fire Performance

- All insulating materials are required to meet the stated Fire Performance of the Authority Having Jurisdiction and references to any standard in this specification to be confirmed by the contractor prior as part of the tender process
- The whole of the insulation work shall be carried out by an approved specialist insulation contractor. All allowances shall be included for arranging a specialist subcontractor accordingly and for informing the specialist subcontractor of all conditions relating to contract and for coordinating his works with the remainder of the Works.
- In addition to complying with the relevant standards, all insulating material shall be free from asbestos.
- The insulating material shall be acceptable only if they are equal to or better than the grades or classes of the fire resistance as follows:
 1. BS 4735, Class Q, for burning rate nil, and not producing melted droplets
 2. BS 476 Part 4, for non-combustible grade
 3. BS 476 Part 5, Class P, for not easily ignitable
 4. BS 476 Part 7, for fire propagation index of a maximum of 12.6
 5. BS 476 Part 7, Class 1, for surface spread of flame
 6. BS 476 Part 9, for production of emitted smoke shall not give more than 35% obstruction of the light beam.

- All insulation finishes and covering shall be classified as Class 1 surface spread when tested in accordance with BS 476, Part 7. They shall not in any way attack the insulation or the surface to which the insulation is being applied and shall be suitable for working temperatures.
- All adhesive, mastics, coatings, sealers and primers shall be classified as Class 1 surface spread when tested in accordance with BS 476, Part 7. They shall not in any way attack the insulation or the surface to which the insulation is being applied and shall be suitable for the working temperatures.

1.10 Vapor Barrier

1. On surfaces operating below ambient temperature a complete vapour barrier seal shall be provided.
2. The vapour barrier shall take the form of a coating or sheet material.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

3. Vapour barriers shall be continuous and the integrity maintained. Where this is not possible, the vapour barrier shall be effectively sealed to the pipe to prevent any ingress of moisture or water vapour.
4. External vapour barriers shall be pre-applied or applied immediately after fitting the insulating material and before the fluid in the pipe, duct, or vessel is cooled.
5. The function of an external vapour barrier shall not be compromised by its additional use for other purposes e.g. as a form of weather protection or as mechanical protection for the thermal insulation.
6. Where required separate layers in the form of coatings or sheet material shall be used for the individual purposes. Where such additional protection is required, the installer shall ensue that its application does not cause any damage to the vapour barrier during installation and is unlikely to cause damage in service.
7. The vapour barrier shall not reduce the fire performance of the system as installed below the limit specified as appropriate to the type of application.
8. The values for water vapour permeance of barriers shall be as BS 5422: 2001

1.11 Fiber glass insulation

- Insulation shall be rigid section of fiber glass insulation with a density of 64kg/cum, having a thermal conductivity factor of 0.034w/sqm./K. The minimum thickness shall be as indicated in the referred codes.
- All pipe insulation to be factory covered with reinforced aluminum foil/kraft paper laminate, the whole providing a Class I rating to BS 476 Part 7.
- Bends are to be insulated with pre-molded polyisocyanurate rigid closed cell foam meeting the same fire ratings as above but with aluminum foil applied separately on site.
- Tees, valves, strainers etc. are to be produced by the Contractor forming suitable metal boxes and pouring in-situ polyisocyanurate chemical system supplied by the pipe insulation manufacturer and in accordance with his instructions.
- High density pipe supports, 80kg/m³, are to be produced from the same chemical system and by the same manufacturer of the insulation PIPE INSULATION
- The manufacturer's installation recommendations shall be strictly adhered to.

1.12 Mineral wool insulation

- For all mineral wool insulation products, test evidence must be submitted to the CA for approval, prior to ordering, showing that the fibers from which the products are made are not classified as a possible human carcinogen, as detailed by European Directive 97/69/EC and the approved supply list of CHIP98.
- Mineral pipe insulation sections shall have a nominal density of not less than 120 kg/m³. Pre-formed pipe sections shall be resin bonded with a thermal conductivity not exceeding 0.038 W/mK at 50 °C mean temperature



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- Mineral wool duct slab shall have a nominal density of not less than 45 kg/m³ with a thermal conductivity not exceeding 0.04 W/mK at 50 °C mean temperature.

1.13 Polyisocyanurate (phenolic foam) duct insulation

- All phenolic foam shall be CFC and HCFC free.
- Phenolic foam pipe and duct insulation shall have a thermal conductivity of not more than 0.018 W/mK at 10 °C mean temperature. (Fully aged values shall be in accordance with BS3927).
- Phenolic foam shall not be used on steam services or services operating above 100 °C.
- Where there is risk of corrosion being initiated by the pipework insulation a standard passivating bore coating shall be provided to reduce the risk. Any aluminium foil overlaps shall not be tucked in between the butt joints of the insulation sections.
- All phenolic pipe insulation shall be a nominal density of 35 kg/m³ for interior piping and 50kg/m³ for external pipework.
- The perpendicular compressive strength shall not be less than 150 kN/m² for pipe insulation and 100 kN/m² for duct insulation.
- All pipe insulation to be factory covered with reinforced aluminum foil/kraft paper laminate, the whole providing a Class I rating to BS 476 Part 7.
- Bends are to be insulated with pre-molded polyisocyanurate rigid closed cell foam meeting the same fire ratings as above but with aluminum foil applied separately on site.
- Tees, valves, strainers etc. are to be produced by the Contractor forming suitable metal boxes and pouring in-situ polyisocyanurate chemical system supplied by the pipe insulation manufacturer and in accordance with his instructions.
- High density pipe supports, 80kg/m³, are to be produced from the same chemical system and by the same manufacturer of the insulation
- The manufacturer's installation recommendations shall be strictly adhered to.

1.14 Closed Cell Insulation Elastomeric Foam

- Closed cell elastomeric rubber insulation or Cross Linked Polyfin foam shall be accepted as an alternative to Phenolic foam subject to the thickness proposed providing equal or better thermal resistance and vapour resistance to the specified thicknesses of Phenolic foam in the relevant codes
- These alternative insulation systems shall be complete with factory applied reinforced aluminium foil finish.
 1. Temperature Range: -100 °C + 105 °C.
 2. Thermal Conductivity: <0.034 W/m.k at 0 °C.
 3. Water Vapour Permeability: μ 7000 (DIN 52 615), 0.09 μ gm/Nh BS 4370/2.
 4. Fire Rating: Class (UN 8457 – UNI 9174), Class 1 BS 476: Part 7: 1987/ Class 0 BS 476 part 6.
 5. Elastomeric Insulation must be FM approved.
 6. Density: 45 kg/m³ up to 65 kg/m³.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7. Noise Reduction: 35 db (A) to the frequency of 500 Hz, European Standard EN 20140 – 10.
8. Closed Cell Content: > 90%.
9. Corrosion Risk: Assessment certified according DIN 1988/7.
10. Ozone Resistance: ASTM-D-1171 - No crack.
11. Material shall be CFC free.

1.15 Acoustic Insulation

- Furnish all labour, materials, tools and equipment and perform all Services and operations necessary for the complete supply and Installation of batt/blanket insulation to areas indicated on the as specified.
- Batt / Blanket Acoustic Insulation:
 1. Mineral fiber semi-rigid insulation in batts or blankets manufactured from stable glass fibers bonded with thermosetting resins, with a flame-spread and maximum smoke-developed indices of 0 and 15, respectively.
 2. Density: 24 kg/m³.
 3. Thickness: 50 mm.(Refer 23 3319 for acoustic treatment)
- Adhesive:

As recommended by insulation manufacturer for specific application with demonstrated capacity to bond insulation securely to substrate indicated without damaging insulation and substrates.
- Accessories:

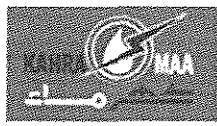
Fasteners and accessories required for the installation shall be as recommended by the manufacturer.

1.16 Acoustic Lining

1. Where ducting is lined, the lining should have a minimum thickness of 25 mm thickness with the following absorption coefficients:

Absorption Coefficient @ Octave Band Centre Frequency (Hz)					
125	250	500	1000	2000	4000
0.05	0.15	0.1	0.45	0.6	0.5

2. The acoustic media should not comprise materials which are generally composed of mineral fibres, either man made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise stabilised to ensure fibre migration is prevented.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1.17 Jackets

- Internal Applications: Glass cloth Jacket: Glass cloth treated with dilute fire retardant lagging adhesive.
- For all external ductwork: Aluminum Jacket:
 1. Thickness: 0.40 mm sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 50 mm laps.
 4. Fittings 0.4 mm thick die shaped fitting covers with factory attached protective liner.
- Vapor Barrier Jacket:
 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. The values for water vapour permeance of barriers shall be as BS 5422: 2001
 3. Secure with pressure sensitive tape

Execution

1.18 Examination

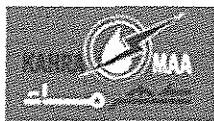
- Verify that ducts have been tested before applying insulation materials.
- Verify that surfaces are clean, foreign material removed, and dry.
- Ensure that surfaces to receive insulation are clean, dry, and suitable to provide a complete and satisfactory installation.

1.19 Insulation Thickness

- The insulation thickness should be in accordance with the requirements of BS 5422 and calculated according to BS EN 10241
- If the thickness given in, or interpolated from, the tables in the British Standard or the specification do not correspond with available thickness, the nearest higher available thickness shall be used.
- In multi-layer applications, where material thickness is rounded up to suit available commercial thickness, the installer shall ensure by calculation (in accordance with the appropriate British Standard) that each interface temperature is below the maximum continuous operating temperature of the materials involved.

1.20 Installation

- Install in strict accordance with manufacturer's instructions.
- In order to ensure that the insulation applied is in all respects in accordance with the Specification, sections shall, as required by the Consultant, be cut from the finished insulation. The Contractor is to allow his price for the removal and replacement of two sections of each type of insulation. If however, defects sections shall be replaced at no cost to the Contract. If further defects are revealed then the Consultant shall have the right, when in his opinion it is necessary, to issue instructions for any part or the whole of the insulation to be removed and replaced. The replacement with new insulation shall be



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

to the satisfaction of the Consultant and the cutting out and replacement shall be at no cost to the Contract.

- Particular attention shall be paid to the finished appearances of all thermal insulation which must present a neat and symmetrical appearance running true in the line with pipe layouts, etc. Any rough, irregular and badly finished surfaces shall be stripped down and re-insulated to the Consultant's satisfaction.
- All metal surfaces shall be thoroughly cleaned and treated with approved corrosion inhibitor before applying the insulation. Insulation can be applied directly to galvanized surfaces.
- Lead bearing inserts shall be provided at all supports to ensure that the insulation is not compressed or damaged. The inserts shall be treated hardwood or approved plastic.
- Mechanical fasteners shall be used when installing slab or roll insulation. The fasteners shall be the self-adhesive type and only fixed after cleaning to ensure proper adhesion.

1.21 Insulation Thickness

- The insulation thickness should be in accordance with the requirements of BS5422:2001
- If the thickness given in, or interpolated from, the tables in the British Standard or the specification do not correspond with available thickness, the nearest higher available thickness shall be used.
- In multi-layer applications, where material thickness is rounded up to suit available commercial thickness, the installer shall ensure by calculation (in accordance with the appropriate British Standard) that each interface temperature is below the maximum continuous operating temperature of the materials involved.

1.22 Aluminium Cladding

- Aluminium cladding shall be formed to fit tightly over the protected equipment of the insulation with longitudinal overlaps of not less than 40 mm the outer part of the overlap to be secured with self-tapping screws or rivets of the appropriate type at centres of not more than 150mm. All longitudinal joints shall be hidden from view as far as possible.
- Where access is required to pumps or other equipment with irregular shapes contractor to submit proposals for materials and methods of applying a demountable finish for approval
- Overlaps to be not less than 40 mm and secured with secured with self-tapping screws or rivets of the appropriate type, not less than four, equally spaced. One circumferential joint should be left free at maximum intervals of 5 metres to allow for expansion and contraction.
- All joints shall be so arranged as to shed liquids and shall be sealed with a suitable gun applied water resistant sealant.
- All bends and fittings shall be covered with matching aluminium sheet cladding tailored to fit the application but using specially segmented purpose made pieces, or mitered bends where applicable.
- All insulation termination points shall be trimmed with compatible aluminium coiled end capping pieces secured over the aluminium cladding with closed head pop rivets.
- All aluminium metal work shall be pre-formed, neatly and correctly installed, and manufactured to ensure a smooth, clean, uniform installation free from sharp and dangerous edges.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.3.14 23 0719 - HVAC Piping Insulation

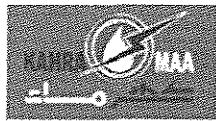
General

1.1 Summary

- This section includes:
 1. Piping insulation.
 2. Jackets and accessories.
- Related Sections
 1. Section 22 1005 - Plumbing Piping
 2. Section 22 0553 – Identification for Plumbing Piping and Equipment.
 3. Section 23 2113 - Hydronic Piping

1.2 References

- BS 476 Fire tests on building materials and structures
 1. Part 4: Non-combustibility test for materials
 2. Part 6: Method of test for fire propagation for products
 3. Part 7: Method of test to determine the classification of the surface spread of flame of products
 4. Part 11: Method for assessing the heat emission from building materials
 5. Part 12: Method of test for the ignitability of products by direct flame impingement
- BS 2972 Methods of test for inorganic thermal insulating materials
- BS 3533 Glossary of Thermal Insulation Terms.
- BS 3927 Specification for Rigid Phenolic Foam (PF) for Thermal Insulation in the form of slabs and Profiled Sections.
- BS 3958: Thermal Insulating Materials
 1. Part 3: Metal mesh faced man-made mineral fibre mattresses.
 2. Part 4: Bonded pre-formed man-made mineral wool pipe section.
 3. Part 5: Specification for bonded man-made mineral wool slabs.
- BS 4735 Laboratory method of test for assessment of horizontal burning characteristics of specimens no larger than 150mm x 50mm x 12mm (nominal) of cellular plastics a small frame.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

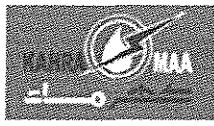
- BS 5422 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range, -40°C to +700°C
- BS 874 Methods for determining thermal insulating properties with definitions of thermal insulating terms
- BS EN ISO 5659-2 Plastics. Smoke generation. Determination of optical density by a single chamber test.
- BS 5970 Code of Practice for thermal insulation of pipework and equipment (in the temperature range -100°C to + 870°C).
- BS EN 10220 Seamless and welded steel tubes
- BS EN 10255 Non alloy steel tubes suitable for welding and threading
- BS EN 10326 Continuously hot dip coated strip and sheet of steel enclosures
- BS EN ISO 12241 Thermal insulation for building equipment and industrial installations. Calculation rules.
- Local Authority regulations and standards.
- NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; 2003.
- ASTM E-84 Test Method for surface Burning Characteristics of Building Materials.

1.3 Submittals

- Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- Samples: Submit two samples of any representative size illustrating each insulation type.
- Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.4 General Requirements

- Thermal insulation shall be provided for the following functions:
 1. Prevent the formation of condensation on pipework, ductwork or equipment
 2. To protect personnel from exposure to extremes of temperature
 3. Conserve energy for both cooled and heated systems
 4. Control process temperatures
- Ensure that all thermal insulation is made from materials with zero ozone depletion potential (CFC and HCFC free). Submit to the Engineer, prior to ordering, written confirmation from the insulation manufacturer(s) that the products to be installed are CFC and HCFC free.
- All insulation products shall maintain their thermal performance for a minimum of the plant design life.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Submit to the Engineer, prior to ordering, details from the manufacturer(s) that define the life expectancy of the materials to be installed.
- Submit to the Engineer, prior to ordering the manufacturer's declared values of thermal conductivity for each material proposed. The declared values shall be appropriate to the mean temperature of the applied insulation and based on results of tests carried out in accordance with the appropriate Standards.
- Where two or more layers of dissimilar insulating material are used, submit to the Engineer the declared value of thermal conductivity for each layer under the appropriate temperature conditions. The thickness of each layer shall also be stated. Ensure that the interface temperature between the two materials does not exceed the limiting temperature for the material of the outer layer.
- All insulating material and associated products shall be applied in accordance with the manufacturer's recommendations and instructions.

1.5 Quality Assurance

- Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of documented experience.
- The installer shall be an insulating firm with at least 5 years of successful insulation experience on projects with pipe, duct and equipment insulations similar to that required for this project.
- All insulation materials and accessories for piping, ductwork and equipment shall meet the requirements of Qatar construction Specification. (QCS) Ratings shall be determined by Underwriters' Laboratories, Inc., "Method of Test of Surface Burning Characteristics of Building Materials". All accessories and materials such as coatings, adhesive and sealer are to be shipped to the job in unopened containers as received from the manufacturer. These accessory materials are to be applied at can consistency and are not to be diluted in any form.

1.6 Delivery, Storage, And Protection

- Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 Environmental Requirements

- Maintain ambient conditions required by manufacturers of each product.
- Maintain temperature before, during, and after installation for minimum of 24 hours.

Products

1.8 General Requirements

- All systems are to have been tested and approved by the Consultant prior to installation of insulation
- All thermal insulation shall be non-corrosive to the metal, water repellent and fire retardant.
- All insulating materials shall be proofed against rotting, mould, fungus growth and attack by vermin.

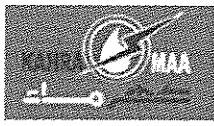


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Materials and their method of application shall not constitute a known risk to health during application or use.
- Thermal conductivity values shall be tested in accordance with BS 2972.
- The uses of galvanized or zinc coated insulation steel jacketing and accessories on or near austenitic stainless steel and austenitic nickel steel/alloy equipment and piping, is prohibited.
- Dissimilar metals and materials subject to galvanic corrosion shall not be installed in contact with one another.
- Where the complete assembly is liable to mechanical damage in use, the final finish shall be sufficiently strong to ensure that the insulation does not become exposed.
- Materials in contact shall be compatible and shall not cause corrosion or degradation under normal site conditions.
- Insulation materials and finishes shall be inherently proof against rotting, mould and fungal growth and attack by vermin, be non-hygroscopic and in all respect be suitable for continuous use throughout the operating temperatures and within the environment where installed.
- Materials shall be free from objectionable odour at the temperature at which they are to be used.
- The insulation shall be suitable for the specified conditions of use without the physical properties falling outside the tolerances allowed in the appropriate British Standard for the material.
- Protect insulated stainless steel surfaces from the risk of stress corrosion in accordance with the recommendations of BS 5970.

1.9 Fire Performance

- All insulating materials are required to meet the stated Fire Performance of the Authority Having Jurisdiction and references to any standard in this specification to be confirmed by the contractor prior as part of the tender process
- The whole of the insulation work shall be carried out by an approved specialist insulation contractor. All allowances shall be included for arranging a specialist subcontractor accordingly and for informing the specialist subcontractor of all conditions relating to contract and for coordinating his works with the remainder of the Works.
- In addition to complying with the relevant standards, all insulating material shall be free from asbestos.
- The insulating material shall be acceptable only if they are equal to or better than the grades or classes of the fire resistance as follows:
 1. BS 4735, Class Q, for burning rate nil, and not producing melted droplets
 2. BS 476 Part 4, for non-combustible grade
 3. BS 476 Part 5, Class P, for not easily ignitable
 4. BS 476 Part 7, for fire propagation index of a maximum of 12.6
 5. BS 476 Part 7, Class 1, for surface spread of flame



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

6. BS 476 Part 9, for production of emitted smoke shall not give more than 35% obstruction of the light beam.

- All insulation finishes and covering shall be classified as Class 1 surface spread when tested in accordance with BS 476, Part 7. They shall not in any way attack the insulation or the surface to which the insulation is being applied and shall be suitable for working temperatures.
- All adhesive, mastics, coatings, sealers and primers shall be classified as Class 1 surface spread when tested in accordance with BS 476, Part 7. They shall not in any way attack the insulation or the surface to which the insulation is being applied and shall be suitable for the working temperatures.

1.10 Fiber glass insulation

- Insulation shall be rigid section of fiber glass insulation with a density of 64kg/cum, having a thermal conductivity factor of 0.034w/sqm./K. The minimum thickness shall be as indicated in the referred codes.
- All pipe insulation to be factory covered with reinforced aluminum foil/kraft paper laminate, the whole providing a Class I rating to BS 476 Part 7.
- Bends are to be insulated with pre-moulded polyisocyanurate rigid closed cell foam meeting the same fire ratings as above but with aluminum foil applied separately on site.
- Tees, valves, strainers etc. are to be produced by the Contractor forming suitable metal boxes and pouring in-situ polyisocyanurate chemical system supplied by the pipe insulation manufacturer and in accordance with his instructions.
- High density pipe supports, 80kg/m³, are to be produced from the same chemical system and by the same manufacturer of the insulation PIPE INSULATION
- The manufacturer's installation recommendations shall be strictly adhered to.

1.11 Mineral Wool Insulation

- For all mineral wool insulation products, test evidence must be submitted to the CA for approval, prior to ordering, showing that the fibres from which the products are made are not classified as a possible human carcinogen, as detailed by European Directive 97/69/EC and the approved supply list of CHIP98.
- Mineral pipe insulation sections shall have a nominal density of not less than 120 kg/m³. Pre-formed pipe sections shall be resin bonded with a thermal conductivity not exceeding 0.038 W/mK at 50 °C mean temperature
- Mineral wool duct slab shall have a nominal density of not less than 45 kg/m³ with a thermal conductivity not exceeding 0.04 W/mK at 50 °C mean temperature.

1.12 Polyisocyanurate (phenolic foam) pipe insulation

- All phenolic foam shall be CFC and HCFC free.
- Phenolic foam pipe and duct insulation shall have a thermal conductivity of not more than 0.018 W/mK at 10 °C mean temperature. (Fully aged values shall be in accordance with BS3927).
- Phenolic foam shall not be used on steam services or services operating above 100 °C.
- Where there is risk of corrosion being initiated by the pipework insulation a standard passivating bore coating shall be provided to reduce the risk. Any aluminium foil overlaps shall not be tucked in between the butt joints of the insulation sections.



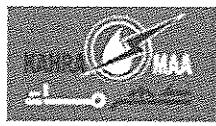
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- All phenolic pipe insulation shall be a nominal density of 35 kg/m³ for interior piping and 50kg/m³ for external pipework.
- The perpendicular compressive strength shall not be less than 150 kN/m² for pipe insulation and 100 kN/m² for duct insulation.
- All pipe insulation to be factory covered with reinforced aluminum foil/kraft paper laminate, the whole providing a Class I rating to BS 476 Part 7.
- Bends are to be insulated with pre-moulded polyisocyanurate rigid closed cell foam meeting the same fire ratings as above but with aluminum foil applied separately on site.
- Tees, valves, strainers etc. are to be produced by the Contractor forming suitable metal boxes and pouring in-situ polyisocyanurate chemical system supplied by the pipe insulation manufacturer and in accordance with his instructions.
- High density pipe supports, 80kg/m³, are to be produced from the same chemical system and by the same manufacturer of the insulation
- The manufacturer's installation recommendations shall be strictly adhered to.

1.13 Closed Cell Insulation Elastomeric Foam

- Closed cell elastomeric rubber insulation or Cross Linked Polyfin foam shall be accepted as an alternative to Phenolic foam subject to the thickness proposed providing equal or better thermal resistance and vapour resistance to the specified thicknesses of Phenolic foam in the relevant codes
- These alternative insulation systems shall be complete with factory applied reinforced aluminium foil finish.
 1. Temperature Range: -100 °C + 105 °C.
 2. Thermal Conductivity: <0.034 W/mk at 0 °C.
 3. Water Vapour Permeability: μ 7000 (DIN 52 615), 0.09 μ gm/Nh BS 4370/2.
 4. Fire Rating: Class (UN 8457 – UNI 9174), Class 1 BS 476: Part 7: 1987/ Class 0 BS 476 part 6.
 5. Elastomeric Insulation must be FM approved.
 6. Density: 45 kg/m up to 65 kg/m .
 7. Noise Reduction: 35 db (A) to the frequency of 500 Hz, European Standard EN 20140 – 10.
 8. Closed Cell Content: > 90%.
 9. Corrosion Risk: Assessment certified according DIN 1988/7.
 10. Ozone Resistance: ASTM-D-1171 - No crack.
 11. Material shall be CFC free.

1.14 Acoustic Insulation



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Furnish all labour, materials, tools and equipment and perform all Services and operations necessary for the complete supply and Installation of batt/blanket insulation to areas indicated on the as specified.
- Batt / Blanket Acoustic Insulation:
 1. Mineral fiber semi-rigid insulation in batts or blankets manufactured from stable glass fibers bonded with thermosetting resins, with a flame-spread and maximum smoke-developed indices of 0 and 15, respectively.
 2. Density: 24 kg/m³.
 3. Thickness: 50 mm.(Refer 23 3319 for acoustic treatment)
- Adhesive:

As recommended by insulation manufacturer for specific application with demonstrated capacity to bond insulation securely to substrate indicated without damaging insulation and substrates.
- Accessories:

Fasteners and accessories required for the installation shall be as recommended by the manufacturer.

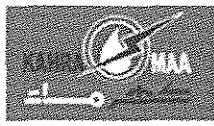
1.15 JACKETS

- Internal Applications: Glass cloth Jacket: Glass cloth treated with dilute fire retardant lagging adhesive.
- For all external ductwork: Aluminum Jacket:
 1. Thickness: 0.40 mm sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 50 mm laps.
 4. Fittings 0.4 mm thick die shaped fitting covers with factory attached protective liner.
- Vapor Barrier Jacket:
 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. The values for water vapour permeance of barriers shall be as BS 5422: 2001
 3. Secure with pressure sensitive tape

Execution

1.16 Examination

- Verify that ducts have been tested before applying insulation materials.
- Verify that surfaces are clean, foreign material removed, and dry.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Ensure that surfaces to receive insulation are clean, dry, and suitable to provide a complete and satisfactory installation.

1.17 Insulation Thickness

- The insulation thickness should be in accordance with the requirements of BS 5422 and calculated according to BS EN 10241
- If the thickness given in, or interpolated from, the tables in the British Standard or the specification do not correspond with available thickness, the nearest higher available thickness shall be used.
- In multi-layer applications, where material thickness is rounded up to suit available commercial thickness, the installer shall ensure by calculation (in accordance with the appropriate British Standard) that each interface temperature is below the maximum continuous operating temperature of the materials involved.

1.18 Installation

- Install in strict accordance with manufacturer's instructions.
- In order to ensure that the insulation applied is in all respects in accordance with the Specification, sections shall, as required by the Consultant, be cut from the finished insulation. The Contractor is allowed his price for the removal and replacement of two sections of each type of insulation. If however, defects sections shall be replaced at no cost to the Contract. If further defects are revealed then the Consultant shall have the right, when in his opinion it is necessary, to issue instructions for any part or the whole of the insulation to be removed and replaced. The replacement with new insulation shall be to the satisfaction of the Consultant and the cutting out and replacement shall be at no cost to the Contract.
- Particular attention shall be paid to the finished appearances of all thermal insulation which must present a neat and symmetrical appearance running true in the line with pipe layouts, etc. Any rough, irregular and badly finished surfaces shall be stripped down and re-insulated to the Consultant's satisfaction.
- All metal surfaces shall be thoroughly cleaned and treated with approved corrosion inhibitor before applying the insulation. Insulation can be applied directly to galvanized surfaces.
- Lead bearing inserts shall be provided at all supports to ensure that the insulation is not compressed or damaged. The inserts shall be treated hardwood or approved plastic.
- Mechanical fasteners shall be used when installing slab or roll insulation. The fasteners shall be the self-adhesive type and only fixed after cleaning to ensure proper adhesion.

1.19 Insulated Support Blocks

- At the points of support where insulation bears the weight of pipework and contents, purpose designed load bearing, high density blocks of an approved material shall be installed at all support positions to facilitate installation of a continuous thickness of vapour sealed insulation and finish.
- The pipe insulation shall be butted up to the block and the joints sealed with a suitable adhesive tape to provide a continuous vapour seal through the support.
- Sharp edges on metal support brackets/clips shall be ground smooth to ensure that the brackets/clips do not perforate the foil facing, thus destroying the vapour seal.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Where pipework is supported on steel bearers/rollers, purpose designed high density blocks of an approved material fitted with galvanised metal wearing plates shall be used. The support blocks shall be butt jointed, wrapped with adhesive tape and vapour sealed.

1.20 Valve Flange And Ancillary Insulation

- Provide thermal insulation to all valves, flanges, strainers and all ancillaries. The insulation shall be suitable for the service to be insulated and provide the same thermal performance as the adjoining pipework and maintain the continuity of the vapour barrier where required.
- All services at below ambient temperature's valves and flanges shall be insulated and complete with vapour barrier.
- Aluminium boxes shall be the split casing type fabricated from 0.91mm aluminium sheet or 0.7 mm fitted with spring clip fasteners and neoprene or similar seals. The internal insulating material lining shall have the same thermal performance as the adjoining insulation and be secured to ensure the lining will not collapse when the box is removed and re-installed. Aluminium boxes shall be re-useable and facilitate removal without disturbing the adjacent insulation.
- All valves shall be provided with valve boxes unless otherwise stated

1.21 Aluminium Cladding

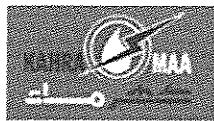
- Aluminium cladding shall be formed to fit tightly over the outer circumference of the insulation with longitudinal overlaps of not less than 40 mm the outer part of the overlap to be secured with self-tapping screws or rivets of the appropriate type at centres of not more than 150mm. All longitudinal joints shall be hidden from view as far as possible.
- Circumferential overlaps to be not less than 40 mm and secured with self-tapping screws or rivets of the appropriate type, not less than four, equally spaced. One circumferential joint should be left free at maximum intervals of 5 metres to allow for expansion and contraction.
- All joints shall be so arranged as to shed liquids and shall be sealed with a suitable gun applied water resistant sealant.
- All bends and fittings shall be covered with matching aluminium sheet cladding tailored to fit the application but using specially segmented purpose made pieces, or mitred bends where applicable.
- All insulation termination points shall be trimmed with compatible aluminium coiled end capping pieces secured over the aluminium cladding with closed head pop rivets.
- All aluminium metal work shall be pre-formed, neatly and correctly installed, and manufactured to ensure a smooth, clean, uniform installation free from sharp and dangerous edges.

1.22 Insulation Schedule

- Chilled water pipework (internal)

Phenolic foam or Elastomeric foam with aluminium cladding where exposed to view (i.e. no false ceiling)

- Chilled water external (not buried)

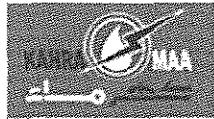


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

Phenolic foam or Elastomeric foam with aluminium cladding

- LTHW pipework
 - Phenolic foam or Elastomeric foam with aluminium cladding where exposed to view (i.e. no false ceiling) or installed externally
- Condensate drains
 - Elastomeric foam with aluminium cladding where exposed to view (i.e. no false ceiling) or installed externally or in plant rooms. Thickness shall be as per chilled water requirements.
- Ductwork AHU intake / discharge
 - lined with 25mm of acoustic insulation (neoprene or vinyl coated fiberglass of 24 kg/3 density)
- Condensate receivers
 - 50mm Phenolic or Elastomeric foam
- Blow Down Tank
 - 38mm Phenolic or Elastomeric foam
- Domestic Hot water
 - Phenolic foam or Elastomeric foam with aluminium cladding where exposed to view (i.e. no false ceiling) or installed externally or in plant rooms
- Domestic Cold Water
 1. Phenolic foam or Elastomeric foam with aluminium cladding where exposed to view (i.e. no false ceiling) or installed externally or in plant rooms
 2. All insulation shall be provided with continuous vapour barrier. Such as Kraft paper with glass fiber yarn and bonded to aluminized film.
- All insulation shall be provided with continuous vapour barrier.
- Elastomeric foam applied externally shall be complete with impregnated aluminium finish to protect it from UV during installation and before application of cladding.
- All external supports shall be galvanized steel.
- Contractor is to provide galvanized steel step overs in all necessary locations to facilitate full access to all plant for maintenance and to help protect the insulation during construction.
- Step-overs shall be provided by the Contractor in the locations required by the engineer and to the engineers approval.

1.23 Insulation Schedule



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

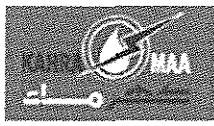
PIPING	TYPE	DENSITY (kg/m3)	THICKNESS mm
Chilled water supply return and refrigerant suction piping, valves and fittings	Rigid Fiberglass	64	75
Condensate drain piping	Rigid Fiberglass	64	25
Condenser water return pipe, valves and fittings	Rigid Fiberglass	64	19
Condenser water return pipe, valves and fittings	Rigid Fiberglass	64	12
Duct in ceiling plenums and exposed in AC area	Flexible Fiberglass	48	25
Duct in shafts & Plant rooms and exposed in non-AC area	Rigid Fiberglass	48	50
Ducts exposed outdoors	Rigid Fiberglass	48	50
Acoustical lining	Rigid Fiberglass	48	25
Drain pan	Rigid Fiberglass.	50	25
Expansion tank /Air separator	Rigid Fiberglass	50	25
Chilled water pumps	Rigid Fiberglass	50	50

7.3.15 23 0800 - Commissioning of HVAC

GENERAL

1.1 SUMMARY

- This section outlines the administrative activities related to the commissioning. Each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- Related Sections
 1. Section 23 0130 – HVAC Air Duct Cleaning.
 2. Section 23 2500 – HVAC Water Treatment



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

3. Section 23 0923 – Direct-Digital Control System for HVAC.
4. Section 23 0913 – Instrumentation and Control Devices for HVAC.
5. Section 23 0993 – Sequence of Operations for HVAC Controls.
6. Section 23 0593 – Testing, Adjusting, and Balancing for HVAC.

1.2 REFERENCES

- CIBSE current Commissioning Codes
 1. Series A Air Distribution Systems - High and Low Velocity
 2. Series B Boiler Plant
 3. Series C Automatic Control Systems
 4. Series R Refrigeration Systems
 5. Series W Water Distribution Systems
- BSRIA Current Application Guides
 1. AG 3/89.3 Commissioning of air systems
 2. AG 2/89.2 The commissioning of water systems in buildings
 3. AG 1/91 Commissioning of VAV systems in buildings
 4. AG 1/2001 Pre-commission cleaning of pipework services
- HVCA (Heating and Ventilating Contractor's Association) Current Standards
 1. HVCA DW 144 Specification for sheet metal ductwork
 2. HVCA DW 143 A practical guide to ductwork leakage testing
- BS EN 12056 Gravity drainage systems inside buildings
- BS 5306 Fire extinguishing installations and equipment on premises
- BS 6880-3 Code of Practice for low temperature hot water heating systems of output greater than 45kW. Installation, commissioning and maintenance.
- BS 6700 Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages
- BS EN 12327 Gas supply systems. Pressure testing, commissioning and decommissioning procedures. Functional requirements
- The Institution of Gas Engineers IGE/UP/4 Commissioning of gas-fired plant on industrial and commercial
- SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.3 General requirements

- The entire HVAC system shall be commissioned, including commissioning activities for the following specific items:
 1. Automatic Building Control system.
 2. Major and minor equipment items.
 3. Piping systems and equipment.
 4. Ductwork and accessories.
 5. Smoke Exhaust System.
 6. Terminal units.
 7. Sound control devices.
 8. Vibration control devices.
 9. Variable frequency drives.
 10. Other equipment and systems explicitly identified



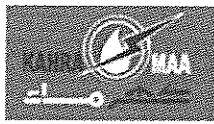
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

11. Elsewhere in Contract Documents as requiring commissioning.

- The Pre-functional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.
- The Contractor shall execute a Commissioning Program, which delivers the intended results of Mechanical System Commissioning, using whatever personnel, time and resources are required.
- This Section provides minimum program requirements; however, the Contractor shall exceed those requirements whenever necessary to achieve the intent of Mechanical System Commissioning. Refer to the agreed commissioning codes or ASHRAE Guideline 1, 1996, "HVAC Commissioning Process" for additional requirements, reports and standard report forms.
- Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow BSRIA Application Guide 3/89.3 for water systems and BSRIA Application Guide 2/89.2 for air systems
- Report data in SI (metric) units only.

1.4 Definitions and Abbreviations:

- Where used in the specification the following definitions shall apply:
- Commissioning: the advancement of an installation from the stage of static completion to working order to the specified requirements.
- Testing: the measurement and recording of specified quantifiable characteristics of an installation or parts thereof. This includes off site testing.
- Setting to work: the process of setting a static system in motion
- Regulation: the process of adjusting the rates of fluid flow in a distribution system to achieve specified values
- Environmental testing: the measurement and recording of internal environmental conditions
- System proving: the measuring, recording, evaluating and reporting on the seasonal performance of the systems against their design values
- System demonstration: demonstrating the capability of the installation to achieve and maintain the specified performance criteria
- Fine-tuning: the adjustment of the system where usage and system proving has shown such a need. This may include the re-assessment of design values and control set points to achieve the required system performance.
- Pre-commissioning checks: systematic checking of a completed installation to establish its suitability for commissioning
- Verify: To positively determine that the measured or observed quantity satisfies all required criteria. Simply performing the test, measurement or observation does not constitute verification. The test result must also satisfy all design criteria as shown in Contract documents. Tests which fail must be repeated at no additional cost to the Employer after repairs or adjustments are made, until final verification is achieved
- Commissioning Authority (Specialist): The Contractor shall employ a registered professional engineer who has the required knowledge and skills relating to the building

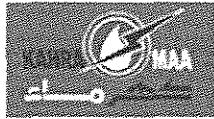


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

services trades in order to effectively function as a Commissioning Authority to coordinate the Commissioning Program, and as a commissioning specialist to supervise and witness testing, adjusting and balancing activities before these activities are demonstrated to the Employer or Consultant. The Commissioning Authority reports to the Contractor.

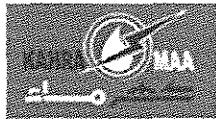
1.5 SUBMITTALS

- See Section 01 General Commissioning Requirements, for submittal procedures.
- HVAC Control System Documentation: Submit detailed sequences of operation, control system drawings, and points list, as specified.
 1. Incorporate the sequence of operation information specified in other HVAC specification sections.
 2. Incorporate the shop drawing submittal information specified in the HVAC control system section.
 3. Submittals prepared for other sections may be used in preparation of this documentation.
- Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- DRAFT Pre-functional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
 1. System name.
 2. List of devices.
 3. Step-by-step procedures for testing each controller after installation, including:
 - a. Process of verifying proper hardware and wiring installation.
 - b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
 - c. Process of performing operational checks of each controlled component.
 - d. Plan and process for calibrating valve and damper actuators and all sensors.
 - e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
 4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has "passed" and is operating within the contract parameters.
 5. Description of the instrumentation required for testing.
 6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.
- Startup Reports, Pre-functional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
 1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
 2. Full as-built set of control drawings.
 3. Full as-built sequence of operations for each piece of equipment.
 4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
 - a. Floor.
 - b. Room number.
 - c. Room name.
 - d. Air handler unit ID.
 - e. Reference drawing number.
 - f. Air terminal unit tag ID.
 - g. Heating and/or cooling valve tag ID.
 - h. Minimum air flow rate.
 - i. Maximum air flow rate.
 5. Full print out of all schedules and set points after testing and acceptance of the system.
 6. Full as-built print out of software program.
 7. Electronic copy on disk of the entire program for this facility.
 8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
 9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
 10. Control equipment component submittals, parts lists, etc.
 11. Warranty requirements.
 12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
 13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
 - a. Sequences of operation.
 - b. Control drawings.
 - c. Points lists.
 - d. Controller and/or module data.
 - e. Thermostats and timers.
 - f. Sensors and DP switches.
 - g. Valves and valve actuators.
 - h. Dampers and damper actuators.
 - i. Program setups (software program printouts).
- Project Record Documents: See Section 01 for additional requirements.
 1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014**

**Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- 2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.
- Draft Training Plan: In addition to requirements specified in Section 01, include:
 1. Follow the recommendations of ASHRAE Guideline 1.
 2. Control system manufacturer's recommended training.
 3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- Training Manuals: See Section 01 for additional requirements.

Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

PRODUCTS

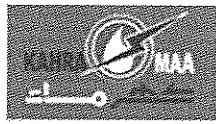
1.6 TEST EQUIPMENT

- Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of the client.
- Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to the client; such equipment, tools, and instruments are to become the property of the client.

EXECUTION

1.7 TESTING AND BALANCING PLAN

- The contractor is to produce a detailed Testing and Balancing Plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component. The TAB plan is to be submitted six weeks prior to starting the testing, adjusting, and balancing work.
- Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the other installers to sufficiently understand the design intent for each system. Include at least the following in the plan:
 1. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 2. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 3. Identification and types of measurement instruments to be used and their most recent calibration date.
 4. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 5. Final test report forms to be used.
 6. Detailed step-by-step procedures for TAB work for each system and issue, including:

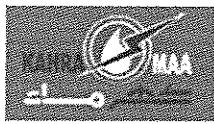


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- j. Terminal flow calibration (for each terminal type).
- k. Diffuser proportioning.
- l. Branch/sub-main proportioning.
- m. Total flow calculations.
- n. Rechecking.
- o. Diversity issues.
- p. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
- q. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
7. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
8. Confirmation of understanding of the outside air ventilation criteria under all conditions.
9. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
10. Method of checking building static and exhaust fan and/or relief damper capacity.
11. Proposed selection points for sound measurements and sound measurement methods.
12. Methods for making coil or other system plant capacity measurements, if specified.
13. Time schedule for TAB work to be done in phases (by floor, etc.).
14. Description of TAB work for areas to be built out later, if any.
15. Time schedule for deferred or seasonal TAB work, if specified.
16. False loading of systems to complete TAB work, if specified.
17. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
18. Interstitial cavity differential pressure measurements and calculations, if specified.
19. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
20. Procedures for formal deficiency reports, including scope, frequency and distribution.

1.8 PREPARATION

- Cooperate with the Commissioning Authority in development of the Pre-functional Checklists and Functional Test Procedures.
- Furnish additional information requested by the Commissioning Authority.
- Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

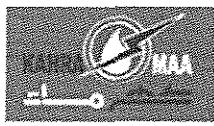
- Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
 1. Include cost of sheaves and belts that may be required for testing, adjusting, and balancing.
- Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.
- Provide temperature and pressure taps in accordance with the contract documents.
 1. Provide a pressure/temperature plug at each water sensor which is an input point to the control system.

1.9 RECORDING AND ADJUSTING

- Field Logs: Maintain written logs including:
 1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- Ensure recorded data represents actual measured or observed conditions.
- Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Engineer

1.10 DEMONSTRATION AND TRAINING

- Demonstrate operation and maintenance of HVAC system to project personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- These demonstrations are in addition to, and not a substitute for, Pre-functional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- Provide classroom and hands-on training for the project designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- TAB Review: Instruct the project personnel for minimum 8 hours, after completion of TAB, on the following:
 1. Review final TAB report, explaining the layout and meanings of each data type.
 2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
 3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 5. Other salient information that may be useful for facility operations, relative to TAB.
- HVAC Control System Training: Perform training in at least three phases:
 6. Phase 1 - Basic Control System: Provide minimum of 45 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
 - a. This training may be held on-site or at the manufacturer's facility.
 - b. If held off-site, the training may occur prior to final completion of the system installation.
 - c. For off-site training, shall pay expenses of up to four attendees.
 7. Phase 2 - Integrating with HVAC Systems: Provide minimum of 45 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
 - a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
 - b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing set-points and alarms and other typical changed parameters, overrides, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - c. Trend logging and monitoring features (values, change of state, totalisation, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
 - d. Every display screen, allowing time for questions.
 - e. Point database entry and modifications.
 8. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of 18 hours of training. Tailor training session to questions and topics solicited beforehand for the project (DCC+T). Also be prepared to address topics brought up and answer questions concerning operation of the system.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

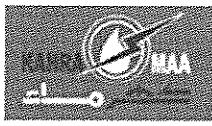
- Provide the services of manufacturer representatives to assist instructors where necessary.
- Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

1.11 NOTIFICATION OF SYSTEM COMPLETION AND REQUEST FOR FINAL MECHANICAL SYSTEM COMMISSIONING VERIFICATION

- When systems are ready for final commissioning verification, the Mechanical Trade Representative shall notify the Commissioning Authority in writing. Commissioning data sheets must be complete through the column labeled "Balanced" and included with the request.
- Should the verification test reveal that the equipment is not performing as specified or control operation is not acceptable, the Contractor will be entitled to one re-inspection of any failed item at no additional cost.
- Should the verification test determine that the equipment is still not performing as specified or control operation is not acceptable on the second inspection, the time and expenses of the Consultant if applicable, and the Employer to make further verification shall be considered as additional cost to the Employer. The total sum of such costs shall be deducted from the final payment to the Contractor.

1.12 VERIFICATION OF COMPLETION AND PERFORMANCE

- Verification of completion and performance will take place after certification of the completion of the construction. Demonstration shall be done by the Mechanical Trade Representative or the TAB Trade Representative and shall be witnessed by the Commissioning Authority and the Employer's Representative.
- Verification shall include demonstration of performance listed in Section 23 0593, TESTING, ADJUSTING AND BALANCING. The "specified", "submitted" and "balanced data" shall be entered on the attached Commissioning Data Sheets prior to the verification. The witnessed performance data shall be added to the data sheet at the time of verification.
 1. Verification of the performance of the cooling system shall be done when the outdoor temperature is above 40 degrees C.
 2. Air handling unit control operation performance shall be verified in the cooling mode.
- The following demonstrations will be required.
 1. Fan Coil Terminal Unit and VAV/CAV Terminal Unit Performance (up to 10 percent of each type of terminal unit): During normal occupied operation, temperature sensor shall be set so that the terminal goes to both maximum and minimum flow and calls for full water flow.
 2. Primary pump control: Demonstrate the variable volume controls of the primary pumps based on imposed loads via the system differential pressure sensors
 3. Major Duct Flow and Pressure Checks: The TAB Trade Representative shall identify all places where temperature, pressure and/or velocity readings were



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

taken. On 10 percent of the locations, performance, as listed in the TAB Report, shall be demonstrated.

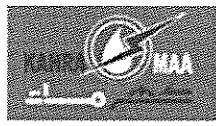
4. Fire and Smoke Damper Installation and Operation: All dampers shall be inspected. Smoke detectors shall be checked for proper performance. Smoke dampers shall be checked for proper operation, fire damper operation shall be checked by removing fusible link and demonstrating closure.
5. AHU Coil Performance: Cooling coils shall be demonstrated with the unit under control and at full air and water flow. Air and water temperature data and pressure loss shall be recorded together with airflow as measured at the airflow measuring station.
6. Fan and Motor Performance: Demonstrate performance with the unit under control and at full flow. LPS, static pressure and motor volts/amps shall be recorded.
7. Control Damper Operation and Performance: Demonstrate operation on shutdown and startup. Dampers shall close tightly and operate smoothly.
8. Pump Performance: Demonstrate shutoff and full flow conditions.
9. Exhaust Fan Performance:
 - a. Fan Schedule.
 - b. Demonstrate during normal operation.
10. Smoke Control System Performance:
 - a. Review complete smoke control philosophy. Prepare detailed list of action in each mode.
 - b. Demonstrate in presence of Fire Marshal.
 - c. Record equipment operating airflow and pressures.
11. Energy Management and HVAC Controls System:
 - a. ON/OFF control of each applicable piece of equipment.
 - b. Sequential operation of dampers.
 - c. All control loops:
12. Demonstrate tracking of supply and return fans to maintain building pressurization.

1.13 VERIFICATION OF SMOKE CONTROL SYSTEMS

- Where Code authorities perform acceptance tests on dedicated smoke control systems, this shall constitute verification for the commissioning. The Mechanical Trade Representatives shall notify the Commissioning Authority of acceptance testing dates so that a representative can be present.

1.14 REPORT REQUIREMENTS

- The Commissioning Authority shall document each commissioning event with meeting minutes or a report. The documents shall separately list deficiencies observed or discovered during the event. The document shall be distributed to Commissioning Team members.
- The Commissioning Authority shall also document any noted apparent operational deficiencies which might be the result of a design deficiency such as a condition where the equipment is performing as specified yet the space is not cool and bring this to the attention of the Consultant for confirmation and resolution.
- The Commissioning Authority shall prepare a final formal report to the Employer and Consultant which will include a narrative in the form of an Executive Summary of the



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

results of program, impressions of the training sessions and the level of operating competence and certification that the verification of each item is complete and all systems are operating as intended.

- Transmitted with the report shall be edited Operation and Maintenance Manuals including the following.
 1. Commissioning Data Sheets.
 2. Warranties.
 3. Permits and Inspection Reports.
 4. TAB Balancing Reports

7.3.16 23 0900 - Instrumentation and Control for HVAC

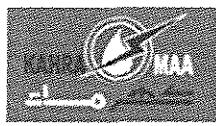
GENERAL

1.1 Summary

- This section includes:
 1. Input Sensors.
 2. Humidistat.
 3. Control valves.
 4. Dampers.
 5. Damper operators.
 6. Flow switches.
 7. Magnetic Flow Meter
 8. Energy Meters
 9. Flow control devices
 10. Differential Pressure Control Valves
 11. CO Control Panel and Sensors
- Related sections:
 12. Section 23 0519 – Meters and Gauges.
 13. Section 23 0548 – Vibration and Seismic Controls for HVAC Piping and Equipment
 14. Section 23 2113 – Hydronic Piping.
 15. Section 23 3300 – Air Duct Accessories.
 16. Section 23 0993 – BMS Sequence of Operation for HVAC Controls.
 17. Section 25 5100 – Building Management System
 18. Section 26 2726 – Wiring Devices

1.2 REFERENCES

- BS EN 837-1 Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
- BS 5235 Specification for dial-type expansion thermometers
- BS EN 13190 Dial thermometers
- Local authority regulations and standards.

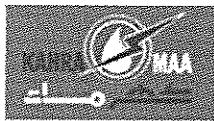


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- AMCA 500-D - Laboratory Methods for Testing Dampers for Rating; Air Movement and Control Association International, Inc.; 2007.
- ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).
- ASTM B 32 - Standard Specification for Solder Metal; 2004.
- ASTM B 88 - Standard Specification for Seamless Copper Water Tube; 2003.
- ASTM B 88M - Standard Specification for Seamless Copper Water Tube (Metric); 2005.
- ASTM B 819 - Standard Specification for Seamless Copper Tube for Medical Gas Systems; 2000 (Re-approved 2006).
- ASTM D 1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics; 2005.
- NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats; National Electrical Manufacturers Association; 2003.
- NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2003.
- NFPA 90A - Standard for the Installation of Air Conditioning and Ventilation Systems; National Fire Protection Association; 2002.

1.3 GENERAL REQUIREMENTS

- A schedule of field devices (Sensing and Actuating) shall be submitted to the Engineer, cross referenced to the points schedule and showing the total number and specification of the devices to be supplied. The information shall include manufacturer, model, range, accuracy, flow characteristics, working/operating and static pressure ranges.
- Sensors shall be selected to have a suitable measuring range and IP rating for their required application.
- Sensors shall be located to achieve representative and accurate readings of the controlled or monitored medium. The Controls Specialist shall be responsible for the correct output and positions for sensors. Where sensor positions are indicated the Controls Specialist shall advise any corrections to the Engineer at a very early stage of the project.
- Sensors shall in all cases be installed in accordance with the manufacturer's instructions.
- Sensors, detectors and associated meters shall have a proven record of precision and reliability when used with BMS and building services systems.
- All devices shall be installed with adequate access and clearance to permit maintenance, testing and removal of any item. Inspection of all wiring connections shall be possible without removal of the component.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Each device shall be labelled and the location of concealed devices marked and recorded. Where a device type is not stated the Controls Specialist shall submit data to the Engineer for approval.

1.4 SUBMITTALS

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:

1. Schematic flow diagrams.
2. Power, signal, and control wiring diagrams.
3. Details of control panel faces.
4. Damper schedule indicate arrangement, velocities, and static pressure drops for each system.
5. Valve schedule indicating size, flow, and pressure drop for each valve
6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
7. Control System Software: Schematic diagrams, written descriptions, and points list.
8. 2 types of each thermostat and cover
9. Manufacturers installation and operation and maintenance data

- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats

- Project Record Documents:
 1. Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
 2. Revise shop drawings to reflect actual installation and operating sequences.

1.5 QUALITY ASSURANCE

- Design system under direct supervision of a Professional Engineer experienced in design of this Work.
- Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience approved by manufacturer.
- Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.6 WARRANTY

- Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five (5) years from date of Substantial Completion.

1.7 MAINTENANCE SERVICE



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Provide service and maintenance of control system for One (1) year from date of Substantial Completion.
- Provide complete service of controls systems, including call backs. Make minimum of 52 complete normal inspections of approximately 20 hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

PRODUCTS

1.8 MANUFACTURERS

- Materials and products proposed by the Contractor shall be compliant with the Specification. All material submittals shall be approved by the Engineer prior to procurement.
- Refer the Approved Suppliers List in the "General Requirements and Scope of Works".

1.9 INPUT/OUTPUT SENSORS

- Temperature sensors shall comply with the following minimum requirements:

1. Fluid: Air
 - a. Temperature Range: -10 to +60 °C
 - b. Sensor Accuracy: ± 0.2
2. Fluid: CHW
 - a. Temperature Range: -10 to +60 °C
 - b. Sensor Accuracy: ± 0.2
3. Fluid: Water
 - a. Temperature Range: -10 to +150 °C
 - b. Sensor Accuracy: ± 0.5
4. Where a fluid is not identified the error range shall be agreed with the Engineer.
5. Drift shall be less than 0.1K per year.
6. Thermistor sensors shall have a hysteresis error which shall not exceed 0.5%.
7. Temperature sensors shall be thermistor types unless otherwise indicated. Compensation for the non-linear characteristic shall be such that the accuracy at range ends shall not exceed ±5% and at the setpoint ±2%.
8. Sensor ranges shall be chosen so that the range extends to those which might be experienced under plant fault conditions.
9. Strap-on temperature sensors shall only be installed in applications as agreed with the Engineer.

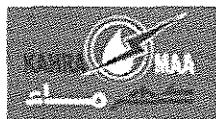
- Humidity Sensors shall comply with the following minimum requirements:

1. Humidity sensors shall be of good stability and have a humidity range of 10% - 90% with a sensor accuracy of ± 3% RH.
2. Drift shall not exceed 2.5% of the full range per year.
3. Humidity sensor/stat – duct location
 - a. The air velocity in the vicinity of the sensor shall not exceed 10 m/s.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- b. Sensors shall not be located in areas where there is no air flow.
 - c. A test hole shall be provided downstream of each sensor, plugged off when not in use.
 - d. Sensors shall be positioned beyond the spray distance of humidifiers.
- Humidity sensor/stat – room location.
 - a. Unless otherwise indicated sensors shall be installed at a height of approximately 1.5 m in the occupied space and at least 50 cm from adjacent walls or directly adjacent to doors.
 - b. Sensors shall not be exposed to direct solar radiation or be located near heat sources and be protected from airborne contaminants.
 - c. Adjacent to the space dry-bulb temperature sensor unless otherwise indicated.
 - d. External wall locations shall be avoided except where unavoidable. Insulated back-plates shall be used for external wall locations.
- Pressure Sensors:
 - 1. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
 - 2. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 20 to 85 degrees C.
 - 3. Accuracy: One percent of full scale with repeatability 0.3 percent.
 - 4. Output: 0 - 5 vdc with power at 12 vdc.
 - 5. Sensors shall be supplied complete with pressure connections and connecting tubes.
 - 6. Pressure sensors for measuring air at pressures greater than 1 bar shall be rated to meet two times the maximum pressure and 1.5 - 2 times the working pressure.
 - 7. DP sensors for measuring air at duct pressure shall have an accuracy linear out of 1% +/- FS and a resolution of 0.1%. The sensors shall be supplied complete with pressure connections and connecting tubes. Ensure a steady zone upstream and downstream of the orifice plate/flow grid.
 - 8. Differential pressure switches for fan proving and filter monitoring and sensors for VAV static pressure control shall be supplied complete with duct connections and PVC connecting tubes of suitable length. The range and hysteresis adjustments shall be concealed to prevent tampering. Error shall not exceed $\pm 2\%$ of full range after 200ms with a hysteresis of less than 0.4% and repeatable within 0.25%.
- Equipment Operation Sensors:
 - 1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches 0 10 to 1250 Pa.
 - 2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 50 to 450 kPa.
 - 3. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- Digital to Pneumatic Transducers:



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

Convert plus or minus 12 vdc pulse width modulation outputs to 0 to 138 kPa.

- Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.
- Carbon Monoxide Detectors:
 1. Single or multi-channel dual level detectors, using solid state sensors with three year minimum life. Sensor replacement shall take maximum 15 minutes. Suitable over temperature range of -10 to 60 degrees C.
 2. Provide individual indicators and contractors for each level, initially calibrated for 50 ppm and 100 ppm.
 3. Maximum response time to 100 ppm CO calibration gas: Two minutes.
- Indoor Air Quality Sensors:
 1. CO₂ sensors shall have an accuracy of $\pm 1\%$ of measurement range and of $\pm 5\%$ of measured value (indicated value).
 2. Indoor air quality (mixed gas) sensors shall detect combinations of pollutant gases.
 3. Duct mounted sensors shall be located in the return air duct from the space as close as possible to the room extract point(s).
 4. Room mounted sensors shall be located in a representative location at 1.5 to 3 m above the floor unless otherwise indicated.
 5. Single or multi-channel dual level detectors, using solid state sensors with three year minimum life. Sensor replacement shall take maximum 15 minutes. Suitable over temperature range of -5 to 55 degrees C.
 6. Provide individual indicators and contractors for each level, initially calibrated for 50 ppm and 600 ppm.
 7. Maximum response time to 550 ppm CO₂ calibration gas: Two minutes.
- Flow velocity/flow rate sensors
 1. Air velocity sensors shall comply with the following minimum requirements.
 - a. Sensor: Pitot Static Tube
 - 1) Sensor range: 3 to 80 m/s
 - 2) Sensor accuracy: $\pm 2\%$ of reading
 - b. Sensor: Thermo anemometer
 - 1) Sensor range: 0 to 20 m/s
 - 2) Sensor accuracy: $\pm 3\%$ of reading or ± 0.1 m/s whichever is the lowest
 2. Sensors shall be positioned at an adequate distance from bends, tees, fans and coils such that the centre line velocity is representative of the average velocity.
 3. Averaging velocity sensors across the duct shall be used where the minimum separation distance from a flow disruption is not available. The flow grid shall be sized correctly for the duct dimensions.
- Differential Pressure Switches (Liquid)



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. Error shall not exceed $\pm 2\%$ of full range after 200ms with a hysteresis of less than 0.4% and repeatable within 0.25%.
2. Differential pressure switches for water applications shall be rated to meet 2 times the static pressure and/or 4 times the working pressure.
3. All wetted parts shall be stainless steel and switch housing protection to IP67 standard. The range and hysteresis adjustments shall be concealed to prevent tampering.
4. The mechanical services installer shall install the differential pressure switches and connect suitable pressure pipes to service isolating cocks.

1.10 CO Control Sensors

- Description:
 1. Controller to use common 3 wires communication link between the central panel and the local stations (points).
 2. The operation of the system is based on the Time Division Multiplexing Principle where each point is sequentially scanned by the central panel and its "CO" status stored in panel memory.
 3. The Central Panel displays the point number currently being scanned. The panel front displays 2 or 3 LED arrays for simultaneous and continuous visual inspection of 35PPM, 100PPM and 100PPM time delayed (as applicable) conditions of all locations in the space (monitored areas).
 4. Display also includes visual SENSOR TROUBLE indicators (one for each sensor). Upon sensor trouble condition the "LOW LEVEL" CO relay for that point automatically energizes in order to run the fans continually until trouble is corrected.
- Remote Sensor Stations:
 1. Sensor assembly and its electronics include the necessary temperature compensating circuits for operation in variable conditions.
 2. Enclosure for sensor stations is of compact corrosion resistant PVC split enclosure with vandal proof screws. Dimensions are 6" x 6" x 4" (152mm x 152mm x 101mm), suitable for vertical mounting.
- Operating Levels:

Factory calibrate to 15, 30, 50, 100 PPM.
- Inputs/Outputs:
 1. ON-OFF: The panel incorporates the necessary logic circuits to operate the exhaust logic circuits to operate the exhaust and supply fans and motorized dampers for fresh air and / or exhaust according to specified project requirements.
 2. Flexibility of the system will enable the relay logic of the ventilation control system to be set or modified. Selector switches with indicating lights for manual energization "ON" of all fans controlled by the panel will be provided.
 3. Provide all necessary devices for interfacing with BMS.
- Proportional Outputs:
 1. Proportional (analog) outputs as a function of the total number of points at 35 PPM condition in a particular zone available. The proportional outputs may be one of the following: 0-1 VDC or 0-10 VDC or 4-20 mA DC.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- 2. The proportional outputs can be manually set to a desired value whenever a minimum signal to the controlling elements is required.
- Self Checking:
Integrity of the system is under constant supervision. Should a remote station not confirm a response, a fault condition will be displayed at the central panel with indication of faulty station locations.
- Response Time:
The local reaction time of the remote station shall be in the order of a few minutes.
- Time Delay:
Panel includes an optional time delay of approximately 30 minutes between the time 100PPM is detected and the time of visual display on unit cover (or panel), audible alarm and closure of alarm contacts.

1.11 Flow Switches

- General:
 1. Bronze body up to a pressure of 1000kpa and cast iron or approved equal above this pressure.
 2. Product: on/off indication
 3. Rate for service pressure of 1800 kPa at 100 degrees C
 4. Switch reliability for 10,000 cycles.

1.12 TRANSMITTERS

- Building Static Pressure Transmitter:
One pipe, direct acting, double bell, scale range 0.0025 to 1.5 kPa positive or negative, and sensitivity of 0.125 Pa. Transmit electronic signal to receiver with matching scale range.
- Pressure Transmitters:
One pipe direct acting indicating type for gas, liquid, or steam service, range suitable for system, proportional electronic output.
- Carbon Monoxide Detectors:
 1. CO Detector shall sense and transmit to BMS Controller or automation system for the control of ventilation equipment. The detector sensing element be electrochemical with a standard accuracy shall to be $\pm 5\%$ of reading for 0-300ppm with electrochemical and $\pm 3\%$ of reading for 0-500ppm with electrochemical and capable of operating with 5-50oC and 15-95%RH.
 2. Sample method shall be diffusion or flow through or via sample tube if measuring within ductwork.
 3. There shall be no greater than 5% signal loss per year with an output signal to be 4-20mA active or passive and 0-5Vdc or 0-10Vdc jumper selectable with an output resolution of 10 bit PWM ($\pm 0.4\text{ppm}$)
 4. The CO detector shall allow for field replaceable calibrated sensor modules.

1.13 MAGNETIC FLOW METERS

- General:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. Electro-magnetic induction type producing AC signal proportional to flow.
2. 304 Stainless steel tube, Teflon® liner, Carbon steel ANSI 150 # RF flange connection
3. 316 stainless steel conical raised electrodes
4. Stainless steel grounding rings shall be furnished
5. Operating Temperature Range: 4 to 15 °C
6. Design Pressure: 1034 kPa
7. Ambient temperature: -20 ° to 60 °C
8. Accuracy to 0.15%
9. Flow range 1500:1
10. Size range DN 15 to DN 2600
11. Provide remote electronic display unit. Unit shall be minimum IP 65.
12. Pressure rating - 16 bar.
13. Communication protocol - Field bus or Profibus or as required to communicate with the control system.
14. Standard of Acceptance - ABB MagMaster Electromagnetic Flowmeter

1.14 ENERGY METERS

- General:

Provide BTU meters that are packaged with ultrasonic flow measuring, and temperature sensors. BTU meters shall be able to communicate on M-bus.

- Material:

1. Integrator top: SAN
2. PCB casing: ABS
3. Connection unit and bracket: PP
4. Gaskets: Sarlink 3150B
5. Flow meter to be Ultrasonic Type.
6. Temperature Sensors - Pt 500 with 10 m of cabling.

- Approvals

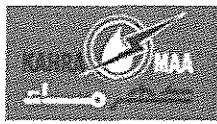
1. All meters shall be certified for use either in the UAE for use by district energy utility providers.
2. The meter output shall be certified for use in billing.
3. Complies with test: OIML R75, EN1434, DS2340, PTB.

- Performance:

1. Accuracy: +/- (0.15+2/Δt)%
2. Range: 1 °C - 40 °C
3. Flow Calculation: 30s intervals
4. Back up battery 20 year life
5. Power supply 220-240V AC, 50 Hz, 1 ph.
6. Backlit LCD display

- Display Features:

1. Accumulated thermal energy: MWh
2. Accumulated water flow: m³
3. Actual thermal power: kW
4. Actual water flow: l/h
5. Supply temperature: °C



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

6. Return temperature: °C
7. Peak thermal power: kWp
8. Peak water flow: l/h P
9. Hour Counter: HRS
10. RS-232 data communication including inlet temp, outlet temp, volumetric flow, calculated energy, and delta temp

EXECUTION

1.15 EXAMINATION

- Verify existing conditions before starting work.
- Verify that systems are ready to receive work.
- Beginning of installation means installer accepts existing conditions.
- Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- Ensure installation of components is complementary to installation of similar components.
- Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

1.16 INSTALLATION

- Install in strict accordance with manufacturer's instructions.
- Solder copper tubing except at instruments or equipment where compression fittings may be used.
- Conceal tubing. Run exposed only in mechanical rooms, storage rooms and like, in neat manner and properly supported in line with this specification and industry best practice.
- Mechanically attached tubing to supporting surfaces. Sleeve through concrete surfaces in minimum one inch (25 mm) sleeves, extended 6 inches (150 mm) above floors and one inch (25 mm) below bottom surface of slabs.
- Provide instrument air tubing with check and hand valves to expansion tanks with Schraeder fittings and hose
- Check and verify location of thermostats with plans and room details before installation. Locate 60 inches (1500 mm) above floor. Align with lighting switches and humidistats.
- Mount freeze protection thermostats using flanges and element holders.
- Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
- Provide separable sockets for liquids and flanges for air bulb elements.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Provide thermostats in aspirating boxes in front entrances.
- CO detectors shall be installed as indicated on the drawings.
- Provide guards on thermostats in entrances.
- Provide valves with position indicators and with pilot positioners where sequenced with other controls.
- Provide mixing dampers of opposed blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors. Provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
- Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- Provide conduit and electrical wiring in accordance with Section 262717. Electrical material and installation shall be in accordance with appropriate requirements of Section 26.

1.17 Pipe Mounted Immersion Sensor

- The full active length of the sensor shall be immersed in water.
- Allow adequate space so that sensors can be removed from their immersion pockets. Immersion pockets shall be stainless steel and appropriate pressure rating. Pockets shall be free issued to the Installer for installation in positions as indicated by the Controls Specialist. Immersion temperature sensors shall be installed into pockets with the facility for removal without disruption to the system(s). Immersion pockets shall be filled with a heat conducting compound.
- Unless otherwise indicated a Binder test point or an additional immersion pocket, adjacent to the sensor, shall be provided for test purposes
- Sensors shall be positioned not less than 12 pipe diameters downstream from a point of mixing to take account of stratification.

1.18 Duct Mounted Immersion Sensor

- Sensors for air temperature in ductwork shall be located in positions to most effectively sense the measured condition.
- The full active portion of the sensor probe shall be exposed to the air flow.
- The active portion of the probe shall be located central to the airflow.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- A test hole shall be provided adjacent to every sensor with plug when not in use.
- Probe-type sensors shall not be used in areas where stratification can occur.
- Sensors positioned near to coils shall be shielded against radiative heat transfer.
- Return air duct sensors shall be located near to the occupied space to avoid heat gain or loss and radiant effects influencing readings.
- Sensors shall be positioned in an area of representative air flow.
- Sensors representing zone temperature should be offset to account for heat gains.
- Sensors used for determining the dew-point shall be of material and construction suitable for use in moist air.

1.19 Averaging sensor (ducts and air handling units)

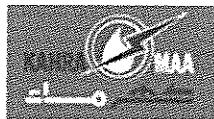
- Allow a distance of at least 50 mm between any heat exchanger and the sensor.
- The entire length of an averaging sensor must be fully inside the air-duct.
- The sensor element must be evenly distributed over the full cross-section and adequately secured to prevent vibration.
- The sensor element shall be installed in the air flow, downstream of the eliminator plate when air washers are used for humidification.

1.20 Room sensor

- Unless otherwise indicated sensors shall be installed at a height of 1.5 m in occupied spaces and at least 50 cm from any adjacent walls.
- A sensor shall be located in an area representative of the entire control zone and located away from heat sources.
- Sensors shall not be located near air currents generated by diffusers or openable windows and not be exposed to direct solar radiation.
- External wall locations shall be avoided where possible. Insulated back-plates shall be provided for external wall locations.
- Conduit entry points to the sensor wall box shall be sealed where there is a risk of air from another zone flowing over the sensor element.

1.21 Outdoor air temperature sensors

- Sensors shall have protection to IP67 unless otherwise stated.
- Shall be complete with a radiation shield.
- Sensors shall not be located on facades affected by significant rising heat or facades which will be heated by solar radiation.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Sensors shall not be located under eaves, above windows, ventilation extracts or subject to wind influence.
- Ensure accessibility for safe inspection and maintenance.

7.3.17 23 0993 – SCADA Sequence of Operation for HVAC Controls

GENERAL

1.1 SUMMARY

- This Section includes:
 1. Sequence of Operation for MEP equipment
- Related sections:
 1. Section 23 0800 – Commissioning of HVAC
 2. Section 23 0913 – Instruments and Control Devices for HVAC
 3. Section 23 0923 – Digital Control Equipment
 4. Section 23 0943 – Analog Control Equipment
 5. Section 25 5100 - Building Management System
 6. Section 26 0500 – Common Work Results for Electrical
 7. Section 26 2726 – Wiring Devices
 8. Section 26 3213 – Package Engine Generators

1.2 GENERAL REQUIREMENTS

- This Section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other Sections.

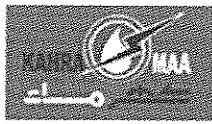
1.3 SUBMITTALS

- Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
 1. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function
 2. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in the contract documents.
 3. Include at least the following sequences:
 - a. Start-up.
 - b. Warm-up mode.
 - c. Normal operating mode.
 - d. Unoccupied mode.
 - e. Shutdown.
 - f. Capacity control sequences and equipment staging.
 - g. Temperature and pressure control, such as setbacks, setups, resets, etc.
 - h. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
 - i. Effects of power or equipment failure with all standby component functions.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- j. Sequences for all alarms and emergency shut downs.
- k. Seasonal operational differences and recommendations.
- l. Interactions and interlocks with other systems.
- 4. Include initial and recommended values for all adjustable settings, set points and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that are set during testing and operating the equipment.
- 5. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
- 6. Include schedules, if known.
- Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
 - 1. Label with settings, adjustable range of control and limits.
 - 2. Include flow diagrams for each control system, graphically depicting control logic.
 - 3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - 4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
 - 5. Include all monitoring, control and virtual points specified in elsewhere.
 - 6. Include a key to all abbreviations.
- C. Points List: Submit list of all control points indicating at least the following for each point.
 - 1. Name of controlled system.
 - 2. Point abbreviation.
 - 3. Point description; such as dry bulb temperature, airflow, etc.
 - 4. Control point or set-point (Yes / No); i.e. a point that controls equipment and can have its set-point changed.
 - 5. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
 - 6. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
 - 7. Calculated point (Yes / No); i.e. a "virtual" point generated from calculations of other point values.
- Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.
- Warranty Documents
- Point-wise compliance statement to the specifications duty signed by the manufacturer / manufacturer's authorized representative and by the Contractor.
- The Contractor shall follow the submittal procedures outlined in the "General Requirements and Scope of Works".



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1.4 QUALITY ASSURANCE

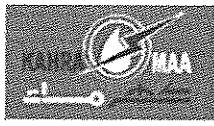
- Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed at the State in which the Project is located.
- The following DDC Points List shall be the minimum requirement of the control systems. It shall be the responsibility of the nominated control system specialist to confirm and re-submit a detailed, points schedule and control system strategy (sequence of operation) that shall achieve stable control performance together with thorough and complete system monitoring. The point schedule and control sequence shall be submitted for approval in line with item 1.4.

PRODUCTS - NOT USED

EXECUTION

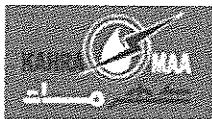
1.1 COMMON SEQUENCES

- For each system equipment a mode selection switch shall be provided on the MCC i.e. "Hand, Off, Auto" switch.
- In 'Auto' mode the complete operation of the pump/equipment shall be carried out by the SCADA i.e. control setpoints, hours run, auto changeover etc.
- In 'Hand' mode the pumps/equipment shall run continuously, independent of the SCADA, all necessary interlocks shall be provided by relays, auxiliary contacts etc.
- In 'Off' mode the equipment should be shut down
- In all instances the Hand Auto Off status should be reported at the SCADA head end
- Safety interlocks
 1. All safety interlocks shall be hardwired and have precedence over all other control functions. Safety interlocks shall only be reset manually and locally (not from the operator workstation). All hardwired safety interlocks shall have corresponding software interlocks to prevent cascading nuisance alarms.
- Fire interlocks
 1. All fire interlocks shall be hard wired. In the event of a fire, all non-essential plant shall be shut down by a signal generated by the fire alarm unless otherwise stated.
- Time Scheduling
 1. Each field controller shall be capable of enabling plant according to multiple pre-set time programmes. It shall be possible to schedule each item of plant for a minimum of three separate switching periods per 24 hours. Separate schedules shall be capable of being defined for each day of the week.
 2. Time schedules shall be capable of:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- a. Grouped to form global time schedules
- b. Defined on a weekly basis on a single 'page/screen'
- c. Defined 12 months in advance.
- d. Copied from existing schedules
- e. Linked to optimum start/stop control facilities.
- f. Accommodating leap years.
- g. Fixed extensions and contractions (the time schedule shall revert to the 'normal' switching periods following the extension/contraction period)
- 1. Provide:
 - a. Time schedule override facility to accommodate holiday periods, etc.
 - b. Optimum start/stop over-ride facility for user-defined override days. Optimum start/stop control shall be enabled following the override period.
 - c. Operator over-ride facility.
- Plant Start / Stop
 - 1. Field controllers shall be capable of starting and stopping plant according to the sequences indicated including any specific requirements for 'off' position or status of plant items, valves and dampers, etc.
 - 2. Field controllers shall be capable of automatically enabling standby plant on failure of duty plant and automatically report plant failure alarms at the operator workstation. The failure of a flow switch or other device shall not continuously cycle plant.
 - 3. If a flow switch fails the operator shall have the option to force either the duty or standby plant to come on.
 - 4. Provide the operator with the option to override any start/stop action configured within the field controllers. When reverting to normal automatic control, ensure that the original program is automatically reinstated and updated to the correct time.
 - 5. Provide delayed plant-starting facilities in order to reduce power surges. It shall be possible to start plant sequentially by adjusting the delay period for each item of plant.
 - 6. Delayed plant starting shall initiate following power failure/re-instatement and plant shut down/restart on fire/fireman override.
 - 7. Provide the operator with a facility to specify minimum on/off cycle times and/or the maximum number of starts per hour for specified items of plant.
 - 8. Provide a plant protection routine that enables the operator to select and automatically run items of plant for short periods during out of season shut down. Run periods shall be operator adjustable.
- Plant Sequencing Control



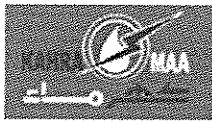
Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. Provide sequence control routines to automatically sequence the operation of multiple items of plant by monitoring load parameters and efficiently matching the plant to the load.
 2. It shall be possible to define different automatic sequences of control. Provide the operator with a facility to override the automatic sequence and define an alternative sequence.
 3. Set-point values for each control action shall be variable and adjustable by the operator and associated alarm limits shall be modified automatically.
 4. The operator shall be capable of adjusting switching control differentials to prevent short cycling.
 5. Routines shall include a facility to operate all plant ancillaries associated with sequence control, unless these have been specifically excluded.
 6. Routines shall include the facility to proceed with the defined sequence when one of the items of plant in the sequence is isolated or fails to operate (unless the safety requirements dictate otherwise). Ensure that failed items of plant are removed from the sequence.
- Plant rotation control
 1. The relevant field controllers shall be capable of alternating the lead plant items where duty and standby equipment is installed. This shall be achieved both by an operator command and on a time-scheduled basis.
 2. The rotation control shall be capable of being provided on the basis of run hours, elapsed time and calendar basis.
 3. Provide routines to ensure that when the maximum number of start/stop cycles for a particular plant is reached then its schedule is automatically modified eg by rotating the standby equipment or changing the lead machine.
 4. Ensure that each item of plant operated under rotation control can operate at any stage of the rotation sequence as indicated
 5. The plant rotation control shall accommodate a plant failure condition, in such a way that a failed item of plant is 'replaced' by the next in the rotation cycle. An alarm condition shall be raised in response to plant failure.
 6. Rotation control shall be capable of being initiated outside normal operating periods.
 - Optimum start stop for cooling
 1. Provide an optimum-start routine for the cooling system to compute the daily minimum pre-cool period necessary to achieve target comfort conditions at occupation start time. Provide an optimum stop routine to compute the earliest time for the cooling system to be shut down in order to retain minimum comfort conditions in the space at the end of occupation.
 2. The optimum start/stop routines shall have access to the system real-time clock, calendar facility and time programme to define the occupation periods.
 3. Routines shall be capable of operating the ventilation system for building purging prior to optimum start of cooling plant.
 4. It shall be possible to apply optimum start/stop control both to individual zones and overall plant operation.
 5. Provide routines to operate PHEX and ventilation plant as necessary to achieve the required target conditions while ensuring that heating and cooling systems do not conflict in any controlled zones.
 6. Provide the operator with the facility to adjust the following cooling system optimum start/stop parameters.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- a. Target temperature for optimum start.
 - b. Maximum pre-cool period.
 - c. Earliest time for building purging during out of hours period.
 - d. Inside and outside temperature limits for building purging.
 - e. Separate time/temperature relationships for optimum start and optimum stop.
 - f. Minimum space temperature during building purging.
7. The internal and external air temperature sensors associated with the optimiser shall be positioned correctly in order to provide representative readings.
- Load shedding
 - 1. As indicated the system shall be capable of monitoring the overall rate of electrical power consumption and if a pre set demand level is projected to be exceeded, the system shall be capable of shedding electrical load in a pre-determined manner.
 - 2. The system shall be capable of as many levels of load priority as are necessary to meet the requirements as indicated. The order of priority in each level shall be capable of rotation if required.
 - 3. Under conditions of partial/total power loss the system shall be able to trim demand in a controlled manner to match available power from stand-by generator sets.
 - 4. If load shedding routines are set up the facility to log consumption continuously shall be provided.
 - 5. Similarly, the system shall be capable of enabling loads in a controlled sequence to restore normal operation.
 - Cascade start
 - 1. As indicated the control system shall prevent the simultaneous operation of heavy electrical loads at start up by incorporating time delays between plant start up signals.
- 1.2 CHILLER CONTROLS
- The chiller management system will be provided by and operated independently by the Chiller supplier and incorporate all control items associated with the chillers, condenser fans and primary pumps etc.
 - To ensure the information provided by this system is available to all necessary personnel the SCADA system will integrate these controls into its network through BACnet protocol on either TCP/IP or MS/TP. All information will be displayed and alarmed and available for access on both a read and write basis
 - A graphical representation of the plant will be produced with all set points, alarms and time schedules displayed with simple mouse clicks. Access to the graphic will be through a system of site plans, plantrooms and systems.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- All values are to be historically recorded at controller level so that locally any laptop or Portable operator's terminal may retrieve the data as well as the network SCADA Supervisor.
- 1.3 **CHILLED WATER PUMP CONTROLS**
 - Each primary pump shall be provided with a variable speed drive (VFD) and the operation and controls of pumps shall be by the SCADA. For each of the chilled water pumps a mode selection switch shall be provided on the MCC i.e. "Hand, Off, Auto" switch. In 'Auto' mode the complete operation of the chilled water pumps shall be carried out by the SCADA i.e. determining number of pumps required to be operated to meet the cooling demand, hour run equalization, auto changeover to standby pump, pressurisation unit and other interlocks etc. In 'Hand' mode the pump shall run continuously, independent of the SCADA, all necessary interlocks shall be provided by relays, auxiliary contacts etc.
 - When the pumps are signaled to start, the lead pump shall start first and a frequency inverter shall vary the speed of this duty pump depending on the differential pressure in the pipework network. Multiple (3 minimum) pressure sensors in the supply and return chilled water pipework shall be installed in the main runs of each circuit approximately two third of the hydraulic distance from the pumps. The exact location of the pressure sensors shall be finalized in accordance with the recommendation of the controls manufacturer. When the chilled water 2-port valves on each AHU/FCU start to close due to partial load, the differential pressure switch shall send a signal to the SCADA which in turn shall control the VFD on the CHW pumps to maintain the set differential pressure in the pipework thus reducing the CHW flow in the circuit.
 - In the event the lead pump reaches 95% its maximum speed, its speed increase shall be arrested and the 2nd pump shall start and its speed shall increase until the differential pressure set point is met. Once met the lead pump's speed shall reduce and the lag pump's speed shall increase until both pumps have the same speed and are maintaining the differential pressure. From now on the speed of both pumps shall be the same.
 - On reducing demand the lag pump shall be de-coupled when the speed of both pumps drops below say 70%. The actual de-couple speed shall be determined by experiments on site.
 - In addition to a digital output enable signal and a 0 ~ 10V analogue output control signal from the SCADA a digital input alarm signal and an analogue input feedback speed signal shall be provided from the inverter to the SCADA.
 - There shall be a water flow proving differential pressure switch across each of the pumps. In the event there is no water flow detected across the pump, or there is an inverter alarm, after a predetermined time delay after the pump has started, or during the operation of the pump, the SCADA shall changeover to the stand-by pump and annunciate an alarm.
 - When the chilled water demand has reduced to the extent that the duty pumps are operating at 40% of their capacity, one of the duty pumps shall be switched off automatically and the other pump shall increase in speed to maintain the set pressure.
 - The chilled water circuits shall be provided with a two way modulation bypass valve at the end of the index run to allow the minimum required flow of one of the duty pumps of the circuit. The minimum bypass flow shall be 30% of the flow of one of the duty pumps. The



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

bypass valve shall be modulated to open position when the pump flow reduces to minimum speed and the set pressure is exceeded.

- The SCADA shall equalise run hours of pumps in the set. The SCADA shall also monitor the ELCB and overload, interlock the pump operation with the pressurization unit, annunciate alarms as indicated elsewhere etc.

1.4 PRESSURISATION / MAKE UP WATER UNIT CONTROLS

- The Plant shall be fed from the MCC and shall incorporate all necessary pressure controls.
- The pressurisation unit shall include volt free contacts for alarm condition (ie. the static pressure at the inlet to pumps is outside the operating range).
- Contacts for remote indication of a common fault are also to be provided. 'Panel live', 'system pressure outside operating range' and 'common fault' indications shall be provided at the MCC feeding the pressurisation unit and the SCADA.
- The SCADA shall monitor the position of the local isolator as well as a number of fault, alarm and status signals.
- The SCADA shall log the running hours of the pump and interface with the maintenance software to provide a maintenance schedule.
- Electronic level sensors and controllers shall be used to monitor and maintain the water levels with the basement. When the water level drops to low operating water level, a signal opens a make-up water solenoid valve to add water to the system. When the water level rises to the high operating water level, a signal closes the makeup valve.

1.5 AUTOMATIC DOSING SYSTEM

- The plant shall be a packaged unit with all necessary controls, it shall operate under manual control of dosing rate operation.
- The SCADA shall monitor the position of the local isolator as well as a number of faults, alarm, status and stored chemical level signals.

1.6 CHILLED WATER FILTRATION SYSTEM

- The plant shall be a packaged unit with all necessary controls, it shall operate under manual control of dosing rate operation.
- The SCADA shall monitor the position of the local isolator as well as a number of faults, alarm, status dirty filter status.

1.7 FAN COIL UNIT CONTROL SEQUENCE

- FCU controllers will be standalone and battery backed to protect data in the event of power failure. These controllers will be pre configured to PI control the cooling valve at the desired temperature to the satisfaction of their space/return air temperature detectors as applicable.
- All fan coil units shall be controlled individual DDC controllers being provided with an individual room/space wall mounted intelligent controllers with thermostatic, fan speed,



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

night set back and time schedule functions. Where it is not required to have a space mounted thermostat controller the fan coil units shall be controlled based on wall mounted or return air mounted sensors at the discretion of the engineer. All room unit controllers will also allow the user to override the system on/off.

1.8 COMMON HVAC CONTROL SEQUENCES

- Smoke detectors shall stop all supply fans upon the presence of smoke through the Fire Alarm System (FAS). All controls shall return to their normal position. A critical alarm shall be raised on the FAS and the SCADA. The Contractor shall provide wiring, relays, conduit, etc from the FAS shutdown module which should bye-pass the VFD/controls (Coordinate VFD terminations with approved VFD shop drawings) to shut down the equipment.
- Low suction and high discharge pressure switches for the supply and the exhaust fans shall stop both the fans via hardwired interlocks. VFD shutdown circuits should raise a critical alarm at the SCADA workstation when the duct pressure exceeds design. The fans shall remain off until the pressure switches are manually reset. The Automatic Controls Specialist shall coordinate static pressure high and low set points with the Contractor.

1.9 SYSTEM OFF:

1. When the system is off all valves, dampers and controlled devices shall be in their normal positions as stated above.

1.10 SYSTEM START-UP:

1. The supply, extract and exhaust systems (excluding stair pressurization and smoke extract systems) shall be started by the DDC system optimum start routine, time of day schedule, or via a manual command from the SCADA workstation.
2. When the system is commanded the outside air damper shall open. The supply air fan shall start after the outside air damper has opened sufficiently as proven by the damper end switch.
3. The exhaust air damper shall open. The exhaust air fan shall start after the exhaust air damper has opened sufficiently as proven by the damper end switch.
4. After the supply and exhaust fan run status is proven, the control sequences shall be enabled and the system shall be indexed to the cool-down or occupied mode.
5. Occupied Mode: Upon receipt of both the supply and exhaust fan running status the equipment shall run under normal temperature and airflow control.
6. The fan operation shall be proven when the supply air pressure switch is made as a result of the differential pressure between the duct and atmosphere rising above 500 Pa (adjustable) / or velocity rising above 1.0 m/s.
7. If the proven signal is not achieved, following a 30 second start up period, a fan failure warning signal shall be sent to the SCADA and the fan operation signal shall be removed.

1.11 FILTER MONITORING:

1. All filters shall be monitored by differential pressure transmitters. A maintenance alarm shall be raised on the SCADA workstation on indication of a dirty filter. The set points for dirty condition shall be confirmed by the filter / AHU manufacturer.

• TIME SCHEDULE

1. The SCADA shall be capable of initiating start & stop of ALL plant within the building through DDC panels on time schedules or by operator's interventions. The access



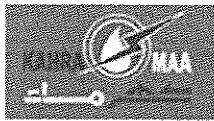
**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- and setting of the schedules or manual starting is to be by authorized personnel only.
2. During unoccupied periods the motorized dampers shall be activated closed (supply & extract) by the Building Management System. During unoccupied periods, the dampers shall remain closed, even while the on floor fan coil is operating.
- 1.12 **CONSTANT VOLUME TYPE OUTSIDE AIR AHUS**
- The Constant Volume fresh air ventilation AHUs shall operate under the dictates of one of the DDC controllers inbuilt time schedules and control in the following manner.
 - Once flow is established, as described above, the system will allow its temperature control algorithm to operate and the exhaust fan shall be started.
 - A chilled water coil with a 2 port pressure independent control valve shall be provided for supply air dehumidification and sensible cooling. The CHW valve shall be positioned closed when the air handling plant is not operating. When the SCADA signals a low outside temperature.
 - The chilled water valve shall be fully open when the SCADA signals a high outside temperature. The valve shall fully open when the supply fan is proven and the SCADA signals an optimum cooling start operation.
 - The valve position shall be modulated for supply air temperature control when a normal operating period is signalled by the SCADA and the supply fan is proven.
 - The CHW valve's position is modulated in response to a PI control signal in order to obtain the required set point.
 - A constant volume supply fan shall be provided with VFD for initial commissioning and future flexibility.
 - The supply fan shall be disabled when the SCADA signals a shutdown period.
 - A smoke detection device shall be provided in the return air ductwork. On sensing smoke the supply fan (and extract fan) shall be stopped and an alarm raised at the SCADA central supervisor. The detector shall be manually reset.
 - A constant volume extract fan shall be provided with VFD for initial commissioning and future flexibility.
 - The extract fan shall be disabled when the SCADA signals a shutdown period. The fan operation signal shall be disabled if a supply fan fail signal is received by the SCADA.
 - The extract and associated supply fan shall be interlocked so that they only operate in unison. A hand/off/auto selector switch shall be located on the extract fan control panel. The extract fan motor shall be hardwired to this selector switch, the supply fan fail and the damper proving end switches.
 - The control logic may increase the supply air temperature from the design levels to minimize the system energy consumption provided the conditions are maintained within the following limits:



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1. The supply air moisture content is to be limited to the level of the design off coil air condition (12°C DB 10.5 °C WB)
 2. The supply air dry bulb temperature after the wrap around heat pipe is to be limited to 20°C
 - If the supply air temperature rises above a set point of 24 °C or below a set point of 10 °C during normal operation the SCADA shall give a supply air temperature high/low warning.
- 1.13 PACKAGED DX AIRHANDLING UNITS**
- Direct expansion air cooled split unit is to be controlled by DDC. The control to consist of the following
 1. Fan Motors
 2. Compressor State /stop
 3. Room Temperature
 4. Reverse Cycle
 - SCADA to initiate start & stop of the unit through the DDC on time schedules. The access and setting of the schedules or manual starting is to be by authorized personnel only.
 - The temperature sensor located in the room shall be used by the DDC to control the room supply air temperature by starting and stopping of the compressor. At all times the fan shall be operational
 - When the room temperature is +1.0 deg higher than the set point temperature the SCADA shall enable the cooling. When the temperature is -1.0 lower than the set point the reversing valve and the compressor shall be enabled. The normal set point shall be 23 Deg C.
 - The set point shall be user adjustable via the SCADA to authorized personnel only
 - The DDC to monitor the room temperatures, compressor & fan start/stop status & fault indication.
 - A smoke detection device shall be provided in the return air ductwork. On sensing smoke the supply fan (and extract fan) shall be stopped and an alarm raised at the SCADA central supervisor. The detector shall be manually reset.
- 1.14 PUMP HALL VENTILATION SYSTEM**
- The pump hall ventilation system shall be supplied through the supply air fan rooms and ducted to low level within the pump hall and exhausted at high level through the roof to atmosphere. The system shall operate in two modes:
 1. Normal mode: Pump hall positive pressure ventilation mode (low speed).
 2. High Heat mode: Pump hall High temperature ventilation cooling mode (high speed).
 - Normal mode ventilation purpose to positively pressurise the pump hall preventing uncontrolled ingress of dust and other particulate matter. Supply fan to run, extract fan off.
 - High heat mode ventilation to control the pump hall to below 55 °C using the external ambient air. Supply fan to run at high speed, extract fans running ensuring that positive pressure within the space is maintained.



**Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)**

- SCADA to initiate start & stop of the unit through the DDC on time schedules. The access and setting of the schedules or manual starting is to be by authorized personnel only.
- The temperature sensor located in the room shall be used by the DDC to control the room supply air volume and temperature. At all times the fan shall be operational
- A chilled water coil with a 2 port pressure independent control valve shall be provided for supply air dehumidification (for mode one only). The CHW valve shall be positioned closed when the air handling plant is not operating.
- The chilled water valve shall be fully open when the SCADA signals an outside humidity of 50%RH or above. The valve shall fully open when the supply fan is proven and the SCADA signals an optimum cooling start operation.
- The valve position shall be modulated for supply air temperature control when a normal operating period is signalled by the SCADA and the supply fan is proven.
- The CHW valve's position is modulated in response to a PI control signal in order to obtain the supply airs required set point.
- A constant volume supply fan shall be provided with VFD for initial commissioning and future flexibility.
- The supply fan and extract fan shall be disabled when the SCADA signals a shutdown period.
- A smoke detection device shall be provided in the return air ductwork. On sensing smoke the supply fans (and extract fans) a signal shall be sent to the fire alarm control panel to commence sequenced plant shut down. An alarm shall be raised at the SCADA central supervisor.
- A constant volume extract fan shall be provided with VFD for initial commissioning and future flexibility.
- The extract fan shall be disabled when the SCADA signals a shutdown period. The fan operation signal shall be disabled if a supply fan fail signal is received by the SCADA.
- The extract fans and associated supply fans shall be interlocked so that they operate in unison achieving the design flow rates for high heat mode.
- A hand/off/auto selector switch for each fan shall be located on the control panel. The supply and extract system shall have the ability to be controlled independently.

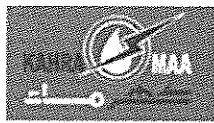
1.15 GAS SUPPRESSION ROOM VENTILATION

- All set points shall be adjustable and all proportional bands and dead bands shall be field determined. Start, stop and below modes of the control shall be commanded by the DCC Panel.
- Fans shall not start until their respective dampers are proven open. When the fans are stopped, the dampers shall close.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- On command by operator, all damper(s) open, end switch shall allow fan(s) to be on after dampers open.
 - A manual switch in a nearby electrical room shall also be provided to operate the fans. Fans off and dampers close at the command of operator.
 - Upon a signal from the fire alarm system, the relay in the starter circuit shall be energized to stop the fans. The system shall automatically return to normal operation when the alarm system has been manually reset
 - Sequence of operation for FM-200 system shall be as follows:
 1. Actuation of one detector, within the system shall:
 2. Illuminate the alarm lamp on control panel face. Energize an alarm bell and an optional visual indicator. Transfer two sets of the 10 amp rated auxiliary contacts which can perform auxiliary system functions such as:
 - Operate door holder/closures in access doors. Transmit a signal to fire alarm system.
 - Actuation of a 2nd detector, within the system shall:
 1. Illuminate the pre-discharge lamp on the control panel face.
 2. Energize an alarm horn or horn/strobe device. Shut down the HVAC system and /or close dampers. System abort sequence is enabled at this time.
 - After completion of the time delay sequence, argon system shall discharge and the following shall occur.
 - Illuminate a system fired lamp on the control panel face. Shutdown all power to high voltage equipment. Energize visual indicator outside the hazard in which the discharge occurred.
 - The system shall be capable of being actuated by manual discharge devices located at each hazard exit. Operation of manual devices shall duplicate the verified detection sequence description above except that the time delays and abort functions shall be bypassed.
 - In case main power supply fails, transfer switches are provided to automatically switch power to back-up battery.
 - Smoke detector S3 is also provided on return air duct to detect early signs of fire within ductworks. This shall also give signal to FACP and SCADA system that shall shut down supply and return duct.
- 1.16 **DIRECT EXPANSION (DX) SPLIT SYSTEMS**
- Direct expansion air cooled split unit is to be controlled by DDC. The control to consist of the following
 1. Fan Motor
 2. Compressor State /stop
 3. Room Temperature



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

4. Reverse Cycle
- SCADA to initiate start & stop of the Air Conditioning unit through the DDC on time schedules. The access and setting of the schedules or manual starting is to be by authorized personnel only.
- The temperature sensor located in the room shall be used by the DDC to control the room temperature by starting and stopping of the compressor. At all times the fan shall be operational
- When the room temperature is +1.0 deg higher than the set point temperature the SCADA shall enable the cooling. When the temperature is -1.0 lower than the set point the reversing valve and the compressor shall be enabled. The normal set point shall be 23 Deg C.
- The set point shall be user adjustable via the SCADA to authorized personnel only
- The DDC to monitor the room temperatures, compressor & fan start/stop status & fault indication.

7.3.18 23 1113 - Facility Fuel Oil Piping

GENERAL

1.1 Summary

- This section includes:

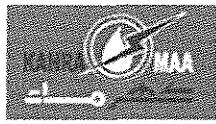
1. Pipe and pipe fittings
2. Fuel Tanks
3. Fuel transfer and control – day tanks.
4. Fuel transfer and control – duplex pump sets.
5. Multi-tank selection control.
6. Tank level and leak monitoring system.
7. Tank fill system and controls.
8. Tank power fill and controls.
9. Fuel filtration system.
10. Integrated control and monitoring.

- Related Sections:

1. Section 22 0553 - Identification for Plumbing Piping and Equipment.
2. Section 23 0553 - Identification for HVAC Piping and Equipment.

1.2 REFERENCES

- BS 799-5:2010 - Oil burning equipment. Carbon steel oil storage tanks. Specification
- API Std 650 - Welded Steel Tanks for Oil Storage; American Petroleum Institute; 1998 and Addendum 4, 2005.
- API Std 2000 - Venting Atmospheric and Low-Pressure Storage Tanks: Non-refrigerated and Refrigerated; American Petroleum Institute; 1998, and Errata 1999.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).
- ASME B31.4 - Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids; The American Society of Mechanical Engineers; 2006.
- ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2004 (ANSI/ASME B31.9).
- ASME B36.10M - Welded and Seamless Wrought Steel Pipe; The American Society of Mechanical Engineers; 2004.
- ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2006a.
- ASTM A 234/A 234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2006a.
- MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.
- MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 1996.
- UAE Fire Life Safety Code

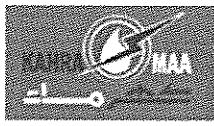
1.3 SUBMITTALS

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:

1. Pipe materials
 2. Pipe fittings, valves and accessories.
 3. Manufacturers catalog information
 4. Indicate valve data and ratings.
 5. Indicate tanks, system layout, pipe sizes, location, and elevations.
 6. Dimensions and accessories of Fuel Oil Tanks including manholes and hold down straps.
 7. Manufacturers installation guides
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats

1.4 QUALITY ASSURANCE

- Welding Materials and Procedures: Conform to ASME (BPV) Code. Welders Certification: In accordance with ASME (BPV IX).
- Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
- Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Valves: Manufacturer's name and pressure rating marked on valve body.

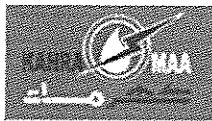
PRODUCTS

1.5 ABOVE GROUND PIPING

- Steel Pipe: ASTM A 53/A 53M or ASME B36.10M, Schedule 40 black.
 1. Fittings: ASME B16.3, malleable iron, or ASTM A 234/A 234M, wrought carbon steel or alloy steel welding type.
 2. Joints: NFPA 30, welded to ASME B31.1.
 3. Finish: Prime and finish paint with industrial enamel.
- Pipeline Ancillaries:
 1. Unions:
 - a. Pipe Size 50 mm and Under:
 - 1) Ferrous pipe: 1034 kPa malleable iron threaded unions.
 - b. Pipe Size Over 50 mm:
 - 1) Ferrous pipe: 1034 kPa forged steel slip-on flanges; 1.6 mm thick preformed neoprene gaskets.
 2. Ball Valves: Carbon steel construction, two piece body, chrome plated steel ball.
 3. Swing Check Valves: Carbon steel body, steel swing disc, threaded ends.
 4. Swing Check Valves with Integral Pressure Relief Valves: Carbon steel body, steel swing disc, teflon seat, steel stem and springs, automatic, direct, pressure actuated at maximum 275 kPa (40 PSI), threaded ends, UL listed for fuel.
 5. Anti-Siphon Valves: Carbon steel body, steel swing disc, spring loaded, normally closed, threaded ends, size to resist static siphon head.
 6. Solenoid Valves: Bronze, 0kPa ("0" PSIG) pressure differential, normally closed or normally open per plans, NEMA 7, explosion proof and watertight, threaded ends.
 7. Flexible Connectors: Stainless steel inner hose and braided exterior sleeve, suitable for minimum 1378 kPa (200 psi) WOG and 121 degrees C (250 degrees F). All flexible connectors must have welded (not swaged or crimped) ends. All flexible connectors must be vacuum rated.
 8. Relief Valves: Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated at maximum 400 kPa, UL listed for fuel oil, capacities ASME certified and labelled.

1.6 PIPE HANGERS AND SUPPORTS

- Conform to ASME B31.1.
- Hangers for Pipe Sizes 15 to 40 mm: Carbon steel, adjustable swivel, split ring.
- Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.
- Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- Wall Support for Pipe Sizes to 80 mm: Cast iron hook.
- Vertical Support: Steel riser clamp.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- 1.7 ABOVEGROUND FUEL STORAGE TANKS**
 - General Requirements. Day tank shall be for use with main tank in order to provide an automatic, self-refilling fuel supply system. Where a generator base tank is used, the day tank is deleted and the control panel only is provided for installation on the base tank.
 - Day Tank: The day tank capacity as indicated on the drawings. The tank shall be UL 142 listed rectangular steel tank with minimum 110 % containment basin. The day tank shall be finished with prime and finish coats of fuel resistant industrial coating.
 - Dual Inlet Solenoid Valves: If required by the fuel storage system configuration the day tank shall be equipped with dual solenoid valves, 100 PSI rated, normally closed, under control of level controller described below. The solenoid valve shall be protected by an upstream strainer. An inlet shutoff valve shall be provided.
 - Day Tank Level Controller : Provide an electronic liquid level controller/indicator with functions to include: pump/valve level control, high / low / critical low level sensors, system alarms and manual operating controls. Level controller shall be based on an industrial grade controller with networking capabilities for system monitoring integrated to the building BMS
- 1.8 Tank Fill system**
 - General Requirements
 - Provide a fill station including spill container to facilitate the safe transfer of fuel to aboveground tanks or tanks in buildings. The system shall accept a hose connection from a pump equipped delivery truck, and provide overfill alarms & fill pipe valve closure
 - Spill Container: Welded steel liquid tight spill container shall have minimum 75L (20 gallon) capacity. The spill container shall have an integral lockable weatherproof enclosure. The spill container shall have an epoxy paint finish. Where indicated on the drawings the spill container shall be stainless steel construction.
 - Fuel Piping and Accessories: The hose connection shall be 50, 75, or 100 mm (2, 3, or 4") diameter as shown on the drawings. The piping shall include a camlock type hose adapter, adapter cap, manual shutoff valve, and check valve.
 - Controls: Provide an electronic tank level controller consisting of a tank level sensor, inlet actuated valve, and control module. The module shall be microprocessor based and shall monitor tank levels during the fill operation. The panel shall respond to tank fill levels as follows:
 1. green light (normal operation at 85% or less),
 2. yellow light (active at 85%),
 3. red light & audible alarm (active at 90%), & flashing
 4. red light/audible alarm (active at 95%)
 - Control Valve: Provide an actuated butterfly valve for the fill pipe high level shutoff. The valve shall be a lug style iron body butterfly valve with stainless steel trim and viton soft

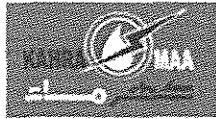


Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

goods. The valve actuator shall be NEMA 4 enclosure with limit switches, position indicator and manual override.

**1.9 Fuel Filtration system
General Requirements**

- Provide a packaged pump and filter set to provide filtration of stored fuel on a timed cycle. The pump and filter set shall be integrated with a control panel to provide motor control, system status, and alarm indication.
- Transfer Pumps: The transfer pump shall be rated at a minimum of 10 GPM or the design flow as indicated on the drawings. Pump motors shall be as required to provide the design flow. Motors shall be TEFC.
- Filter Housing: The filter housing shall be welded carbon steel construction rated at a minimum 1034 kPa (150 PSI). The unit shall have minimum 25mm inlets and outlets, and minimum 6mm openings for top air vent, pressure gauge connections, bottom water drain and water sensing. The interior of the housing shall be epoxy coated and the exterior shall have a prime and finish coat of industrial enamel.
- Filters: The filters shall provide two stage separation and coalescing of water and dirt from the diesel fuel. The stage 1 filter shall be rated at 25 microns, and the stage 2 coalescing filter shall be rated at 10 micron. The filters shall be gasketed and have corrosion protection metal components. The filters shall be rated at up to 517 kPa (75 PSI) differential pressure.
- Containment Base & Frame: Pumps shall be mounted on a welded steel liquid tight containment basin. The base shall include a welded steel support for piping & accessories
- Pump Motor Starters: Each pump shall be equipped with an individual motor starter disconnect panel. The panel shall include an HOA switch for operator use. The panel shall include output relays for pump overload trip and Not-In-Auto signals. In auto mode the pump shall be controlled by the filter control module.
- Control Module: The pump set shall be controlled by a microprocessor based control module. The unit shall be programmed to activate the pump on a time cycle to provide one complete filtration cycles each week. The unit shall monitor a differential pressure switch across the filter and shall provide an alarm at a 137 kPa (20 PSI) differential pressure. The unit shall monitor a high level switch and indicate a high level alarm. Indicator lights shall be provided for power on, pump on, & pressure alarms.
- Accessory Equipment
 1. Ball Valves: Brass ball valves at unit inlet, outlet and to isolate the pump and filter.
 2. Check Valves: Brass swing check valves at the discharge of the pump.
 3. Pressure Relief Valve: Brass relief valve set at 689 kPa (100 PSI) at pump discharge.
 4. Strainers: Brass basket strainers at the inlet for the pump.
 5. Flow Switch: Differential pressure switch across filter.
 6. Water Switch: High water level switch in the filter housing.
 7. Differential Pressure Gauge: Provide filter DP gauge.
 8. Leak Sensor: Liquid sensor for containment.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

9. Enclosure: Where indicated on the drawings the pump set shall be enclosed within a welded steel weatherproof enclosure.

EXECUTION

1.10 Fuel Tank Installation

- Install tanks in strict accordance with the manufacturer's recommendations, and local civil defense requirements.
- Electrical work shall be in accordance with applicable codes and shall be rated for hazardous area as required. Tanks shall be electrically grounded
- The tank installation shall be inspected and approved by the tank supplier or its certified contractor. The tank supplier shall submit a comprehensive check-list of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

1.11 Tank Level and Monitoring System

- Install in accordance with the manufacturer's recommendations
- Electrical work shall be rated for hazardous area as required.
- Install the monitoring system control panel as indicated on the drawings.
- Install the tank level probe and the interstitial leak probe in the proper locations in the fuel tank. Install the piping sump sensor in the piping sump.
- Install the overfill alarm and acknowledgment switch as shown in the plan.
- The leak monitoring system installation shall be inspected and approved by the equipment supplier or its certified contractor. The leak monitoring system supplier shall submit a comprehensive check-list of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

1.12 Above ground Piping installation

- Install in accordance with the manufacturer's instructions and local Civil Defence requirements.
- Inspect all materials for signs of damage, and confirm compliance with specifications.
- Avoid damage to piping materials or coatings during handling, installation and testing.
- Install piping to allow for expansion and contraction so that pipe, joints, or connected equipment will not be stressed.
- Provide clearance for access to valves and fittings.
- Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of the completed system.
- Install unions, couplings, valves, & flexible connectors in accordance with manufacturers' recommendations.

1.13 Below ground Piping installation

- Install in accordance with the manufacturer's instructions and local Civil Defence requirements.
- Inspect all materials for signs of damage, and confirm compliance with specifications.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Avoid damage to piping materials or coatings during handling, installation and testing.
- Secondary containment piping must slope to piping sump at a minimum 1/8" per foot.
- Trench & backfill per manufacturer's instructions
- Test primary and secondary pipe for integrity using pressurized air per manufacturer's instructions.
- Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of the completed system.

7.3.19 23 2113 - Hydronic Piping

GENERAL

1.1 Summary

- This Section includes pipe and fitting materials, joining methods and specialties for the following:
 1. Steel Pipework Above Ground
 2. Threaded connections and flanges
 3. Grooved pipe couplings
 4. Sleeves
 5. Escutcheons
 6. Flexible connectors
 7. Dielectric Fittings
- Related Sections:
 1. Section 22 0553 – Identification for Plumbing Piping and Equipment
 2. Section 22 0719 – Plumbing Piping Insulation
 3. Section 22 0516 – Expansion Fittings and Loops for Plumbing Piping
 4. Section 23 0516 – Expansion Fittings and Loops for HVAC Piping
 5. Section 23 0553 – Identification for HVAC Piping and Equipment
 6. Section 23 0719 – HVAC Piping Insulation
 7. Section 23 2114 – Hydronic Specialties
 8. Section 23 2500 – HVAC Water Treatment

1.2 REFERENCES

- ASTM 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc- Coated, Welded and Seamless
- BS 21 Specification for pipe threads for tubes and fittings where pressure – tight joints are made on the threads (metric dimensions)
- BS 143 and 1256 Threaded pipe fittings in malleable cast iron and cast copper alloy
- BS 416 Discharge and ventilating pipes and fittings, sand-cast or spun in cast iron. Specification for spigot and socket systems.
- BS 437 Specification for cast iron spigot and socket drain pipes and fittings.
- BS 476 Fire tests on building materials and structures
- BS 3506 Specification for unplasticized PVC pipe for industrial uses



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- BS EN 10088 Stainless steels
- BS EN 10216-1 Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties.
- BS EN 10217-1 Welded steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties.
- BS EN 10226 - 1 Pipe threads where pressure tight joins are made on threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation.
- BS EN 10253-1 Butt welding pipe fitting. Wrought carbon steel for general use and without specific inspection requirement
- BS EN 10255 Non alloy steel tubes suitable for welding and threading
- BS EN 10312 Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption. Technical delivery conditions.
- BS EN 1057 Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications.
- BS EN 1092 Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated.
- BS EN 12201 Plastic piping systems for water supply. Polyethylene (PE)
- BS EN 12449 Copper and copper alloys. Seamless, round tubes for general purposes
- BS EN 12450 Copper and copper alloys. Seamless, round copper capillary tube
- BS EN 1254 Copper and copper alloys. Plumbing fittings.
- BS EN 12735-1 Copper and copper alloys. Seamless copper tubes for air conditioning and refrigeration. Tubes for piping systems
- BS EN 13244 Plastics piping systems for buried and above ground pressure systems for water for general purposes, drainage and sewerage. Polyethylene (PE).
- BS EN 1329-1 Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticized poly(vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system.
- BS EN 14324 Brazing. Guidance on the application of brazed joints.
- BS EN 1452 Plastics piping systems for water supply. Unplasticized poly(vinyl chloride) (PVC-U).
- BS EN 1453-1 Plastics piping systems with structured-wall pipes for soil and waste discharge (low and high temperature) inside buildings. Unplasticized poly(vinyl chloride) (PVC-U). Specification for pipes and fittings.
- BS EN 378 Specification for refrigerating systems and heat pumps. Safety and environmental requirements.
- BS EN 545 Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test method.
- BS EN 598 Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test method.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

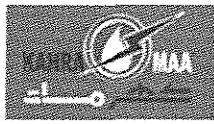
- BS EN 877 Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance.
- BS EN ISO 228-1 Pipe threads where pressure-tight joints are not made on the threads. Dimensions, tolerances and designation
- BS EN ISO 8434 Metallic tube connections for fluid power and general use
- CIBSE:TM13 Minimising risk of legionnaires disease
- ASTM A53, Schedule 40 grade B: Black Steel Pipes.
- ANSI/ASME B- 16.3 (Up to 50mm dia.): Threaded MI Fittings.
- ASME B 16.9 (65mm and above): Butt Welded MS Fittings.

1.3 General requirements

- Pipework shall follow the routes and approximate positions indicated on the drawings. However it should be noted co-ordination with other services, architecture, structure and any furniture or equipment in the served areas is the Contractor's responsibility. Fully coordinated shop drawings including builders work drawings shall be submitted by the Contractor to the Engineer for approval.
- The Contractor shall make due allowance in his tender for full co-ordination of services and pipework routing, supporting, expansion and contraction of pipework, venting, draining, flushing, cleaning etc. as required.
- Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. All pipe material and fittings shall be selected 1.5 times the operating pressure. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

1.4 SUBMITTALS

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 1. Product Material
 2. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings. Furnish a material list with technical data documenting the primary function, quality, and performance of each system used in the Work, including but not limited to the dimensions and instructions for the following.
 - a. Piping, Tubing, Fittings, Couplings and Valves
 - b. Pipe Line Accessories
 - c. Pipe Expansion and Contraction Devices
 - d. Expansion Tanks and Accessories
 - e. Strainers
 - f. Pressure Reducing Devices
 - g. Metering Devices and Flow Measuring and Control Devices
 - h. System Filling Units
 3. Manufacturers installation instructions



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

4. Calculations: Submit for Consultant's information. Calculations shall be prepared and sealed by a qualified Structural Engineer. Furnish engineering calculations showing the design criteria, including, but not limited to, the following items:

- a. Hanger design criteria.
- b. Point loadings.
- c. Wall and column attachments.
- d. Stresses and forces on piping, anchors, hangers and supports from thermal movement, shrinkage and creepage.
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats
- Welders Certificate: Include welders certification of compliance with ASME (BPV IX).
- Project Record Documents: Record actual locations of valves.
- Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.5 DELIVERY, STORAGE, AND HANDLING

- Accept valves on site in shipping containers with labeling in place. Inspect for damage. Deliver and store materials in manufacturer's original packaging labelled to show name, brand, type, and grade. Store materials in protected dry location off ground in accordance with manufacturer's instructions. Do not open packaging nor remove labels until time for installation.
- Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 REGULATORY REQUIREMENTSDELIVERY, STORAGE, AND HANDLING

- Conform to ASME B31.9 code for installation of piping system.
- Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.7 WARRANTY

- Provide five year manufacturer warranty for motors larger than 15kW from date of significant completion.
- Furnish 5 year written warranty in form stipulated by Employer, signed by the Contractor and Installer, agreeing to repair or replace packed slip type expansion joints which fail as a result of defects in materials or workmanship. Upon notification of such defects, within the warranty period, make necessary repairs or replacement at the convenience of the Employer.

PRODUCTS

1.8 Steel pipework- above ground

- Pipework up to and including 450mm. diameter nominal bore shall be ERW black mild steel to ASTM A53, Grade B Schedule 40, plain ends, ANSI B36.10
- Above this bore, carbon steel pipes shall comply to BS EN 10216-1 and BS EN 10217-1



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Pipe Fittings:
 1. All fittings shall withstand without failure, leakage, or impairment of their serviceability, a hydrostatic test pressure equal to that prescribed for the specified matching pipe of equivalent material.
 2. Elbows shall be factory moulded with beveled ends ready for welding. Field fabricated segmented elbows will not be acceptable.
 3. Tees shall be factory manufactured with beveled ends ready for welding. Field fabricated Tees using are not acceptable.
- 1.9 Threaded Connections & FLANGES
 - Threaded Connections below 50mm Nominal Bore
 1. Where screwed pipework joints are used, tapered threads as BS 21 and BS EN 10226-1 or threaded to ANSI B16.4 class 150 will be accepted subject to being able to withstand maximum operating pressure.
 2. Class 300 shall be provided where system pressures exceed 8.6 Bar. All jointing systems shall be suitable for the operating pressure of the system.
 - Flanged Connections above 65mm Nominal Bore
 1. Pipework with a nominal bore of 65mm. and above shall employ flanges for jointing at periodic distances.
 2. Where flanges are used these shall comply with BS EN 1092-1 and BS EN 1515-1 or ASTM A181, class 150 (minimum) ANSI B16.3 and to the table/class suitable for the working pressure of the system.
 3. Flanges shall be machine faced and trimmed at the edges.
- 1.10 Grooved Pipe End Couplings:
 - Where proposed by the contractor and approved by the engineer mechanical grooved couplings may be considered
 - The contractor shall provide a full and detailed technical submittal detailing all aspects of the installation inclusive of thrust analysis, control of thermal expansions, pipe work supports and connections
 - General Requirements:

To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by a single supplier. Grooving tools shall be supplied by the same manufacturer as the grooved components.
 - Mechanical Couplings DN 50 - DN 300
 1. Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12.
 2. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000.
 3. Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183, minimum tensile strength 110,000 psi (758450 kPa)
 4. Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide System rigidity and support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 13.
 5. Grooved couplings shall meet the requirements of ASTM F-1476.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Mechanical Couplings DN 350 - DN 600
 1. Couplings shall consist of two ASTM A-536 ductile iron housing segments, a wide elastomer pressure responsive gasket, and zinc electroplated carbon steel track head bolts and nuts conforming to the physical and chemical requirements of ASTM A-449 and the physical requirements of ASTM A-183.
 2. Coupling housings designed with the wedge-shaped profile to engage the mating pipe(s)/component(s) wedge-shaped grooves. Housings include lead-in chamfer to accommodate a wider acceptable range of initial pipe positions. Housings shall be coated with enamel or galvanized.
 3. Gaskets to be wide width, pressure-responsive, synthetic rubber conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D-2000.
 4. Rigid Couplings: Coupling key shall be designed to fill the groove to provide a rigid joint that corresponds with support spacings as defined by ASME B31.1 and B31.9. Systems incorporating rigid couplings require the calculated thermal growth/contraction of the piping system to be fully compensated for in the design of the piping system through use of adequate flexible components.
 5. Flexible Couplings: coupling key shall be designed to fit into the groove and allow for linear and angular movement, vibration attenuation, and stress relief.
 - Grooved End Fittings
 1. Fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12, forged steel conforming to ASTM A-234, Grade WPB 0.375" wall (9.53 mm wall), or fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A-53, Type F, E or S, Grade B.
 2. Fittings provided with an alkyd enamel finish or hot dip galvanized to ASTM A-153.
 3. Zinc electroplated fittings and couplings conform to ASTM B633.
- 1.11 Fan coil connections**
- Where indicated flexible hose fan coil connections shall be provided unless stated otherwise.
 - Fan coil connections shall consist of an EPDM inner liner with a stainless steel wire braid. The fittings shall be nickel plated brass with stainless steel ferrules.
 - Hoses shall have an overall length of not less than 300mm. and resist kinking when bent through 180 degrees and shall be designed for a working pressure of 20 bar and a temperature of 110 C.
 - The hoses shall be colour coded red and blue to indicate its suitability for hot or chilled water.
 - Chilled water connections shall be fully insulated and the insulation fitted with end caps.
- 1.12 MECHANICAL SLEEVES**
- Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.
 - The following materials are for wall, floor, slab, and roof penetrations:
 1. Steel Sheet Metal: 0.6mm minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

3. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
4. Underdeck Clamp: Clamping ring with set screws.

1.13 Escutcheons

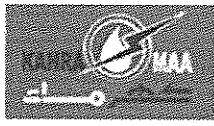
- Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 2. OD: Completely cover opening.
 3. Cast Brass: One piece, with set screw and polished chrome-plated finish.
 4. Cast Brass: Split casting, with concealed hinge, set screw and polished chrome-plated finish.
 5. Stamped Steel: One piece, with spring clips and chrome-plated finish.
 6. Stamped Steel: Split plate, with concealed hinge, set screw, and chrome-plated finish.
 7. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
 8. Cast-Iron Floor Plate: One-piece casting.
- Screws: Provide Stainless Steel screws for outdoor and wet applications

1.14 FLEXIBLE CONNECTORS

- General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 860 kPa minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
 1. DN50 and Smaller: Threaded.
 2. DN65 and Larger: Flanged.
 3. Option for DN65 and Larger: Grooved for use with keyed couplings.
- Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.
- Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.
- Rubber, Flexible Connectors: CR or EPDM elastomer rubber construction, with multiple plies of NP fabric, molded and cured in hydraulic presses. Include 860 kPa minimum working-pressure rating at 104 deg. C. Units may be straight or elbow type, unless otherwise indicated.

1.15 DIELECTRIC FITTINGS

- General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- Insulating Material: Suitable for system fluid, pressure, and temperature.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

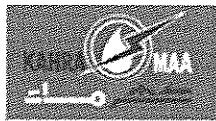
- Dielectric Unions: Factory-fabricated, union assembly, for 1725 kPa minimum working pressure at 82 deg. C.
- Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 1035 or 2070 kPa minimum working pressure as required to suit system pressures.
- Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full- face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
Provide separate companion flanges and steel bolts and nuts for 1035 or 2070 kPa minimum working pressure as required to suit system pressures.
- Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 2070 kPa minimum working pressure at 107 deg. C.
- Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 2070 kPa minimum working pressure at 107 deg. C.

EXECUTION

1.16 DELIVERY, STORAGE, AND HANDLING

- Accept valves on site in shipping containers with labeling in place. Inspect for damage. Deliver and store materials in manufacturer's original packaging labelled to show name, brand, type, and grade. Store materials in protected dry location off ground in accordance with manufacturer's instructions. Do not open packaging nor remove labels until time for installation.
- Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- Adequate storage facilities shall be provided to ensure that tube does not suffer any deterioration from the 'as new' delivered condition.
- During construction work care shall be taken to prevent any foreign matter entering the pipework either in storage or during installation.
- Open ends shall be capped with the appropriate pipework fitting. Wooden plugs and the like shall not be used.
- Valves fitted on the ends of pipework shall not be accepted as a means of preventing the ingress of foreign materials.
- Failure to comply with these requirements shall mean the Engineer shall have the right to instruct that pipework so left uncovered to be dismantled for such lengths as the Engineer requests and the pipework blown through and/or cleaned at no cost to the contract.
- Remove all cement adhering to pipework surfaces and brackets.
- Remove scale, rust by wire brushing and paint pipework and brackets as stated elsewhere in the specification.

1.17 PREPARATION



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

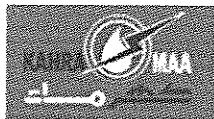
- Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- Remove scale and dirt on inside and outside before assembly.
- Prepare piping connections to equipment with flanges or unions.
- Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- After completion, fill, clean, and treat systems. Refer to Section 23 2500 for additional requirements.
- Application of Epoxy Coating and Primer to the Steel Pipes:
 1. External Surfaces
 - a. All surfaces shall be thoroughly cleaned prior to painting.
 - b. Surface irregularities including weld spatter, rough capping, undercut and slag together with sharp edges and burrs, surface laminations and laps shall be removed or made smooth prior to commencement of surface preparation.
 - c. Grease or oil contamination shall be removed before any other surface preparation is performed.
 2. Internal Surfaces
 - a. Clean by chemical flushing after hydrostatic test.
 3. Follow coating manufacturer's recommendations at all times.
 4. Ensure that pipe surface temperature is kept at a minimum of 5 deg C above dew point at all times during application.
 5. Field coat any welded joints. Coating shall extend 100 mm onto existing coating.
- Prior to jointing piping in the field the following shall be carried out:
 1. The factory end caps shall be kept on the pipe until it is ready for jointing.
 2. Inform the engineer to inspect the already installed section and ensure that there are no debris left in the pipe.
 3. Once the engineer has certified that the existing installation is clean and free of debris, the pipe can be jointed.
 4. Carry out radiography of the joint.
 5. After radiographic testing, the engineer shall be called again to witness the cleaning, preparation and epoxy coating of the joint.
 6. At the end of the work day, the open end of the installed piping system shall be sealed and witnessed by the engineer.

1.18 CLEANING

- General: Upon completion of the Work, remove unused materials, debris, containers and equipment from the project site. In addition to the initial cleaning procedure required, and not more than 2 days before occupancy by the Employer, clean the Work as recommended by the manufacturer.

1.19 Venting and draining

- All pipework must be graded accordingly.
- Equipment shall be provided with drains and vents which shall be accessible from outside the casing.
- Adequate drains and vents shall be provided to facilitate draining and venting the pipework system



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

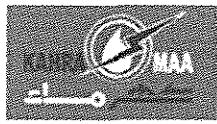
- Drain points shall be located in accessible positions and shall include drain cocks with hose union and removable key.
- Where pipework sections can be isolated, drain and vent points shall be provided to facilitate draining down and venting of that section of pipework.
- Drain points on medium and high temperature pipework shall be fitted with a flanged valve and blank flange.
- In plantrooms a 30 m length of 25 mm flexible rubber/armoured hose pipe shall be provided and fixed to a wall. The hose shall have a connection to match the drain valves.
- The installer shall allow for the provision of fast fill and drain connections in accordance with the water treatment specialists' requirements and also in accordance with the current COP relating to water treatment and cleaning.

1.20 STRESS & SURGE ANALYSIS

- Complete stress and surge analysis is to be carried out by the contractor using the service of a third party stress analysis consultant with a minimum of five years experience. The design of expansion, contraction and restrain system shall be fully developed by the contractor in accordance with the requirements of the stress analysis. Submit shop drawings complete with surge & stress analysis.

1.21 EXPANSION PROVISIONS AND ANCHOR POINTS

- Adequate provision shall be made for expansion and contraction of all pipework, and, where possible, advantage shall be taken of pipework changes in direction to accommodate movement in pipe systems.
- Anchors and guides shall be positioned to contain all movement and resist the maximum loads imposed.
- Anchors and guides are to be located at points which prevent excess stresses on pipework, joints and equipment connections.
- Similar provisions shall be made for building movement or building settlement.
- Where natural flexing of the pipework is not practicable thermal and building movement shall be accommodated by the use of expansion joints.
- Expansion joints may be of the restrained or unrestrained type and shall be provided with welded, screwed or flanged ends as appropriate and as indicated.
- Expansion joint convolutions shall be of a stainless steel, super multi-ply construction fitted with stainless steel inner sleeves.
- Expansion joint shall be capable of not less than 2000 complete reversals of movement at the given working conditions and the manufacturer shall be able to produce calculations to that effect.
- Expansion joints shall be capable of withstanding a pressure test of twice their design pressure without loss of performance.
- The manufacturer's guidelines for selection and installation shall be strictly adhered to. On completion of the installation, prior to heat being applied, the installer shall arrange for the manufacturer's representative to inspect and check that the installation of the expansion joints is in accordance with his instructions. This shall be agreed with the manufacturer prior to placing an order.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

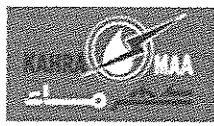
- Axial unrestrained expansion joints shall only be used in positions where their pressure thrust can be contained by adequate anchor points. The installer shall arrange for the manufacturer to submit calculations for loadings on main anchors. Recommended guide spacings must be strictly adhered to.
- Restrained expansion joints may be used for angular or lateral movement. Their restraints shall be capable of absorbing the full pressure thrust of the bellows, plus forces due to the connecting pipework.
- Angular expansion joints shall be constructed using an ultra-low friction rocking hinge mechanism, which limits the movement to one plane. Angular expansion joints shall be used in pairs or in threes.
- Lateral expansion joints shall be fitted with threaded tie bars and low friction self-lubricating hemispherical nuts allowing movement in two planes.
- Stainless steel convoluted hose with a stainless steel wire braid may be used to absorb small lateral movements in pipework branches or for building movement in accordance with the manufacturer's recommendations.
- Pipework subject to expansion and contraction shall be supported via swivel type hangers.
- The contractor/installer shall be responsible for arranging the manufacturer to approve the expansion joints provisions prior to ordering of materials and commencement of the works.
- The contractor/installer shall be fully responsible for designing the expansion and contraction provisions for the pipework systems. Expansion joints if shown on drawings are indicative only; the final requirements shall be determined by the installing contractor. All calculations for expansion and contraction shall be submitted to the engineer for approval. All loads imposed by the support system, anchors and guides etc. shall be submitted to the engineer and shall take full cognizance of the existing structural design. Where required in order to reduce thrust / loads etc. of anchors or any support system on the structure, thermal expansion devices shall be installed. The contractor shall allow for all necessary provisions in his tender for expansion and contraction.

1.22 Escutcheons

- Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1.23 INSTALLATION

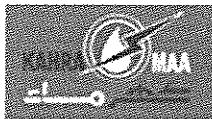
- Install in accordance with manufacturer's instructions.
- Route piping in orderly manner, parallel to building structure, and maintain gradient.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

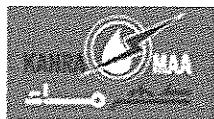
- Install piping to conserve building space and to avoid interfere with use of space.
- Group piping whenever practical at common elevations.
- Sleeve pipe passing through partitions, walls and floors.
- Slope piping and arrange to drain at low points.
- Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- Examine the areas to receive the Work and the conditions under which the Work would be performed. Identify conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.
 6. Verify clearances under beams and over windows to provide maximum headroom and verify locations of lines and types of fittings used to obtain these clearances.
 7. Determine the required height of suspended ceilings, the size of pipe shafts in which piping is to be concealed, and the location and size of structural members in and adjacent to pipe shafts. Coordinate the piping installations with ductwork, lighting and other equipment. Where space is insufficient for piping above suspended ceilings or in vertical shafts, obtain clarification from the Consultant
- Inserts:
 8. Provide inserts for placement in concrete formwork.
 9. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 10. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm.
 11. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 12. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- Pipe Hangers and Supports:
 13. Install pipework in accordance with ASME B31.9, MSS-SP-69 and MSS-SP-89 (or equivalent)
 14. Support horizontal piping as scheduled.
 15. Install hangers to provide minimum 13 mm space between finished covering and adjacent work.
 16. Place hangers within 300 mm of each horizontal elbow.
 17. Use hangers with 38 mm minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 18. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 19. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 20. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 21. Spring Hangers and supports: A stress analysis of the Hydronic piping system shall be performed by the contractor to determine the quantity and type of spring hangers required for installation on the project.
- Sleeves

 22. Cut sleeves to length for mounting flush with both surfaces.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 50 mm above finished floor level. Extend sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
23. Build sleeves into new walls and slabs as work progresses.
24. Install sleeves large enough to provide 20 mm annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than DN150.
 - b. Steel, Sheet-Metal Sleeves: For pipes DN150 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of soil pipe to extend sleeve to 50 mm above finished floor level.
25. Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.
 - a. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.
 - b. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
26. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 25 mm annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - a. Install Steel Pipe for sleeves smaller than 150mm in diameter.
 - b. Install Steel Sheet Pipe for sleeves 150mm in diameter and larger.
 - c. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
27. Underground, Exterior-Wall, Pipe Penetrations: Install Steel Pipe for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 25mm annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - a. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with architectural ceiling plans.
- Use eccentric reducers to maintain top of pipe level.
- Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
- Install valves with stems upright or horizontal, not inverted.



7.3.20 23 2113.13 - Underground Hydronic Piping

GENERAL

1.1 SUMMARY

- Section Includes:
 1. Steel pipes and fittings.
- Related Sections:
 1. Section 22 0553 – Identification for Plumbing Piping and Equipment
 2. Section 23 0516 – Expansion Fittings and Loops for HVAC Piping
 3. Section 23 0553 – Identification for HVAC Piping and Equipment
 4. Section 23 0719 – HVAC Piping Insulation
 5. Section 23 2114 – Hydronic Specialties
 6. Section 23 2500 – HVAC Water Treatment

1.2 REFERENCES

- ASTM 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc- Coated, Welded and Seamless
- EN 253 Pre-insulated bonded pipe systems for underground hot/chilled water networks.
- EN 448 Pre-insulated fitting assemblies.
- EN 488 Pre-insulated steel valve assembly.
- EN 489 Joint assembly for pre-insulated underground chilled water networks
- BS EN 10088 Stainless steels
- BS EN 10216-1 Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties.
- BS EN 10217-1 Welded steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties.
- BS EN 10226 - 1 Pipe threads where pressure tight joins are made on threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation.
- BS EN 10255 Non alloy steel tubes suitable for welding and threading
- BS EN 1092 Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated.
- BS EN 14324 Brazing. Guidance on the application of brazed joints.
- BS EN 545 Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test method.
- BS EN 598 Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test method.
- BS EN 877 Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance.

1.3 General requirements



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Pipework shall follow the routes and approximate positions indicated on the drawings. However it should be noted co-ordination with other services, architecture, structure and any furniture or equipment in the served areas is the Contractor's responsibility. Fully coordinated shop drawings including builders work drawings shall be submitted by the Contractor to the Engineer for approval.
- The Contractor shall make due allowance in his tender for full co-ordination of services and pipework routing, supporting, expansion and contraction of pipework, venting, draining, flushing, cleaning etc. as required.
- Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. All pipe material and fittings shall be selected 1.5 times the operating pressure. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

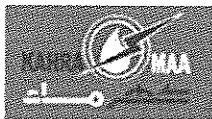
1.4 SUBMITTALS

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 1. Pipe Material
 2. Pipe fitting data sheets
 3. Manufacturers installation instructions
 4. Calculations: Submit for Consultant's information. Calculations shall be prepared and sealed by a qualified Structural Engineer. Furnish engineering calculations showing the design criteria, including, but not limited to, the following items:
 - a. Stresses and forces on piping from thermal movement, shrinkage and creepage.
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats

PRODUCTS

1.5 STEEL pipework- below ground

- Buried Chilled water pipework shall be pre-fabricated with insulation and jacket.
- The pre-fabricated pipes and fittings shall be made of a steel pipe, polyurethane foam insulation with an integrated leak detection system and an outer casing of high-density polyethylene.
- The materials shall be bonded together to form a solid unit. When tested according to EN 253, the following properties of the bonded system shall be proved:
 1. Axial shear strength: min.0,12 N/mm² (MPa)
 2. Tangential shear strength: min. 0,2 N/mm² (MPa)
- All components in the pipe system shall fulfill the technical requirements as described in the following EN standards:
 1. EN 253 Pre-insulated bonded pipe systems for underground hot/chilled water networks.
 2. EN 448 Pre-insulated fitting assemblies.
 3. EN 488 Pre-insulated steel valve assembly.
 4. EN 489 Joint assembly for pre-insulated underground chilled water networks.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Pipe work up to and including 450mm. diameter nominal bore shall be carried out in ERW black mild steel to ASTM A53, Grade B Schedule 40, plain ends, ANSI B36.10
- All pipework joints shall be welded.
- Pipes shall be furnished in lengths of 6.00 m or 12.00 m. Tolerance of lengths is – 0/+15mm.
- Pipe ends shall be prepared for welding as described in EN 253 or equal standard.

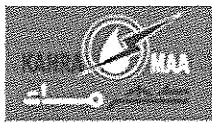
EXECUTION

1.6 General Requirements

- Pipe ends shall be prepared for welding as described in EN 253 or equal standard.
- Prior to insulation, every steel pipe shall have the outer surface cleaned by shot blasting so that it is free from rust, mill scale, oil, grease, paint, moisture and other contaminants. Items not cleaned accordingly, shall be rejected.
- All fittings shall be delivered as pre-insulated components, which after their installation shall appear in the same quality as the pre-insulated pipes. They shall be ready to install and comply with EN 448 and EN 488.
- No flanges shall be allowed.
- Welds to the PE casing pipe of fittings is to be done strictly according the standard EN 448.
- All welds shall be absolutely leak-tight to ensure a waterproof system, and comply with the requirements of the test for PE welds as described in the standard EN 448.
- If any PUR foam is visible on the outside of a weld, the item shall be rejected and the whole production series of equal products shall be inspected.
- No welding to the PE casing pipe shall be done in the area where the Field Joints are to be installed.
- The PUR insulation material shall fulfill requirements of the most recent EN 253

1.7 PIPING INSTALLATION

- Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- Remove standing water in the bottom of trench.
- Do not backfill piping trench until field quality-control testing has been completed and results approved.
- Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, DN 20 ball valve, and short DN 20 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.
- In conduits, install drain valves at low points and manual air vents at high points.
- Install components with pressure rating equal to or greater than system operating pressure.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- Install piping free of sags and bends.
- Install fittings for changes in direction and branch connections.
- See Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping" for sleeves and mechanical sleeve seals through exterior building walls.
- See Division 26 Section "Cathodic Protection" for cathodic devices and connections to piping and conduit systems.

1.8 JOINT CONSTRUCTION

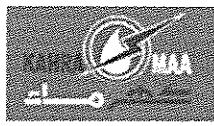
- Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- All joints to be fabricated and installed as BS EN 489
- Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- Conduit and Cased Piping Joints: Assemble sections and finish joints with pourable or split insulation and exterior jacket sleeve, and apply shrink-wrap seals.

1.9 IDENTIFICATION

- Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 150 to 200mm below finished grade, directly over piping.

1.10 FIELD QUALITY CONTROL

- Perform the following tests and inspections:
 1. Prepare hydronic piping for testing according with this specification and the relevant BSRIA AG and as follows:
 - a. Leave joints, including welds, uninsulated and exposed for examination during test.
 - b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
 - c. Use vents installed at high points to release trapped air while filling system.
 2. Test hydronic piping as follows:
 - d. Subject hydronic piping to hydrostatic test pressure that is not less than 1.5 times the design pressure.
 - e. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.
 3. Test conduit as follows:
 - f. Seal vents and drains and subject conduit to 105kPa for four hours with no loss of pressure. Repair leaks and retest as required.
- Prepare test and inspection reports.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

7.3.21 23 2114 - Hydronic Specialties

GENERAL

1.1 SECTION INCLUDES

1. Expansion tanks.
2. Air Valves
3. Strainers
4. Expansion Vessels
5. Pressure maintenance systems
6. Vacuum Degasser
7. System fill units
8. Air / Dirt Separators
9. Disc Filtration

- **RELATED SECTIONS**

1. Section 22 1006 – Plumbing Piping Specialties: Backflow Preventers.
2. Section 23 2113 – Hydronic Piping.
3. Section 23 0516 – Expansion Fittings and Loops for HVAC Piping
4. Section 23 0553 – Identification for HVAC Piping and Equipment
5. Section 23 0719 – HVAC Piping Insulation
6. Section 23 2500 – HVAC Water Treatment

1.2 Referred documents

- BS EN 13831:2007 Closed expansion vessels with built-in diaphragm for installation in water
- BS 7074-1:1989 Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems. Code of practice for domestic heating and hot water supply
- ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2004.

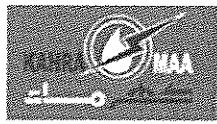
1.3 General requirements

- All water ancillaries are to be selected by the contractor with duties calculated based on project shop drawings. The selections given in the design drawings give indicative selections only

1.4 SUBMITTALS

- Contractor to provide the following information as part of a complete and comprehensive technical submittal:
 1. Pointwise Compliance statement
 2. Selection calculations
 3. Body material
 4. Pressure and temperature classification
 5. End connection details
 6. Seating Materials
 7. Trim materials and arrangement
 8. Dimensions and required clearances
- Refer to the MEPF General Requirements and Scope of Work document for submittal procedure and formats

PRODUCTS



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1.5 EXPANSION TANKS

- General Requirements
 - 1. Expansion vessels are to be in accordance with BS EN 13831
 - 2. Expansion tanks shall be bladder type, closed air cushion type of volumes sufficient to allow for expansion of the total system volume.
 - 3. Selection of the expansion vessels shall be in accordance with BS 7074 and based on the approved shop drawings
 - 4. Tanks shall be of capacity and size required for the system volume and pressure. Submit sizing calculations for review.
 - 5. The vessel shall be configured to allow replacement of the membrane bag without removal of the vessel from the base frame or interruption in service.
 - 6. Production and quality management are certified and monitored according to ISO 9001:2000.
- Construction
 - 1. Closed, welded steel, tested and stamped in accordance with BS EN 13831 cleaned, prime coated, and supplied with steel support saddles; with tappings for installation of accessories.
 - 2. Finished to manufacturers standard
 - 3. Vessel should be CE-tested, according to the requirements of the European Directives PED/DEP 97/23/EC
 - 4. The vessel bag should be made up from airproof butyl rubber according to EN 13831 with reliable protection of the expansion water against the admission of oxygen.
 - 5. The bag must have surpassed the requirements of DIN 4807-T3 in order to insure long life cycle and extremely reliable operation.
 - 6. Pressure rating to suit the calculated system pressure
 - 7. Cavity between the membrane bag and the vessel shall be filled with nitrogen or clean dry compressed air. The nitrogen/air cushion pressure shall be as specified by the manufacturer.
 - 8. To be supplied complete with filling draining and venting connections
 - 9. All components in contact with water shall be non-ferrous
 - 10. Provide safety vents to BS 7074 with integral strainer. Safety valve to be set at 10% above the system maximum operating pressure
 - 11. Pressure relief valve to be piped to nearest drain
 - 12. All components shall be fully identified with permanent labels inline with overall services identification system
- Temperature:
 - 1. Max. vessel temperature: -10°C
 - 2. Min. vessel temperature: 120°C
 - 3. Max. bag temperature: 70°C
 - 4. Min. bag temperature: 5°C

1.6 AIR VENTS

- Air Release valves shall be of the double orifice pattern with ductile cast iron body for distribution network installation only or air release & vacuum break valve -for detail specification refer to Clause 11.3.4.3) for all pipeline systems - distribution network, transmission pipelines and pump stations. The inlet flange shall be faced and drilled in accordance with BS 4504 PN 16.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- The valves shall be adequately sized for the release of air from the pipeline (or other container) without restriction of rate of filling or flow due to backpressure and also to allow admission of air during pipeline emptying at a rate sufficient to prevent excessive depression of pressure in the pipe.
- All air valves shall be fitted with an isolating sluice valve and gearing shall be provided where necessary to facilitate operation.
- Fixing nuts and bolts supplied by the manufacturer shall comply with the appropriate specification and standards in BS 5150 and 5163.
- All air release valves shall be works tested hydraulically and capable of withstanding test pressure of 24 bars and working pressure of 16 bars. All valves and operating linkages shall be prepared and painted in accordance with the general specification for painting and protective coating.
- All materials used in the manufacture of the valves shall conform to the following minimum standards:
 1. Float chamber- Ductile cast iron to BS 4772 or ISO 2531
 2. Flange and cover - Ductile cast iron to BS 4772 or ISO 2531.
 3. Liquid float - Copper, polycarbonate or approved equivalent.
 4. Air valve float and guide -Polycarbonate or approved equivalent.
 5. Orifices, guides and mechanisms -Stainless steel to BS 970 Pt.4
 6. Sealing rings. - Moulded rubber or suitably approved

1.7 Balancing Valves:

- Valves 65mm dia and above.

Valve to be cast iron, or ductile iron, flanged to ANSI 860 kPa or grooved fitting. Valves 65mm dia to 75mm dia shall have brass ball with glass and carbon filled TFE seat rings. Valves 100mm to 300mm diameter shall be fitted with a bronze seat, replaceable bronze disc with EDPM seal insert and stainless steel stem. Valves shall be shut-off, balancing and flow calibrated, with memory stop.
- Valves 19mm dia to 50mm dia.

Bronze body, npt connections design pressure of 2069 kPa at 121°C, brass ball construction with glass and carbon filled TFE seat rings. Differential pressure read out ports, 1/4 NPT tapped drain port, memory stops and calibrated name plate.

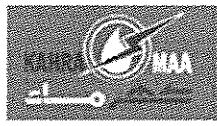
1.8 STRAINERS

- Size 50 mm and Under:

Screwed brass or iron body for 1200 kPa working pressure, Y pattern with 0.8 mm stainless steel perforated screen.
- Size 65 mm to 100 mm:

Flanged iron body for 1200 kPa working pressure, Y pattern with 1.2 mm stainless steel perforated screen.
- Size 125 mm and Larger:

Flanged iron body for 1200 kPa working pressure, basket pattern with 3.2 mm stainless steel perforated screen.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1.9 Pumped Pressure Maintenance systems

- General Requirements
 - 1. Closed system pressurisation units shall be complete package units containing expansion vessel(s), pumps, break tank and all controls, interlocks and ancillary equipment necessary to maintain the system operating conditions.
 - 2. The whole unit shall be factory wired and shall be controlled via an integral control panel..
 - 3. Expansion vessels shall be in accordance with this specification.
 - 4. Vessels shall be all welded steel construction and contain a removable butyl rubber sac or diaphragm enclosing a permanent pre-charged air cushion.
 - 5. The actual system water contents and he capacity of the pressure vessel and pressure maintenance pumps shall be calculated by the installer to achieve and accept the total system contraction/expansion volume of water.
 - 6. Under reductions in system pressure the pressure maintenance pumps are to automatically active to discharge water back into the system from the water reservoir in the expansion vessel
 - 7. Increases in system pressure shall cause the bypass solenoid valve to open automatically allowing system water into the expansion vessel.
 - 8. Production and quality management are certified and monitored according to ISO 9001:2000.
- Construction
 - 1. Expansion vessels inline with section 23 2114 - 2.1 of this specification
 - 2. Pumps shall be complete with drain plug, isolating valves and neoprene/rubber flexible compensators.
 - 3. Pressure test points shall be provided on the suction and discharge connections.
 - 4. Enclosure to be IP54 rated
 - 5. Vessel should be CE-tested, according to the requirements of the European Directives PED/DEP 97/23/EC
- Temperature:
 - 1. Max. water temperature: 70 °C
 - 2. Min. water temperature: 0 °C
 - 3. Max. ambient temperature: 40 °C
 - 4. Min. ambient temperature: 5 °C
 - 5. Max. admissible temperature for water make-up: 30 °C
- Accuracy:

Precision pressure maintenance $\pm 0,2$ bar.
- Supply voltage:

230 V/50 Hz
- Control
 - 1. Control unit should be CE-tested, according to the requirements of the European Directives PED/DEP 97/23/EC, 2004/108/EC, 2006/95/EC.
 - 2. All pressure maintenance operations shall be controlled by the dedicated unit controller supplied as part of the pressure maintenance system, factory wired, tested and commissioned.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

3. The controller is to be integrated into the building BMS such that the current set point is adjustable from the building head end and all system faults and statuses are available via the BMS
4. Automatic changeover of the pumps shall be provided on pump failure. The changeover shall be remotely indicated.
5. Provision shall be incorporated for periodic variation of the duty pump.
6. Each pump shall be fitted with an 'hours run' counter. The over frequent starting of the duty pump shall be indicated.
7. High and low level pressure switches shall be provided for pump control. Separate high and low pressure switches shall be provided to interlock and shut off the boiler or chiller plant if the system operating limits are exceeded. The switches shall be hand reset.
8. Facilities for the transmission of the status of pumps, operating pressures and alarms from the unit to the main control panel or building management system, as indicated, shall be provided.

1.10 Vacuum DEGASSERS

• General Requirements

1. The deaerator shall be selected according to manufacturers recommendations based on system volume. Where a single unit cannot deal with the system volume multiple deaerator shall be installed in parallel. The feed line to the deaerator shall be provided with dirt separator.
2. The pressure step deaerator shall expose the system water to a vacuum, this shall force all dissolved gases from the water. These gases shall then be expelled via an automatic air vent. Once the water sample has been deaerated it shall be fed back in to the main system. This cycle shall be repeated every 30 seconds to gradually remove all air from the system.
3. Accumulated gas shall be vented through the units such that air from the atmosphere cannot enter the vessel under any circumstances (sealed operation).
4. Independent of the operating phase of the device, the control ensures that the pump shall run for a few seconds every 3 days.
5. The devices shall be equipped with a measurement device for the determination of the residual gas content in the water.
6. The measurement device shall also report a suspected leakage in the degassing vessel if the gas quantity is too high.
7. The deaeration unit shall be furnished complete with in built electronic timer allowing adjustment of deaeration times.

• Construction

1. Pressure monitoring device should be according to EN 1282-4.7.4.
2. CE-tested, according to the requirements of the European Directives PED/DEP 97/23/EC, 2004/108/EC, 2006/95/EC;
3. The Control unit shall be floor standing, compact with all required functional elements, high quality metal cover with handles, hose connections on back side of panel are easy to assemble
4. To be supplied complete with all required valve assemblies and monitoring sensors factory installed, wired and tested.

• Controls

1. All de-gassing operations shall be controlled by the dedicated unit controller supplied as part of the pressure maintenance system, factory wired, tested and commissioned.



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

2. The controller is to be integrated into the building BMS such that the current set point is adjustable from the building head end and all system faults and statuses are available via the BMS
3. Automatic changeover of the pumps shall be provided on pump failure. The changeover shall be remotely indicated.

1.11 Auto FILL Pressurisation UNITS

- Provide a complete packaged, factory piped, factory wired for single point power connection, pressure fill system consisting of surge tank assembly, water feed make-up assembly, pressurization tank with pump, control panel, pressure reducing valve assembly, pressure indicator, level controller, flow balance valve, pressure switch, bladder expansion tank, etc.
- The system shall automatically detect system pressures below the cold fill pressure the system shall automatically operate to restore the system pressure.
- Backflow prevention to be provided type BA according to EN 1717, WRAS and ACS tested in addition to type AB air gap according to EN 1717
- Construction:
 1. Galvanized vertical surge tank, vented to atmosphere, having reinforced top edge, and required openings.
 2. Float Valve Assembly: One (1) float valve assembly to allow an open break between the potable and the break tank, Provide a float rod for tank depth monitoring.
 3. Multistage Pump: Provide duty / standby, multistage pump for operation on 230volt, 50 hertz with number of stages required to meet system discharge pressure requirements.
 4. Factory wire unit to the pump control panel.
 5. Control unit, variable installation next to the primary vessel, compact with all required functional elements, high quality metal cover with handles, hose connections on back side of panel are easy to assemble, protected isolating valves to the system, including convoluted stainless steel hoses with seals for the connection of the primary vessel;
 6. Enclosure to be IP54 rated
 7. CE-tested according to the requirements of the European Directives PED/DEP 97/23/EC, 2004/108/EC, 2006/95/EC.
 8. To be supplied complete with all required valve assemblies and monitoring sensors factory installed, wired and tested.
- Temperature
 1. Max. water temperature: 65°C
 2. Min. water temperature: 0°C
 3. Max. ambient temperature: 40°C
- Controls
 1. All auto-fil operations shall be controlled by the dedicated unit controller supplied as part of the autofill pressurisation system, factory wired, tested and commissioned.
 2. The controller is to be integrated into the building BMS such that the current set point is adjustable from the building head end and all system faults and statuses are available via the BMS
 3. Automatic changeover of the pumps shall be provided on pump failure. The changeover shall be remotely indicated.
 4. Boiler / Chiller safety interlock relay to be provided



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

1.12 Combination Pressure control Units

- Where specified combination units containing multiple functionality may be required such as expansion vessel, auto-fill pressurisation units with vacuum De-gassing. Under these circumstances the requirements of section 2.1 - 2.4 are to be applied to each component in addition to the following:
 1. All components are to be provided from a single manufacturer as a factory assembled, wired and tested unit complete with all necessary valves, sensors, control equipment and supports.
 2. Site fabrication is not acceptable
 3. Single control unit to be provided by manufacturer fully integrated to the building BMS to control all elements of system pressure maintenance

1.13 Air Sperator

- General Requirements
 1. As indicated in-line air separator to be provided utilising internal spiral structure to induce separation of air from the system fluid.
 2. To be provided complete with automatic air vent and drain valve. An automatic air release mechanism shall be provided at the top of the unit comprising solid polycarbonate floats and spring loaded self-closing valve to ensure positive seal to prevent leakages.
 3. The valve shall be tamper proof and the unit guaranteed against leakage for a minimum of three years.
 4. The units shall be designed to prevent clogging and to maintain a constant pressure drop across the unit
 5. Demountable unit shall be provided in which the lower section can be opened and the internal mechanism removed for cleaning and inspection.

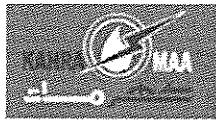
1.14 Dirt Sperator

- General Requirements
 1. As indicated in-line air separator to be provided utilising internal spiral structure to induce separation of dirt from the system fluid.
 2. To be provided complete with drain valve for removal of trapped dirt from the base of the system.
 3. The valve shall be tamper proof and the unit guaranteed against leakage for a minimum of three years.
 4. The units shall be designed to prevent clogging and to maintain a constant pressure drop across the unit irrespective of the amount of dirt trapped.
 5. Demountable unit shall be provided in which the lower section can be opened and the internal mechanism removed for cleaning and inspection.

1.15 Combined Air / Dirt Sperator

- Where specified combination units containing both air and dirt seperation may be sepecified. Under these circumstances the requirements of section 2.6 - 2.7 are to be applied to each component in addition to the following:
 1. All components are to be provided from a single manufacturer as a factory assembled, wired and tested unit complete with all necessary valves, sensors, control equipment and supports.
 2. Factory fabrication is not acceptable
 3. Single control unit to be provided by manufacturer fully integrated to the building BMS to control all elements of system pressure maintenance

1.16 Side stream disk filter



Qatar General Electricity & Water Corporation
Tender NO. GTC 626/2014
Construction of Mega Reservoir PRPSs
(Packages A, B, C, D & E)

- General Requirements
 1. Modular, high capacity, fully automatic disk filter with pump, skid mounted assembly, continuous differential pressure monitoring and automated back flow and blow down facility.
 2. Intrinsic to the design, the filter shall incorporate a fluid spinning turbine mechanism inside the filter housing that generates a centrifugal effect. This effect shall spin heavier particulate to the outer wall of the filter housing, away from the disc stack located in the inner portion of the housing. The dirty water will pass through the disc media from the outside to the inside, capturing lighter contaminants on the surface of the discs and through the depth of the discs.
 3. The inlet on each filter has a 3-way valve with two positions.
 - a. Filtration position: where the inlet of the filter is open, this allows the flow of water from the inlet manifold into the filter and through the element of filtration to the outlet manifold and to the user system.
 - b. Backflush position: where the inlet to the filter is closed, and the drain port is open. This allows clean water from the outlet manifold to flow in the opposite direction into the filter, clean the discs of the filter element, and flush the solid impurities from the filter to the drainage through the drain manifold.
 - c. When the filters are loaded (with solid impurities) the difference of pressure between the inlet and the outlet of the filter battery rises. A differential pressure gauge detects the critical difference of pressure that was programmed on it, and transmits a signal to the control unit, which then starts and runs a backwash process of the filters in the battery.
 - Construction
 1. Filter Housing: Polyamide
 2. Filter Discs: Polypropylene or K-Resin
 3. Inlet/Outlet Manifolds & Filter Leg Assembly: Type 304 Stainless Steel
 4. Backwash Valves: Bronze or Cast Iron Epoxy Coated
 5. Solenoids: Brass/Stainless Steel or Plastic (12vdc or 24vdc)
 6. Pressure-Sustaining Valve: Cast Iron Epoxy
 7. Skid Assembly: Type 304 Stainless Steel or Plastic
 8. Backwash Controller: 120VAC
 - Efficiency

Filter to effectively capture contaminants to 40 micron
 - Controls
 1. All filtration operations shall be controlled by the dedicated unit controller supplied as part of the side stream disk filter system, factory wired, tested and commissioned.
 2. The controller is to be integrated into the building BMS such that the current set point is adjustable from the building head end and all system faults and statuses are available via the BMS
 3. Backflushing shall be automatic based on the differential pressure across the filter disks
 4. Manual over ride of backflushing to be provided
- 1.17 Side Stream Bag filter**
- General Requirements