


**Technical Specification
for
GENERAL PROJECT REQUIREMENTS
for the
South Field Energy Project**

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1.0 GENERAL

1.1 Description

Information contained in this specification is provided as general project information and requirements that apply to equipment and services provided for South Field Energy Project (SFEP). Detailed requirements are provided in the Purchase Orders (POs) or Subcontracts (SCs) and/or equipment specifications for those components and services. In the event of a conflict between the requirements in this document and the POs or SCs, the order of precedence defined in the PO or SC shall determine which set of requirements will govern. Such conflicts shall be communicated in writing to the Buyer/Contractor for resolution.

1.2 Codes, Regulations, and Standards

Design shall be in accordance with the applicable codes, regulations, and industry standards in effect as of Aug. 23, 2018, except as noted in the contents of this section and as noted in the specific MR/SC and/or equipment specification. Applicable sections of codes, standards, and regulations may be further defined in the equipment specifications.

Laws, ordinances, regulations, codes, standards, and pertinent recommendations of the organizations listed in this section and any other relevant organizations shall apply, in addition to any that are specified in the PO/SC, and/or equipment specifications. If conflicts arise among the codes, standards, and specifications described herein and the codes, laws, rules, regulations, standards, etc., of the locality in which the equipment is to be installed, the more stringent code as determined by the Buyer/Contractor shall apply. For fire codes, the Authority Having Jurisdiction (AHJ) shall rule on which code is applicable for each plant design feature.

All materials for piping, valves, pressure vessels, and associated components shall conform to the requirements of the applicable codes, regulations, and industry standards. The design and construction of the equipment shall be in accordance with the best principles of sound engineering practice and good utility practice. Other editions of codes and standards may be permitted, but only with prior written consent of the Buyer/Contractor. Additional codes and standards that are not included in this section shall apply if required in the PO/SC and/or specific equipment specifications.

All materials to be incorporated into the machines and equipment to be provided hereunder, or components thereof, shall conform to requirements of applicable sections of the following codes or standards but not limited to:

- **Ohio Building Code 2017**

- **American Society of Mechanical Engineers (ASME)**

ASME Boiler and Pressure Vessel Code Sections

- I Power Boilers
- II Material Specifications
- V Nondestructive Examination
- VIII Pressure Vessels Division 1
- IX Welding and Brazing Qualifications

ASME B31.1, Power Piping

ASME Standard TDP-1, Prevention of Water Damage to Steam Turbines Used for Electric Power Generation: Fossil Fueled Plants

ASME Power Test Codes

ANSI, American National Standards Institute

- **Industry Standards and Codes**

AASHTO, American Association of State Highway and Transportation Officials

ACI, American Concrete Institute

AISC, American Institute of Steel Construction

AISI, American Iron and Steel Institute

ASCE, American Society of Civil Engineers

ASHRAE, American Society of Heating, Refrigeration, and Air-Conditioning

ASTM – ASTM International

AWS, American Welding Society "Structural Welding Code (AWS D1.1 and D1.3)", "Specification for Welding Industrial and Mill Cranes (AWS D14.1)", "Welding of Reinforcing Steel (D12.1)"

AWWA, American Water Works Association

CGA, Compressed Gas Association

CMAA, Crane Manufacturers Association of America

FAA, Federal Aviation Administration

HEI, Heat Exchangers Institute

IBC, International Building Code, 2015

ICEA, Insulated Cable Engineers Association

IEC, International Electrotechnical Commission

IEEE, Institute of Electrical and Electronics Engineers

IES, Illuminating Engineering Society

MSS, Manufacturers Standardization Society of Valves and Fitting Industry

NEC, National Electrical Code

NEMA, National Electrical Manufacturers Association

NESC, National Electrical Safety Code (by IEEE)

NFPA, National Fire Protection Association

OSHA, Occupational Safety and Health Administration

SMACNA, Sheet Metal and Air Conditioning Contractors National Association

SSPC, Steel Structures Painting Council
 TEMA, Tubular Exchanger Manufacturers Association
 UL, Underwriters' Laboratories

1.3 Laws, Ordinances, Regulations, and Standards (LORS)

Design specifications and construction of the project shall be in accordance with all applicable local, state, and federal laws, ordinances, regulations, and standards (LORSs).

1.4 Registered Professional Engineer Certification and Sealing of Engineering Documents

Where required by the AHJ, LORSs, and/or according to the PO or SC provisions, the Supplier/Subcontractor shall prepare and provide to the Buyer/Contractor documents (drawings, design calculations, etc.) properly sealed by a professional engineer registered in the state of Ohio.

2.0 FACILITY DESCRIPTION

The SFEP will consist of two, independent 1x1x1 combined-cycle power trains. Each train, consisting of one General Electric (GE) 7HA.02 Combustion Turbine Generator (CTG), one Alstom-supplied Heat Recovery Steam Generator (HRSG) (3-pressure reheat with duct burners), one GE-supplied Steam Turbine Generator (STG) with side-exhaust, one wet surface condenser, one mechanical-draft cooling tower, and associated auxiliaries. Fuel for the CTGs and the HRSG duct burners will be natural gas only. Power will be generated at 26 kV in the CTGs and at 18 kV in the STGs and stepped up through their individual generator step up transformers to the utility grid voltage of 345 kV. The total combined-cycle plant nominal output will be approximately 1,182 MW net at 59 °F ambient in the duct-fired condition with evaporative cooler on.

The Facility will consist of GE Rapid Response Lite power trains, which allows for shorter startup times. When using the rapid start sequence, the CTG can be ramped quickly to the required minimum load for emissions compliance, while the steam produced by the HRSG is bypassed to the water-cooled condenser. Under this sequence, the STGs are then brought online with the terminal attenuators (unique feature of the Rapid Response Lite power island) and are used as required for temperature matching and control through the STG speed ascension and loading program. Each power train may start up and operate independently of the other.

Water treatment systems will consist of a pretreatment filtration system and a wastewater filtration system prior to wastewater discharge with thickening and dewatering of filter backwashes.

The Facility will be designed to typically operate as a cycling facility with the capability to reliably start on a daily basis. The Facility will be designed for 250 starts per year.

3.0 SITE-SPECIFIC DESIGN CRITERIA

3.1 Facility Location

The SFEP is located on a site comprised of approximately 86.5 acres of open fields, with smaller areas of maintained lawn (associated with two residences), trees, and scrub-shrub located in Yellow Creek Township, Columbiana County, Ohio.

3.2 Ambient Conditions

The following ambient conditions shall be used as the basis for the design of the SFEP.

<u>Design Criteria for Outdoor Equipment</u>	
Maximum Design Dry Bulb Temperature	100 °F
Minimum Design Dry Bulb Temperature	-10 °F
<u>HVAC Design Conditions</u>	
Maximum Outdoor Dry Bulb Temperature	88.5 °F
Mean Coincident Wet Bulb Temperature	72.5 °F
Minimum Outdoor Dry Bulb Temperature	2.9 °F
Design Wind Speed	21.3 mph
<u>Facility Conditions</u>	
Barometric Pressure	14.095 psia
Elevation (North America Vertical Datum 1988 [NAVD 88])	1,151 feet above MSL
<u>For Indoor Facilities</u>	
Heated and Ventilated (Not Air-Conditioned)	
Design Indoor Bulk Temperature Range for Ventilation Fan Sizing	50 °F - 100 °F
Minimum Indoor Temperature	50 °F (maintained by room heaters)
Minimum Temperature for battery rooms	77 °F
Air-Conditioned Space Indoor Design Conditions	
<u>Occupied Areas</u>	
Maximum	78 °F
Minimum	70 °F
Relative Humidity	55%± 5%
<u>Un-occupied Areas</u>	
Maximum	80 °F
Minimum	60 °F

<u>Guaranteed Conditions for Performance Testing</u>	
Dry bulb temperature	90 °F
Relative Humidity	50%
Wet bulb temperature	74.8 °F

3.3 Precipitation

- Annual average total: 38.9 inches

3.4 Wind and Snow

The wind design basis for the project shall be based on the following design criteria:

Ohio Building Code (OBC), 2017 edition

Wind Design Load Criteria

- Wind speed, 3-second gust 120 mph (for outdoor application)
- Exposure Category C

Snow Design Load Criteria

- Importance Factor 1.1
- Ground Snow Load 25 psf

3.5 Seismology

The seismology design basis for the project shall be based on the following design criteria:

- Ohio Building Code, 2017 edition
- Site Class C
- Mapped Spectral Acceleration for short periods, S_s 0.118g
- Mapped Spectral Acceleration for long periods, S_1 0.054g
- Seismic Design Category A

3.6 Frost Depth

The depth of frost penetration for the site is 36 inches below grade.

3.7 Structural Steel

- Structural steel design per AISC-ASD or LRFD
- Structural concrete design per ACI 318/318R

- Control panels, equipment enclosures, and other electrical apparatus for environmentally controlled indoor equipment - NEMA 12
- Instrument enclosures for outdoor equipment - NEMA 4 or NEMA 4X
- Electrical enclosures for outdoor equipment - NEMA 4 (unless specified differently in the parent specifications or data sheets)
- Areas classified as Hazardous Area Class 1, Div. 2 - NEMA 7

3.9.2 Motor Requirements

Motors shall be the squirrel-cage induction type suitable for full voltage across-the-line starting. Enclosures will be weather-protected Type II (outdoor), open drip-proof (indoor), or totally-enclosed fan-cooled (TEFC) as required for the specific application.

Motors rated 25 HP and above for use in outdoor applications other than HVAC shall have space heaters to prevent condensation formation during non-operational periods.

3.9.3 Compressed Air

The compressed air system shall provide oil-free and dry air for instrument air as noted below.

- Normal Operating Pressure 80 - 120 psig
- Design Pressure and Temperature 150 psig @ 120 °F

3.9.4 Demineralized Water

- Normal operating pressure range at grade 70 - 100 psig
- Normal operating temperature range 40 - 100 °F
- Design pressure 150 psig
- Design temperature 110 °F

Refer to Appendix A for water quality information.

3.9.5 Closed Cooling Water

The closed cooling water system will be corrosion-inhibited demineralized water with approximately 43% propylene glycol by weight.

- Normal operating pressure range at grade 70 - 110 psig
- Normal operating temperature range (inlet to coolers) 40 - 102 °F
- Design pressure 150 psig
- Design temperature (outlet from coolers) 140 °F

Refer to Appendix A for water quality information.

3.9.6 Raw Water

Raw water will come from the Buckeye Water District reservoir (originating from Ohio River).

- Normal operating pressure range at grade 50 - 100 psig
- Normal operating temperature range 40 - 100 °F
- Design pressure 150 psig
- Design temperature 110 °F

Refer to Appendix A for water quality information.

3.9.7 Circulating Water

The circulating water system will be filtered water from Buckeye Water District reservoir and cycled to 7 cycles for concentration.

- Normal operating pressure 20 - 35 psig
- Normal operating temperature range (cold water) 40 - 90 °F
- Design pressure 75 psig
- Design temperature (hot water) 150 °F

Refer to Appendix A for water quality information.

4.0 ELECTRICAL

4.1 General

The electrical systems, equipment, and materials furnished by the Supplier/Subcontractor shall be designed in accordance with applicable industry codes/standards and the other requirements specified in this section and the electric equipment specifications as provided in the PO or SC.

4.2 Motors and Couplings

Furnish electrical motors and coupling as required for all equipment supplied under the technical specifications.

To the extent practical, equipment shall be shipped with the motor installed. If large motors (>50 hp) are shipped separately to the site, the Supplier/Subcontractor shall ship the motor half of the couplings to the motor manufacturer for mounting and balancing, together with the Supplier/Subcontractor's recommended dimensions and mounting instructions. Identify both halves of each coupling to ensure reassembly of the correct pair. If components can be field-erected with the half coupling in place, mount the driven equipment half coupling; otherwise ship it loose.

Shop-installed motors shall be fully aligned, and alignment data shall be submitted to the Buyer/Contractor.

Supply all couplings complete with coupling guards conforming to safety code requirements.

5.0 FABRICATION REQUIREMENTS

5.1 General

Fabrication shall be in accordance with the manufacturer's standard fabrication practices conforming to the codes and standards. Where Supplier's/ Subcontractor's standard procedures conflict with applicable codes or other standards, the most stringent requirements shall apply to fabrication and manufacture of equipment specified. However, Buyer/Contractor shall be notified of any such conflict.

Ragged edges or sharp projections that are hazardous to operating personnel, contribute to additional maintenance, or detract from the finished appearance of machinery or equipment shall be eliminated.

Equipment and machinery shall be designed so that easy access is available to all necessary parts of equipment for purposes of operation, maintenance, adjustment, and repair. This shall include safe access to all valves, instruments, etc. even if not normally required for operation, but which may be required for maintenance or replacement.

Preassemble all components furnished under the PO/SC and/or specific equipment specifications in Supplier/Subcontractor's shops to the extent mutually agreed between Buyer/Contractor and Supplier/Subcontractor consistent with shipping, handling, and erection requirements. The Supplier/Subcontractor shall describe the extent of preassembly for the Buyer/Contractor's acceptance.

Assemble, matchmark, and suitably package all components in order to provide for rapid and accurate erection and installation at jobsite. Identify each package by PO/SC number, assembly drawing number, and associated item numbers.

All components furnished under this specification shall be preassembled in the Supplier/Subcontractor's shops to the maximum extent mutually agreed between Buyer/Contractor and Supplier/Subcontractor, consistent with shipping limitations, handling limitations, and the erection plan in accordance with agreed-upon shipping splits and quantity guarantees to be finalized prior to PO/SC execution.

All equipment and materials shall be maintained in a satisfactory condition during the entire period of manufacture and shall be properly packaged and preserved for shipment and on-site storage. Copies of manufacturer recommendations for preservation and on-site storage shall be provided upon receipt of equipment. (Refer to Appendix C.)

All parts, especially those having working surfaces, or passages or piping for lubricating oil, shall be kept clean and protected during manufacture, storage and assembly. Piping and castings shall be clean of sand, scale, metallic chips and turnings, or other foreign matter. Special measures shall be taken by Buyer/Contractor to prevent corrosion or other deterioration of equipment and material

provided hereunder, especially to unpainted, polished, or moving parts during shipment and on-site storage.

5.2 Materials

All materials to be incorporated into the machines and equipment to be provided hereunder, or components thereof, shall conform to requirements of applicable specifications, standards or codes as stated in Section 1.2. Where galvanizing of materials is required, it shall be done by the hot dip process and shall meet the requirements of ASTM 123. Zinc used shall be not less than 98% pure and repair of damaged galvanizing shall be accomplished with 85% pure zinc.

All parts of machinery and equipment shall operate satisfactorily under the varying degrees of local ambient temperature, humidity, shock and vibration of the expected level of service for the project, as well as during start-up and shutdown. Machinery and equipment shall be selected and constructed by the Buyer/Contractor to ensure its operation is in compliance with generally accepted industry practice.

All similar parts, including repair parts, of corresponding apparatus furnished shall be reasonably interchangeable without additional machining or selective assembly and with a minimum of hand fitting. As far as practicable, equipment or machinery that is functionally interchangeable shall also be physically, electrically, and mechanically interchangeable.

The use of materials differing from those specified for a given application may be approved by the Buyer/Contractor in writing when the Supplier/Subcontractor justifies the necessity thereof and when the material proposed is proven to be a satisfactory alternative of equal quality, in each case, to the reasonable satisfaction of the Buyer/Contractor.

Chlorinated fluorocarbons (CFCs), hydro-chlorofluorocarbons (HCFCs), polychlorinated biphenyls (PCBs), lead paint, hexavalent chrome, mercury, and asbestos or asbestos-bearing materials shall not be used. Refractory Ceramic Fiber (RCF) insulation shall not be used for any application without prior written approval by the Buyer/Contractor.

Materials shall be first-class throughout and due consideration shall be given to interchangeability of parts, wherever good practice allows. All materials shall be new, unused, and undamaged.

Dimensional tolerances, fit, alignment, hardness, and finish shall be in accordance with the approved drawings according to recognized national or manufacturer's association consensus standards, and in accordance with OEM manufacturer standards, when defined.

Anchor bolts and embedded plates exposed to weather shall be made of galvanized material.

5.3 Shop and Field Painting

Painting and coating shall be in accordance with specification 26173-000-3PS-NX00-N0001.

5.4 Insulation

Parts of the plant requiring insulation to reduce heat loss or to provide personnel safety shall be thermally insulated. Temperatures of all indoor and outdoor piping, equipment, ducts, and other hot surfaces within reach of personnel shall be limited to 140 °F considering ambient temperature of 80 °F and air velocity of 5 mph or shall have standoffs and/or protection provided in combination with insulation to meet this standard.

For components insulated for the purpose of heat conservation, heat losses from insulation surfaces shall be designed for approximately 100 Btu/hr/ft² at 80 °F ambient and a wind velocity of 5 mph.

Freeze protection insulation with heat tracing shall be based on maintaining the pipe or equipment temperature to at least 45 °F based on the minimum ambient temperature of -10 °F and a wind velocity of 5 mph. The Seller/Subcontractor shall identify piping and components that require heat tracing and the Seller's/Subcontractor's design shall accommodate heat tracing and 1" of insulation where heat trace is required. The Buyer/Contractor will supply and install heat tracing and insulation except for modularized equipment for which the Seller/ Subcontractor shall supply and install heat tracing and insulation. The scope will be defined in the PO/SC.

Acoustic insulation, whenever required to meet the noise requirement for Seller's/Subcontractor's equipment, will be supplied by the Seller/Subcontractor as part of the Agreement. Seller's/Subcontractor's scope of supply shall include all required acoustic insulation whether the acoustic insulation is affixed directly on the equipment and/or includes barrier walls/enclosure(s). The Seller/Subcontractor shall notify the Buyer/Contractor of the degree of pre-installation of thermal or acoustic insulation at the time of proposal.

The equipment PO, SC, or specific equipment specification will identify the materials and their thermal conductivity to be used. The design temperature for thermal insulation will be based on the system operating temperature during normal operation as specified in the individual equipment data sheet. The Seller/Subcontractor will specify the requirements for insulation thickness and all specialized installation details (including supporting insulation frames).

Thermal insulation materials shall be calcium silicate, fiber glass, or mineral fiber. Use of Asbestos materials and RCF is prohibited. A jacket or suitable coating shall be provided on the outside surface of the insulation. Use of any covering other than an aluminum jacket will require Buyers prior approval. Where a hard-setting compound is used as an outer coating, it shall be nonabsorbent and non-cracking. Thermal insulation shall be chemically inert even when saturated with water. Insulation on steam piping at trap discharges shall be free of chlorine. Insulation

system materials, including jacketing, shall have a flame spread rating of 25 or less, when tested in accordance with ASTM E 84. Outdoor insulation shall be moisture resistant.

Piping shall be insulated with either mineral fiber or fiber glass (fiber glass can only be used for applications less than 1000°F). Aboveground insulated piping shall be clad with embossed or corrugated aluminum not less than 1/64-inch-thick and frame reinforced. At joints, the sheets shall be sufficiently lapped to prevent moisture from penetrating the insulation.

Insulation outside of buildings and structures shall be lagged with weatherproof lagging consisting of embossed or corrugated aluminum not less than 1/64 inch thick and suitably reinforced. At joints, the sheet shall be sufficiently lapped to prevent moisture from penetrating the insulation. The lagging shall be designed to be installed such that the longitudinal laps are below pipe centerline, with downward directional end laps on vertical piping, with mastic plastic cements at penetrations. Removable blankets shall be provided at flanged valves 2-1/2 inches and larger. Valves and equipment or equipment connections should use reusable blankets with stainless steel tie wire.

Antisweat insulation with a moisture-proof barrier shall be furnished in occupied (finished) areas only. A fluid temperature of less than 50°F shall be the basis for using antisweat insulation.

Insulation at valves, pipe joints, and other points where maintenance access may be required shall be removable with a minimum of disturbance to the pipe insulation. At each flanged joint, the molded material shall terminate on the pipe at a distance from the flange equal to the overall length of the flange bolts to permit their removal without damaging the molded insulation.

5.5 Lubrication

The type of lubrication specified for project equipment shall be suited to the operating conditions and shall comply with the recommendations of the equipment manufacturers. Lubrication cannot contain hazardous materials (such as oils with high halogen content) and cannot have a low flash point.

The initial charge of oil and any additional flushing oil required for startup shall be provided with the equipment and shall be the manufacturer's standard lubricant for the intended service. Subsequently, such flushing oil shall be sampled and analyzed to determine whether it can also be used for normal operation.

Rotating equipment shall be splash-lubricated, force-lubricated, or self-lubricated. Oil cups shall be provided as necessary. Where automatic lubricators are fitted to equipment, provision for emergency hand lubrication shall also be specified. Where applicable, equipment shall be designed to be manually lubricated while in operation without removing protective guards. Lubrication filling and drain points shall be readily accessible.

All equipment that requires lube oil reservoirs shall be equipped with sampling taps for predictive maintenance testing.

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5.6 Structural and Miscellaneous Steel

For details of structural and miscellaneous steel requirements, refer to the Technical Specification for Purchase of Structural and Miscellaneous Steel (26173-000-3PS-SS01-00001) attached to the PO/SC.

5.7 Nameplates and Tagging

Nameplates:

Each item of equipment (including skid assembly components such as pumps, instruments, along with automatic and manual valves where applicable) shall be provided with one temporary and one permanent, corrosion-resistant nameplate bearing the PO or SC number, serial number (if applicable), Buyer's/Contractor's equipment tag (identification) number, and conditions of service (if applicable) as a minimum in accordance with the contract documents. The nameplate shall be made of metal (e.g., 16-gauge, 316 stainless steel) or other Buyer/Contractor-approved material and shall be securely affixed by metal screws. The nameplate tags shall have minimum dimensions of 1.5 inches tall by 3.125 inches wide and the information shall be in the English system of units.

Instrument, controls, and electrical nameplate requirements are defined in Specification 26173-000-3PS-JQ07-00001 where attached to the PO/SC and/or specific equipment specifications. If this specification is not attached, the nameplate requirements detailed above for equipment is applicable for instruments, controls, and electrical devices and shall be affixed to the instrument by pins, metal screws, or stainless-steel wire. The Supplier/Subcontractor shall include shipping tag information on shipping containers and bills of materials.

Tagging:

The Buyer's/Contractor's equipment tag numbers will be indicated in the PO/SC and/or specification/data sheets and are to be shown on the Supplier's/Subcontractor's drawings. In some cases, equipment and instrument tag numbers will be supplied as Bechtel comments on the first submittal of a Supplier's/Subcontractor's drawings (e.g., P&IDs). Advanced permission from the Buyer/Contractor is required to submit drawings without equipment or instrument tag numbers. Seller/Subcontractor shall contact Buyer/Contractor with any concerns and for guidance as required.

5.8 Refrigerants

Refrigerants that contain CFCs or HCFCs shall not be used in any equipment (stationary or mobile). Refrigerants legally allowed and locally available shall be used.

5.9 Pump Seals and Packing

Horizontal pumps shall utilize mechanical shaft seals except where specified otherwise on the equipment data sheet or where prohibited by code (e.g. fire pumps). Vertical turbine pumps that take suction from a suction can shall have cartridge-type mechanical seals in lieu of packing. Vertical turbine pumps that take suction from an open source such as a sump, forebay, lake, well, etc., shall be provided with packing with the leakage routed to the suction source. Firewater pumps must have packing and not mechanical seals as specified by NFPA 20.

5.10 Containment

If applicable, proper containment shall be placed around all areas that utilize oils or chemicals and such containers shall be sized to contain the volume of the largest tank, plus the runoff from a design storm event with an additional 10% margin and shall be provided with a depressed area to allow for pumping out the containment area.

6.0 GENERAL EQUIPMENT CRITERIA

6.1 General

This section describes the general mechanical design criteria, maintainability, reliability, and operability philosophy to be used in the design and fabrication of all the equipment to be supplied for the SFEP using this specification. For information on design and construction features for all the equipment and systems, refer to the PO/SC. All systems shall be designed to be able to achieve all guarantees and meet the contract requirements.

6.2 Mechanical Design Criteria

Material selection, sizing, etc. will support overall equipment design, which shall be of a reliable and proven design. The design of the equipment shall be suitable for operating 24-hours/day, 7-days/week with a useful life of 30 years. The design of equipment/component/auxiliary with complete accessories shall be suitable for daily cycling service and support fast start capability.

All materials for piping, valves, pressure containers, and associated components shall conform to the requirements of the applicable ASME standards. Piping shall be arranged so it can be supported and drained.

Valve materials will be suitable for operating at the design pressure and temperature of the piping to which they are connected. Valves in throttling service will be selected with design characteristics and materials that resist valve seat erosion when the valves are operated partly closed.

Pressure vessels, heaters, and any other pressure containing components will have safety valves and relief valves as required by code. Piping systems that can be over-pressurized by a higher pressure source will also be protected by pressure relief valves. Equipment or parts of equipment that can be over-pressurized by

thermal expansion of the contained liquid will have thermal relief valves. Vents will be routed to a safe location. Safety valves will be flanged.

6.3 Maintainability

The primary maintainability objective shall be to minimize the complexity and time required for maintenance. The following general criteria shall be followed to achieve this objective:

- Plant equipment shall be of a low maintenance design and shall be easily maintainable.
- Plant equipment shall be designed to be maintained in place, if possible, with minimum disassembly of surrounding equipment and minimum usage of temporary scaffolding and handling equipment. Permanent maintenance platforms shall be provided where required to assure safety and efficiency.
- Equipment arrangements and pipe routings/cable tray locations (where applicable) shall be designed for maximum equipment accessibility and to allow the following types of access:
 - Minimum of 36" wide x 84" high personnel access aisles shall be provided for personnel access of equipment.
 - 8' wide x 10' high access aisles shall be provided for forklift access to equipment when required for maintenance. Height dimension reflects clearance to lowest steel.
- Space shall be provided to allow plant personnel easy access to all equipment what may require maintenance.
- Space shall be provided to allow unobstructed access for maintenance tools and equipment required for maintenance on permanently installed equipment.
- Adequate space shall be provided to allow removal of any equipment that cannot be maintained in place or may require replacement. Maintenance access pull spaces are to be clearly defined.
- Lifting eyes and other portable equipment supports shall be provided wherever beneficial for equipment maintenance or removal.
- Techniques for minimizing corrosion of structures and equipment exposed to chemically or environmentally corrosive atmospheres shall be incorporated into the equipment design. If grating is required in the chemical areas, fiberglass material shall be utilized.
- Appropriate enclosures and drip guards for fugitive water, hose spray water, chemicals, and oils shall be provided.

- Where feasible, similar equipment shall be provided by the same manufacturer to minimize spare parts inventories and also to minimize the number of different manufacturers, equipment that plant personnel must be capable of maintaining.

6.4 Operability

The primary operability objective shall be to design components and systems that are easy to operate and that require minimum operator surveillance. The plant will operate on function group control; the following general criteria shall be followed to achieve this objective:

- Equipment and system design shall be based on minimizing the amount of operator attention.
- Automatic operation of systems and processes shall be provided where possible; however, manual controls shall also be provided to allow manual operation or manual intervention of the automatic process.
- Control panel layouts shall incorporate human engineering factors.
- Process systems and equipment operation shall be adequately monitored to provide with information required for safe and easy operation of the plant.
- Systems and equipment shall be located for easy operational access and logical operational sequences.

All equipment that requires operator manipulation, including valves, instrumentation, inspection ports, and dampers, shall be located so that the operator can manipulate the equipment from a standing position without obstruction and without having to climb ladders or having to climb on top of equipment. Any deviation from these criteria shall be presented to the Buyer/Contractor in writing for formal approval. Equipment-specific control philosophy may be further defined in the PO/SC.

The following optimum accessibility chart is to be used for the following Supplier/Subcontractor supplied (including skid-mounted) valve types, unless project-specific access requirements are provided in the MR/PO/SC. Safe operation and maintenance of all valves supplied are criteria for the approval of a Supplier's/Subcontractor's layout/arrangement and will be verified before the submitted drawings receive written permission to proceed.

Valve Type	Access Required		
	I	II	III
Control valves, process pressure regulators, and motor-operated valves (MOVs)	X		
Isolation valves around rotating equipment		X	
Manually-operated valves	X		
Safety/relief valves		X	
Check valves		X	
Hydro vent valves – steam lines			X
High point vent valves			X
Low point drain valves			X
Instrument root valves		X	
Automatic air release valves			X
Fire protection interior header isolation valves			X

Legend:

- I. Grade or platform. Manually-operated valves that are normally operated during facility operation and manual block valves that are required for normal plant startup and shut down shall be located such that operation can be performed either from grade, platform, or by chain wheel or extended stem operator.
- II. Grade, platform, stairway, permanent ladder, portable ladder, or manlift. Use of ladders or manlift should be limited to valves 15 feet or less above grade or platform.
- III. Portable ladder or manlift.

Instrument accessibility in piping systems will be in accordance with 26173-000-3PS-JQ07-00001.

6.5 Reliability

All equipment furnished by Supplier/Subcontractor shall have an acceptable history of satisfactory reliable service in central station use for a period of at least three (3) years at comparable design conditions.

6.6 Tools

The Supplier/Subcontractor shall identify all special tools required for erection, dismantling, commissioning, adjustment, calibration, and maintenance.

7.0 SHIPPING, HANDLING, AND STORAGE

Refer to the PO/SC documents for shipping, handling, and storage instructions. As a minimum, the following guidelines shall be followed.

Document Supplier's/Subcontractor's packaging and shipping procedures and make them available for review by Buyer/Contractor at Supplier's/Subcontractor's shop.

Prepare equipment for shipment after shop tests have been completed so that handling can be done in a safe and expeditious manner without distorting equipment or materials, or exposing them to undue risk or damage.

Clearly mark lifting points on equipment and on shipping crates, packaging, etc. for proper handling at all times.

Clearly mark the "package/shipping" weight and center of gravity so that appropriate lifting devices can be used to lift and handle equipment.

Before equipment is shipped, install shipping stops, bolts, ties, etc. in all devices.

Protect electrical and control panels against corrosion, weather, and mechanical damage during transit. Provide temporary structural bracing as required to allow for normal field handling (skidding and hoisting). Temporary bracing shall be painted yellow.

Prevent corrosion of, or damage to, equipment while in transit to jobsite and while in storage awaiting erection. Supplier/Subcontractor is responsible for any damage during shipment due to Supplier's/Subcontractor's or Sub-supplier's/Sub-subcontractor's improper packaging or improper handling instructions.

Assemble, match-mark, and suitably package all components in order to provide for rapid and accurate erection and installation at jobsite. Provide protection for the most severe climatic conditions expected (as given in Section 3.0) that will prevent rusting, weathering, entry of foreign material, or other damage.

Provide protection for equipment from damage during shipping, handling, and storage. Equipment may be stored outdoors at the jobsite for as long as one year before it is installed. If additional or alternate storage is required, it should be clearly identified to the Buyer/Contractor prior to shipment.

Provide inspection and maintenance requirements for short-term and long-term outside preserved storage to protect the equipment.

The Supplier/Subcontractor shall provide Safety Data Sheets (SDSs) for all hazardous materials being furnished or a statement certifying that the data sheets are not required. The data sheets shall also accompany shipment of any hazardous materials.

The Supplier/Subcontractor shall submit a completed template with storage, maintenance, and startup operations. (Refer to Appendix C.). The Buyer/Contractor will use only Appendix C for maintenance activities during construction/startup without referring to any other document (e.g., O&M manuals). It is the Supplier's/Subcontractor's responsibility to indicate all the requirements on the form in Appendix C of this specification and shall submit as part of the document submittal requirements.

APPENDIX A – Water Quality Criteria

The values identified in Appendix A will need to be confirmed prior to the procurement of equipment.

1.0 Demineralized Water Quality

The following table provides the estimated Demineralized Water Quality.

Parameter	Value
Conductivity @ 25 C, $\mu\text{S}/\text{cm}$	<0.1
Total Hardness, $\mu\text{g}/\text{L}$ as CaCO_3	Not Detectable
Dissolved Iron, $\mu\text{g}/\text{L}$	<5
Dissolved Silica, $\mu\text{g}/\text{L}$	<10
Sodium, $\mu\text{g}/\text{L}$	<5
Chloride, $\mu\text{g}/\text{L}$	<3
Sulfate, $\mu\text{g}/\text{L}$	<3
Total Organic Carbon, $\mu\text{g}/\text{L}$	<100

2.0 Closed Cooling Water Quality

Closed cooling water will utilize demineralized water with quality shown above as makeup, with the addition of approximately 43% propylene glycol by weight and a corrosion inhibitor.

3.0 Raw Water Quality

The water quality data from the Buckeye Water District reservoir (originating from the Ohio River) is presented below.

Analyte	Units	Min	Max	Test Method
Alkalinity, Total	mg/L as CaCO_3	39	69	SM 2320B
Aluminum, Total	$\mu\text{g}/\text{L}$	<200	1600	EPA 200.7
Ammonia-N	mg/L	<0.05	0.2	SM 4500-NH ₃
Arsenic, Total	$\mu\text{g}/\text{L}$	<3.0	<3.0	EPA 200.9
Barium, Total	$\mu\text{g}/\text{L}$	20	67	EPA 200.7
Cadmium, Total	$\mu\text{g}/\text{L}$	<0.50	<0.50	EPA 200.7
Calcium, Total	mg/L	22.7	41.4	EPA 200.7
Chemical Oxygen Demand	mg/L	<10	25	SM 5220D
Chloride	mg/L	20	57	EPA 300.0

Chlorine, Free, Lab Analyzed (Estimate)	mg/L	<0.03	0.24	SM 4500-Cl F
Analyte	Units	Min	Max	Test Method
Chlorine, Residual, Lab Analyzed (Estimate)	mg/L	<0.03	0.26	SM 4500-Cl F
Chromium, Total	µg/L	<10	<10	EPA 200.7
Conductivity	µmhos/cm	280	520	SM 2510-B
Copper, Total	µg/L	<10	<10	EPA 200.7
Ferrous Iron	mg/L	<0.05	<0.05	SM 3500-Fe B
Fluoride	mg/L	0.11	0.25	EPA 300.0
Iron, Total	µg/L	110	1000	EPA 200.7
Lead, Total	µg/L	<2.0	<2.0	EPA 200.9
Magnesium, Total	mg/L	6.1	11.6	EPA 200.7
Manganese, Total	µg/L	28	1300	EPA 200.7
Mercury, Total	ng/L	<1.5	8.5	EPA 1631
Nickel, Total	µg/L	<10	<10	EPA 200.7
Nitrate/Nitrite-N	mg/L	0.18	1.04	EPA 300.0
Nitrate-N	mg/L	0.18	1.04	EPA 300.0
Nitrite-N	mg/L	<0.10	<0.10	EPA 300.0
Oxidation Reduction Potential	mV	330	480	ASTM D1498-00
pH	S.U.	7.2	7.8	SM 4500-H B
Phosphate, Total as P	mg/L	<0.04	0.14	EPA 365.3
Phosphate, Total as PO ₄	mg/L	<0.12	0.43	EPA 365.3
Selenium, Total	µg/L	<3.0	<3.0	EPA 200.9
Silica (SiO ₂)	mg/L	0.8	13.5	EPA 200.7
Silica Dissolved	mg/L	0.68	4.9	EPA 200.7
Sodium, Total	mg/L	14	41	EPA 200.7
Strontium, Total	µg/L	65	270	EPA 200.7
Sulfate	mg/L	37	93	EPA 300.0
Total Dissolved Solids	mg/L	160	290	SM 2540-C
Total Organic Carbon	mg/L	1.2	3.8	SM 5310-B
Total Suspended Solids (normal river conditions)	mg/L	<4	11	SM 2540-D
Total Suspended Solids (abnormal river events)	mg/L	11	32	SM 2540-D
Turbidity (normal river conditions)	NTU	2	8	SM 2130-B
Turbidity (abnormal river events)	NTU	8	41	SM 2130-B
Zinc, Total	µg/L	<10	16	EPA 200.7

Note: Raw water will be treated and filtered to reduce some constituents (such as manganese, iron, and total suspended solids) for use as makeup water to the cooling towers.

4.0 Circulating Water Quality (after 7 cycles of concentration and chemical addition):

Parameter	Units	Max
Alkalinity	mg/l	150-220
Aluminum	mg/l	12
Ammonia as N	mg/l	3
Arsenic	mg/l	0.03
Barium	mg/l	0.50
Cadmium	mg/l	0.01
Calcium	mg/l	300
Chemical Oxygen Demand (COD)	mg/l	180
Chloride	mg/l	450
Chromium	mg/l	80
Copper	mg/l	0.1
Flouride	mg/l	2
Iron, Total	mg/l	10
Lead	mg/l	0.01
Magnesium	mg/l	90
Manganese	mg/l	6
Mercury	ng/l (ppt)	80
Nickel	mg/l	0.10
Nitrate-NO ₃	mg/l	34
Nitrite - NO ₂	mg/l	4
pH	S.U.	7.2-7.8
Phosphate-PO ₄	mg/l	4
Residual Chlorine, Total	mg/l	0.2 - 2
Selenium	mg/l	0.02
Silica (SiO ₂)	mg/l	100
Sodium	mg/l	320
Specific Conductance	μS/cm at 25 °C	3800
Strontium	mg/l	2
Sulfate	mg/l	1000
TDS	mg/l	2100
TOC	mg/l	30
TSS	mg/l	50
Zinc	mg/l	0.12

APPENDIX B – Fuel Gas Specification

DTI Gas Supply Data

	Average	Min	Max
Methane (% mol)	92.5720	84.52	95.82
Ethane (% mol)	6.7240	3.56	14.84
Propane (% mol)	0.2254	0.02	0.90
Carbon Dioxide (% mol)	0.1066	0.04	0.23
Nitrogen (% mol)	0.3309	0.26	0.91
N Butane (% mol)	0.0136	0.00	0.11
Iso Butane (% mol)	0.0096	0.00	0.07
Iso Pentane (% mol)	0.0030	0.00	0.03
n-Pentane (% mol)	0.0018	0.00	0.02
Hexane (% mol)	0.0131	0.00	0.03
Sulfur (grains/100 scf)			0.5
Water (lb/MMSCF)		1.7300	4
BTU (HHV) Btu/SCF		1041.8	1120.5
Specific Gravity		0.57	0.63
Modified Wobbe Index (MWI), where $MWI = \frac{LHV}{\sqrt{\text{Specific Gravity} \times T_{abs}}}, \text{ (BTU/SCF}^\circ\text{R}^{1/2}\text{)}$	42.2 ± 5% at rated fuel temperature of 410 °F		

Permanent Plant Equipment Materials Storage and Maintenance Control													
		Balance of Plant Rotating Equipment <25HP		Balance of Plant Rotating Equipment >25HP		Engine	Skid Equipment - Gen	Skid Equipment - CHEM	Transformers - Oil Filled		Vessel - Purged	Vessel - Coated	GearBox
TEMPLATE NAME	ACTIVITY DESCRIPTION	PUMPTAG	PUMPTAG-MOTOR	PUMPTAG	PUMPTAG-MOTOR	EQUIPTAG	SKID TAG	SKID TAG	TRANSFORMER TAG	TRANSFORMER TAG- CONTROL PANEL	VESSELTAG	VESSELTAG	GEARBOX TAG
CORROSION - ELECTRICAL	Clean and apply electrical contact preservative									Monthly			
CORROSION - INHIBITOR	Ensure shaft, flange and other machined or unpainted surfaces are properly coated with recommended rust inhibitor. Re-apply as required	Monthly		Monthly		Monthly							Monthly
DESICCANT	Replace all desiccant bags as needed, with same quantity of new unused bags.									Receipt Monthly			
FME - ENGINE	Ensure all openings are covered and/or closed: i.e. cooling air inlet, combustion air inlet, exhaust outlet, crankcase breather, cooling circuit, fuel system, lubricating oil system, hydraulic oil circuit					Monthly							
FME - ELECTRICAL	Verify all openings to electrical panel/junction box are plugged and sealed to protect from foreign material									Receipt Monthly			
FME - EQUIPMENT	Ensure all covers, caps, plugs and/or blind flanges are installed and properly sealed. Blind Flanges require 50% of the bolts (4 bolts minimum)	Receipt Monthly		Receipt Monthly		Receipt Monthly		Receipt Monthly			Monthly	Monthly	Monthly
FME - INSPECTION	Remove suction/discharge flange covers and inspect for signs of corrosion of foreign material. Spray internals with rust preventative. Inspect flange face temporary coating and re-apply as necessary. If accessible inspect equipment internals for any signs of corrosion, weld spatter, scale, cuttings, filings of foreign materials and wipe/clean as necessary.	6 Months		6 Months									
GREASE - EQUIPMENT	Open/remove drain and apply one pump of project approved grease.		Monthly										
GREASE - PURGE	Open/remove drain and Purge grease while refilling.		Yearly										
HEATER	Ensure space heater or HVAC is energized.				Receipt Monthly				Receipt Monthly	Receipt Monthly			
INSPECTION - COATING	Inspection condition of paint/coating for deterioration/damage - peeling, chipping, cracking or fading and report any poor condition immediately							Monthly			Monthly	Monthly	
INSPECTION - DAMAGE	Inspect equipment for signs of damage.	Monthly	Monthly	Monthly	Monthly				Receipt Monthly	Receipt Monthly			
MEGGER	Measure insulation resistance of motor stator winding with a megohmmeter and record findings along with ambient temperature.		Monthly		Monthly								
NITROGEN PURGE	Check nitrogen purge reading on pressure gauge.										Monthly	Monthly	
OIL - EQUIPMENT	Record Gauge Pressure and Transformer Temperature												
OIL - SAMPLE	Ensure oil level is at minimum level. Inspect for leaks.	Monthly		Monthly	Monthly				Monthly				Monthly
ROTATE SHAFT	Take Oil Sample	6 Months		6 Months	6 Months								
	Ensure Equipment has lubrication as required												
	Rotate EQUIPMENT shaft several revolutions by hand or with appropriate tool that will not damage shaft. Stop shaft approximately 180 degrees from starting point.	Monthly	Monthly	Monthly	Monthly								Monthly
	Do not use excessive force to rotate shaft. Report any turning resistance or rubbing/grating noise.												
STORAGE CATEGORY - 1	Outdoor storage on firm substrate, well drained, not subject to flooding; maintained to reduce growth of vegetation and to prevent the accumulation of debris; and segregated from actual construction areas and traffic.										Monthly	Monthly	
(Discontinued once Equipment is Set in Final Location)	Items shall be stored on pallets or cribbing to allow for air circulation and to avoid trapping of water.												
STORAGE CATEGORY - 2	Outdoor covered storage on firm substrate, well drained, not subject to flooding; maintained to reduce growth of vegetation and to prevent the accumulation of debris; and segregated from actual construction areas and traffic.	Receipt	Receipt	Receipt	Receipt		Receipt	Receipt	Receipt	Receipt			Monthly
(Discontinued once Equipment is Set in Final Location)	Items shall be stored and covered on pallets or cribbing	Monthly	Monthly	Monthly	Monthly		Monthly	Monthly	Monthly	Monthly			
	Ensure equipment is covered to protect against dirt, dust, moisture, rain, during storage and provide adequate ventilation (6-12 inches min)												
STORAGE CATEGORY - 3	Outdoor covered storage on firm substrate, well drained, not subject to flooding; maintained to reduce growth of vegetation and to prevent the accumulation of debris; and segregated from actual construction areas and traffic.												
(Discontinued once Equipment is Set in Final Location)	Items shall be stored and covered on pallets or cribbing and heat applied to the item to prevent condensation or corrosion												
	Ensure equipment is covered to protect against dirt, dust, moisture, rain, during storage and provide adequate ventilation (6-12 inches min)												
STORAGE CATEGORY - 4	Indoor storage structure that is an access controlled, fire-resistant, tear-resistant, weather-tight, well ventilated building or equivalent enclosure												
(Discontinued once Equipment is Set in Final Location)	Flooring shall be paved or finished flooring, and well drained. Items shall be stored on pallets or equal to permit air circulation.												
STORAGE CATEGORY - 5	Indoor storage structure that is an access controlled, fire-resistant, tear-resistant, weather-tight, well ventilated building or equivalent enclosure												
(Discontinued once Equipment is Set in Final Location)	Flooring shall be paved or finished flooring, and well drained. Items shall be stored on pallets or equal to permit air circulation.												
	Temperature controls shall be in place to prevent condensation or corrosion: Minimum Temperature shall be 33 Deg F, or 3 Deg C; Maximum temperature shall be 140 Deg F, or 60 Deg C												
VENDOR EQUIPMENT SPECIFIC PREVENTATIVE MAINTENANCE ITEMS													
	Vendor Specific Items not listed above to be listed here.												
	Do not input construction activities.												