VENDOR DATA REQUIREMENTS FOR TECHNICAL CONTENT

□ CONTROLLED (NO.)
□ UNCONTROLLED

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CONTENTS

1. GENERAL

This specification covers the minimum requirements for technical content of vendor data requirements.

The Vendor shall furnish all Engineering Data identified by the “Vendor Data Requirements” as required with Quotation. Failure to submit data which is required to be submitted with the proposal shall constitute an "incomplete quotation" and shall be cause for elimination of the Vendor from further consideration in the bid analysis process.

In the event of conflict in the purchase order documents, the Vendor shall immediately notify SKEC and request a resolution. The Vendor is not at liberty to assume which instruction shall govern.

2. SCOPE

Project specification PEMS-00035 “Vendor Documentation Requirements”, stipulates what vendor documentation shall be reviewed by SKEC during design and minimum content requirements for Manufacturers’ Record Books and Operating and Maintenance Manuals. This specification details the minimum requirements for the technical content of vendor documentation.

The quantity, mechanism for and timing of vendor document submission are detailed in the CONTRACT (see 3.1 below).

3. REFERENCES

3.1. REFERENCE PROJECT SPECIFICATIONS

- Basic Engineering Design Data for each project
- Vendor Documentation Requirements for Mechanical Equipment

4. DEFINITIONS

OWNER :

PROJECT :

SKEC : SK Engineering & Construction

VENDOR Company / Organisation supplying equipment or materials

5. VENDOR'S RESPONSIBILITIES

5.1. VENDOR DOCUMENTATION

Vendor shall define the extent of vendor documentation required in each Material Requisition, ensuring that these meet SKEC's minimum requirements as defined in PEMS-00035.

Vendor shall ensure that:

- The minimum content of each category of document shall conform to the requirements of sections 6 and 9 below.
- The format of each document shall conform to those defined in section 7 below.
- The format of Manuals shall be as per section 8 below.
- Each document shall have a unique number that includes SKEC's purchase order reference. If the document numbering system does not make use of SKEC'S document categories as listed in section 9, SKEC'S document category will be shown clearly elsewhere in the drawing title block.
- A coding system shall be developed to classify SKEC'S document comments. This must include categories that permit the work to proceed subject to document comments being incorporated and a category that does not allow work to proceed until a revised document has been resubmitted and reviewed.
- VENDOR shall maintain an up to date document index, which includes all identified drawings complete with planned submission (and re-submission) dates.
- VENDOR shall produce a production schedule that is regularly updated.
- VENDOR shall produce a regular progress report that covers materials, fabrication and documentation. This shall be at least monthly and should be weekly for all major purchase orders. This shall cover as a minimum documentation and production status, complete with forecast delivery dates.

6. DOCUMENT CONTENT REQUIREMENTS

6.1. MINIMUM CONTENT

Each document called for in the SKEC'S Requirements PEMS-00035 is given a document category code, e.g. AA, BA, CA, CB etc. The minimum data requirement for each document is given in the corresponding clause of section 9 below.

6.2. CONSOLIDATION OF DOCUMENTS

The VENDOR may consolidate the requirements of two or more documents identified separately (in the SKEC'S or material requisition requirements) onto one single document. Any such intended combinations shall be identified by VENDOR on the Vendor Drawing Index – In such cases all applicable SKEC document Category Codes shall be referenced.

7. FORMAT

7.1. DOCUMENT IDENTIFICATION

All documents shall show:

- Project Name
- SKEC's Purchase Order number
- VENDOR'S Document Title and revision.
- VENDOR'S own drawing number and revision.
- SKEC document number and revision.
- OWNER'S Document Category Code (and Consolidated Codes), if required
- Equipment tag number(s)

7.2. UNITS

Units shall be S.I., in accordance with Basic Engineering Design Data

7.3. LANGUAGE

All drawings and documents shall be in ENGLISH language only.

7.4. MEDIUM

All documents for review shall be submitted electronically as detailed in the Material Requisition.

Submission of documents shall be on SKEC supplied forms / formats where provided, unless otherwise agreed. Where not provided, vendor standard formats are acceptable.

Drawings and documents shall be prepared in a uniform format. They shall be set up to print out on European paper sizes (i.e. A1,A2, A3, A4 etc… per ISO 216). A0 size drawings are not preferred.

When required to submit hard copies, these shall be full size and on European sized paper (A1,A2 etc…). All drawings submitted to OWNER shall be folded to A4 size.

7.5. OWNER PROVIDED STANDARD FORMATS

When specified in the contract, VENDOR shall produce documentation using OWNER provided document templates. (e.g. equipment lists, P&ID's etc.)

8. MANUALS

Installation, Operation and Maintenance Manual (category code NB) and Manufacturing Record Book (category code LB) shall be submitted in the following formats:

8.1. COVER

The template cover of the manual shall be supplied by OWNER and will show:-

- Project Name
- SKEC Purchase Order number
- Equipment tag number(s)
- Title of manual with description of contents of this volume – if complete manual comprises several volumes
- Volume Number (if manual comprises several volumes i.e. Volume 2 of 4)

8.2. BINDER

Installation, Operation and Maintenance Manuals and Manufacturing Record Books shall be submitted in A4 sized, heavy duty four **"pillar and post"** type binders with a 40mm or larger spine with clear plastic sheeting on the spine and front cover. Section Dividers shall be of non-tearable material with tags.

8.3. CONTENTS

All contents within the manual shall show a sequential page number applicable to the volume or section in the manual. Every page shall show the Purchase Order number either typed, written or stamped. In addition to the documentation that has been selected in Section 3 of the Material Requisition the following general points concerning manual contents shall be followed:

8.4. MANUAL INDEX

Manuals shall contain an index of the volumes (if a manual comprises more than one volume) and detailed contents within the individual volume. For larger sections of the manual such as material certificates, it may be necessary to include a further detailed index.

8.5. DOCUMENTS SUBMITTED FOR SKEC REVIEW

Contents of manuals that have been submitted previously for SKEC review shall show SKEC'S review decal together with the review status. Where SKEC'S representative has reviewed certificates at VENDOR'S works or attended an inspection point in manufacture, the copy of the certificate in the manual shall indicate SKEC'S review status code or inspection stamp.

9. TECHNICAL CONTENT FOR STANDARD CATEGORY CODES

9.1. CATEGORY A - CONTROL DOCUMENTS

AA. CONTRACT SPECIFIC INSPECTION & TEST PLAN

The Contract Specific Inspection & Test Plan shall cover the scope for the entire purchase order including major sub-vendor items. The document shall indicate:

- Sequentially identify and describe, briefly, the activities performed to meet all requirements

- Reference all procedures, specifications and instructions used to control these activities
- Identify all tests and inspections as well as their associated hold, witness and review points, for all parties
- Identify all forms and documents which verify the results of tests and inspections
- Identify all acceptance criteria
- Identify all inspection and test plans from sub-vendors
- This document shall be subject to revisions, as necessary, during the contract period.

9.2. CATEGORY B - ARRANGEMENTS

BA. GENERAL ARRANGEMENTS

General Arrangement Drawings for each piece of material on the purchase order (General Arrangements are required for each piece of material to be installed or connected to SKEC'S pipework / foundations or cables) An overall General Arrangement may also be required to indicate the overall placement of the VENDOR'S material. The General Arrangement shall indicate:

- Envelope dimensions
- Access, withdrawal and lay-down requirements for maintenance
- Termination and interface points (numbered per project agreement) for the VENDOR'S connections to process, utilities, drains etc, shall be dimensioned and include number, size, rating and type, preferably in tabular format.
- Electrical junction boxes requiring connection by SKEC.
- Instruments and skid edge junction boxes requiring connection by SKEC
- Identification of all major on-skid components with SKEC'S tag numbers
- Overall weights and maintenance weights for major components
- Lifting points and Centre of Gravity (CofG) of skid and components and overall CofG with skid and components assembled to be shown
- Acceptance nozzle loads based on relevant design standard or SKEC'S standard criteria provided separately
- Cross-reference with the Detail Drawings (FA) for Document Number, Title and Views.
- Static and dynamic forces acting on the foundation during all operating and test conditions
- For control valves and similar, envelope drawings and/or tables showing flange sizes and ratings, face to face dimensions and maximum envelope sizes shall be provided.
- Earthing terminals, electrical trace heating, and cathodic protection anodes if any

- In the case of packages with several different types of equipment, the above information shall be supplied for each individual item or skid as appropriate

Each item or skid shall be separately identified and an overall GA showing the interconnections between each individual item or package provided. In these situations VENDOR shall group the required drawings as a set.

The following data shall be furnished for all types of equipment:

- General arrangement and overall dimensions of equipment
- Foundation bolt locations/orientations on plan
- Foundation bolt diameter(s)
- Base plate thickness
- Special Vendor anchor bolt requirements, e.g. shape, material, pretensioning, etc.
- Minimum grout thickness (if more than 1” or 25 mm)
- Special Vendor grout requirements, e.g. epoxy, precision non-shrinking, fully filled base plate etc.
- Limiting dimensions for plinths and other structural elements where critical for clearances around piping, nozzles and the like
- Special maintenance requirements

Refer to the following tabulations for further specific information required for different types of equipment.

Specific Data requirements by Equipment Type

Information to be specified	Vertical Vessels	Horizontal Vessels	Shell and Tube Exchangers and Reboilers	Air-Cooler Excahngers (per support leg)	Free-Standing Stacks/Chimneys	Guyed Stacks	Furnaces/Fired Heaters (per support leg)	Miscellaneous Equipment
Erected empty weight	x	x	x	x	x	x	x	x
Operating weight	x	x	x	x	x	x	x	x
Test weight	x	x	x	x				x
Wind/earthquake shear force and moment at base	x				x	x		x
Wind/earthquake shear forces at saddle base		x						
Centre of gravity (operating)		x	x					
Fixed saddle location		x	x					
Tube bundle weight			x					
Tube Bundle Length			x					
Operating Temperature	x	x	x	x	x		x	x
Insulation between equipment & support		x	x					x
Longitudinal wind/earthquake shear forces and vertical couples				x			x	
Transverse wind/earthquake shear forces and vertical couples				x			x	
Details of VENDOR provided access platforms and ladders	x			x		x	x	x
Layout of access platforms and ladders (supplied by SKEC or Vendor)	x			x				x
Inlet loads					x	x	x	
Pretension loads on stack and deadmen						x		
Thermal loads on stack and deadmen (+/-)						x		
Wind/earthquake loads on stack and deadmen						x		
Inlet loads on stack and deadmen						x		
Guy rope orientations and deadmen locations						x		
Details of VENDOR-provided deadmen anchorages						x		
Details of any ancillary equipment requiring structural support						x	x	
Basin and pump chamber layout								
Maintenance requirements			x	x		x	x	x

Rotating Equipment					
Reciprocating Compressors & Pumps					
Centrifugal Compressors and Turbo generators					
Vertical Can Pumps Weighing over 2250 kg					
Horizontal Pumps Weighing over 2250 kg					
Pumps and Compressors Weighing 2250 kg or less					
Information to be specified					
Total operating weight (including machine, driver, ancillaries, base plate)	x	x	x	x	x
Machine weight	x	x	x	x	x
Driver weight	x	x	x	x	x
Coupling/gear unit weight		x		x	x
Ancillaries weights		x		x	x
Baseplate weight		x		x	x
Centre of gravity of whole unit (dry and wet) in x, y, z directions		x	x	x	x
Centre of gravity of machine in x, y, z directions				x	x
Centre of gravity of driver in x, y, z directions				x	x
Centre of gravity of gear unit in x, y, z directions				x	x
Centre of gravity of ancillaries in x, y, z directions		x		x	x
Centre of gravity of base frame in x, y, z directions		x		x	x
Centre of gravity pump head + stool			x		x
Centre of gravity pump can & liquid			x		
Machine rotor weight and centre of gravity	x	x	x	x	x
Driver rotor weight and centre of gravity	x	x	x	x	x
High/low speed gear unit rotor weights and centre of gravity		x		x	x
Centre of gravity of machine rotor in x, y, z directions		x	x	x	x
Centre of gravity of driver rotor in x, y, z directions		x	x	x	x
Centre of gravity of gear unit in x, y, z directions		x		x	x
Flywheel weight and centre of gravity					x
Wind/earthquake loads on intake and exhaust support structures (shear forces and couples/moments)				x	
Machine speed (rpm) or range of speeds	x	x	x	x	x
Driver speed (rpm) or range of speeds		x	x	x	x
Maximum lift weight and clearances for maintenance	x	x	x	x	x
Pump can + liquid weight			x		
Pump head + stool weight			x		
Magnitude, location and direction of specific static loads such as thermal, normal torque, short circuit torque and other machine operating loads				x	
Magnitude, location and direction of all dynamic unbalanced forces (transverse and vertical)				x	
Limits of differential deflection between two points on the frame, or allowable differential deflection of the bearings				x	
Special alignment tolerances for supporting foundations / structures	x	x	x	x	x
Specific limits of dynamic amplitudes that could damage the machine at normal operating speed, or could shut down operation of the machine				x	x
Specific recommendations from the VENDOR regarding design and construction of machine foundation, if any				x	x
Sole plate requirements (if SKEC supply)		x		x	x
Levelling screw plate requirements (if contractor vendor)		x		x	x
Primary unbalanced forces and couples and their respective locations and directions					x
Secondary unbalanced forces and couples and their respective locations and directions					x
Piping pulsation study and piping hold-down locations					x

BB. INTERFACE AND CONNECTION SCHEDULE

Interface and Connection Schedule may be shown on the General Arrangement (BA). The schedule shall indicate:

- List by unique number (a numbering system to be agreed by the project) of all VENDOR'S termination points, including piping, electrical, instrument cable terminations and all junction boxes
- Size, rating and specification of all connections (including design temperature and pressure)
- Identification of corresponding connection point on another system
- Identification of supply at each connection point e.g. pressure, temperature, flow rate, voltage signal type etc.
- This document shall always be submitted together with, and cross referenced to, General Arrangement Drawings.
- Entry size and type of all electrical and instrument cable glands

BC. UTILITY REQUIREMENTS

Utility Requirements may be shown on the General Arrangement (BA). This document shall list utility consumptions required to start, operate (under all reasonable conditions/ operating scenarios) and maintain all the equipment in VENDOR'S Scope of supply. The list shall indicate:

- Type of Utility
- Quantities
- Duty
- Pressures
- Temperature
- Flow
- Electrical power requirements shall consist of a detailed breakdown identifying voltage, rating, category (normal, emergency), duty (running, standby or intermittent) etc…

Utilities include Electrical supply requirements, Cooling water, chilled water, potable water, instrument air, plant air, Nitrogen, etc as defined in the Project Specification Basic Engineering Design Data.

BD. FOUNDATION REQUIREMENTS

Separate foundation layout drawings shall be submitted, but may be combined with BA if the equipment is simple and foundations can be clearly shown on the general arrangement drawings. The Drawing shall indicate:

- Overall weights and maintenance weights for major components

- Foundation bolt details, (qty, size, projection, type and location)
- Static and dynamic forces acting on the foundation during all operating and test conditions

BE. ERECTION DRAWINGS

Where components are to be assembled at site, Erection Drawings shall be provided. Erection Drawings shall show construction mark numbers, and references for each piece, such that a competent third party can clearly erect and/or assemble the components/ equipment.

BF. EMISSIONS SCHEDULE

Emissions details may be shown on the General Arrangement (BA). This document shall list details of all normal, intermittent and fugitive emissions.

9.3. CATEGORY C - SCHEMATICS

CA. PFD's AND HEAT AND MASS BALANCE

PFD's shall be provided for all process and utility systems and shall indicate major control functions. The document shall indicate each stream clearly labelled with a tag number, and the duty performed by all items of equipment.

Accompanying the PFD shall be a Heat and Mass Balance Sheet relating to the stream tag numbers on the PFD.

VENDOR'S shall use project Symbology and Format.

CB. P&ID

P&IDs shall be drawn by the VENDOR for all process and utility systems.

Depending on scope, P&IDs shall indicate:

- Equipment names and tag numbers
- Equipment driver type and rating
- Major items of equipment shall have duties and design conditions stated
- Unique interface numbers (refer to BB)
- Insulation and trace heating requirements
- Venting and draining requirements
- Relief valve location, tag numbers, sizes and set pressure
- PSV interlock valves and interlocking sequence and set pressure
- Positive isolation requirements
- Block and check valves, with type identified

- Valves and actuators and solenoids. Failure mode to be stated
- Nozzles of vessels, sizes, man ways, and other inspection provisions
- Slope of vessels
- Levels in vessels, NLL, LSL, LSH, LSLL, LSHH, etc.
- Elevations of major equipment
- Process and utility flow lines with directional arrows
- In/Out Continuation boxes with references to other vendor/contractor P&ID drawing numbers as applicable
- Line sizes, numbers, pipe specifications, specification breaks and product designation
- Piping special items
- Piping notes
- Fieldbus segment details
- Switches and instruments with tag numbers, and alarm / trip set points
- Instrument Signals and interactions with DCS/ESD or other control system. (e.g. VENDOR local plc)
- Emergency Shut Down valves
- Interfaces with other P&IDs including SKEC's P&IDs
- All interface equipment, instruments, valves, etc., shall be tagged in accordance with the PROJECT instrument numbering rules.

VENDOR shall use project Symbology, Format and CAD drafting procedure required.

CC. CAUSE AND EFFECT CHART

Shall be in a matrix format showing the principal actions in the event of process excursion, it shall be in accordance with the PROJECT standard format (HOLD). This includes the automatic measures that will be taken in the plant to make the excursion safe, and if necessary the shut down of the plant, including all alarm and trip actions. The matrix is arranged with the Cause (the excursion or alarm) along the Y-axis and the effect (and resultant control actions) of this excursion along the x-axis. It shall show the SIL required for any safety functions.

CD. OPERATION /CONTROL PHILOSOPHY AND BLOCK LOGIC DIAGRAM

Shall be in the form of a block logic diagram and written description relating to the system tag numbers and shall consider the following:

- Modes of operation
- Basis for selection of the mode of operation

- Operator dependant actions
- Health and Safety responsibilities
- Start-up, shut-down abnormal operating condition and special maintenance operations
- Input, output, permissive signals, including internal logic signals to accomplish start-up, shutdown, etc.
- Information displayed and operator interface
- Listing of pre-alarm and shut-down alarm trip requirements and the failure mode of all valves and equipment must be clearly indicated
- It shall clearly indicate switch room equipment, control room equipment and types of signal to and from, with interface information clearly stated

9.4. CATEGORY D - DATA SHEETS

DA. EQUIPMENT DATA SHEETS / DESIGN SPECIFICATION

All equipment data sheets shall conform to relevant codes / standards.

Where Equipment Data Sheets are issued by SKEC as part of purchase order, the VENDOR shall fully complete. Where no SKEC data sheet or specification is provided, data sheet / specification shall indicate as a minimum:

- Basis of design
- Operating parameters with allowable deviations
- Process guarantees
- Basis of process and utility mass balances
- Identification of all environmental interfaces
- Mechanical details including but not limited to Critical Speeds, Materials of Construction, Bearing, Seal and Coupling details etc.

This category shall also include Generator Datasheets

DB. MOTOR DATA SHEET

All motors shall have dedicated data sheets, Vendor shall fully complete Motor Data Sheets as issued by SKEC as part of purchase order.

DC. INSTRUMENT DATA SHEETS

Each and every instrument shall have a dedicated data sheet completed in accordance with the project specification.

DD. NOISE DATA SHEET

Noise Data Sheets are issued by the SKEC as part of purchase order, the VENDOR shall fully complete.

DE. COMPONENT / AUXILIARY DATA SHEET(S)

Where Component/ Auxiliary data sheets are issued (e.g. gearbox, coupling data sheets) by the SKEC as part of a purchase order, the VENDOR shall fully complete. Where no SKEC data sheet or specification is provided, data sheet / specification shall indicate as a minimum:

- Basis of Design
- Operating parameters with allowable deviations
- Mechanical details including but not limited to Critical Speeds, Materials of Construction, Bearing, Seal and Coupling details etc.

DF. MATERIAL SAFETY DATA SHEET(S) (MSDS)

For items that are Explosive, Toxic, Oxidising, Flammable, Corrosive, Irritant, Harmful or Dangerous to the Environment, vendor shall submit comprehensive MSDS for project information in line with internationally accepted standards e.g. OSHA Hazard Communication Standard, ISO 11014-1, ANSI Z400.1.

9.5. CATEGORY E - CALCULATIONS

EA. DESIGN/CODE CALCULATION

Stress calculations shall be in accordance with relevant code requirements and demonstrate that design (including nozzles) is adequate for operation within the design parameters specified for the item, in terms of pressure, temperature, nozzle loadings etc.

Also to include calculations for lifting lugs, brackets, support brackets, support skirts, support legs and saddles, platform, pipe clip loadings, and foundation/anchor bolts.

All calculations should show formulae used and assumptions.

EB. PROCESS/UTILITY CALCULATION

Process Criteria

Calculations demonstrating the selection and/or sizing of equipment and the associated utilities

Heat Emission Calculations

Calculation to determine heat emitted to atmosphere including radiation and convection for various loadings, versus the extremes of environmental temperatures specified by EPC CONTRACTOR. Discharge temperatures of exhaust gases from both equipment and exhaust stack/pipe to be substantiated.

System Head Loss Calculations

Calculations to indicate equipment-sizing basis including pipe friction losses, equipment elevations, and terminal point static pressures. Calculations shall also include acceleration head loss for reciprocating pumps.

Lube and Seal Oil System Sizing Calculations

Calculations to substantiate the oil system design in accordance with project requirements shall include:

- Oil flow
- Reservoir and overhead tank sizing including retention capacities
- Component sizing for coolers, pumps, filters, control valves, motors, etc.
- Line sizing

To be accompanied by a sketch of the system (or P&ID), and/or adequate details included on GA.

Exchanger Thermal Rating Calculations

Calculations to show basis of thermal sizing of heat exchangers, including checks for flow induced vibrations.

Fired Heaters

Calculations for fired heaters shall generally include:

- Tube Wall Thickness
- Maximum Film Temperature
- Draft through the system.
- Combustion
- Refractory Heat Transfer

Flares

Calculations for flares shall include:

- Isopleth (if VENDOR is responsible for Radiation Limits and overall Height of Flare.)

Acoustic Enclosure Ventilation System / Building HVAC Calculations

Calculation of air flow requirements and power requirements to substantiate system design and sizing criteria, taking into account:

- Air mass flows
- Inlet and exhaust pressure drops
- Temperature rise, heat loads and temperature gradients
- Filtration requirements
- Back pressure at worst wind conditions

- Motor sizing and rating
- Sketch of system to be provided. Full details of all assumptions shall be stated.

Safety Related Calculations

Calculations shall include:

- Detailed capacity calculations for each overpressurizing cause of each pressure relief valves / Rupture discs.
- Gas dispersion calculations for design of vent stacks.

EC. STRUCTURAL FOUNDATION AND SUPPORT CALCULATIONS

Lifting Aid Calculations

Shall determine that any lifting aid is suitable for all phases of lifting, transportation, installation and operation without over stressing any component.

Foundation Support Calculations

Calculations of foundation support loads and base plate deflections under normal, fault, transportation and installation conditions taking into account static and dynamic loads as defined in the VENDOR'S specifications. Calculations shall include:

- Effect of base plate deflection on shaft alignment
- Anchor/foundation bolt calculations
- Tolerances required on leveling

Support Structures

Calculations to substantiate the design, and defining forces and moments acting on the support structure including:

- Thermal expansion
- Support location temperature gradients and heat transmitted to the structure
- Static and dynamic loads including wind loads and snow and ice loads
- Temperature and mass flow profiles

Building Structures.

As a minimum these shall include calculations for the following structural elements:

- Main building supporting columns
- Main building roof beams
- Crane girders
- Main building foundations (including piling if applicable)

- Structural walls
- Main bracing in walls and roof

ED. ROTATING ELEMENT CALCULATION

Bearing Life Calculations

Calculations for Rolling Element bearings shall determine anticipated L10 life with bearing identification in accordance with ANSI B3.15 or B3.16 for radial, axial or combined loading, considering methods of lubrication, dimensions, and load variation determined from performance envelope.

Thrust Bearing Sizing Calculations

Calculations and curves taking into account static and dynamic forces over full range of operating conditions including:

- Aerodynamic or hydrodynamic thrust load and balance drum compensating load to be shown
- Variation in balance drum compensating load with increased leakage rate to be shown

A comparison with the manufacturer's design data shall be included.

Lateral Critical Speed Calculations

Calculations shall determine the natural frequency of the shaft assembly and identify forcing frequencies and harmonic components thereof, relative to operating speed range. Results shall be presented in graphical and narrative form, and shall include:

- Rotor drawings showing each shaft segment clearly numbered
- Table of masses and stiffness values for each segment
- Plot of critical speed against support stiffness with stiffness both in vertical plane and horizontal plane to be shown for each support point
- Plot of speed against vibration amplitudes (Campbell Diagrams) to demonstrate the specifications of operating modes from harmonic regions

Torsional Critical Speed Calculations

Calculation shall determine the Torsional critical speeds for driver /transmission /driven equipment trains. Calculation shall clearly indicate number and details of finite elements that the system has been divided into for the calculation and a table of stiffness and inertia's for each element shall be included. Results shall be presented in graphical and narrative form, and shall include:

- Rotor drawings showing each shaft segment clearly numbered
- Table of masses and stiffness values for each segment
- Plot of critical speed against support stiffness with stiffness both in vertical plane and horizontal plane to be shown for each support point

- Plot of speed against vibration amplitudes (Campbell Diagrams) to demonstrate the specifications of operating modes from harmonic regions

Coupling Selection Calculations

To show speed range, torque, power, lock up axial stiffness, Torsional stiffness, service factors, etc., to substantiate coupling selection.

Rotor/Shaft System Imbalance Response Analysis

Demonstration of the sensitivity of the rotor/shaft design to imbalance at various locations by plotting amplitude against shaft speed for both vertical and horizontal vibration

Plot of shaft vibration mode, shape, showing displacement against axial length and bearing locations with the rotor excited at its critical speeds

Reciprocating Elements

- Primary and secondary unbalance forces and moments with information on component weights and counter balance weights as appropriate
- Flywheel sizing calculations with information on moments of inertia of all components and the expected torque curves for all conditions of unloading and operation
- Expected resulting speed and current variations
- Rod load calculations in accordance with API 618 for all stages and specified conditions of operation and all available load steps

EE. INSTRUMENT SIZING CALCULATION

Calculations to be presented for the following items:

- Hydraulic line sizing
- Flow measuring devices & Restriction orifices (sizing)
- Control valves and regulators (sizing and noise)
- Bursting discs (Sizing, case and basis)
- Safety relief valves (Sizing, case and basis,) including assumed/ actual inlet/outlet losses, expected noise levels and any special requirements
- Thermowells (natural and vortex shedding frequency)
- Ball valve operating torque and actuator torque

For Control Valves, this shall include:

- CV figures for minimum, normal and maximum flow conditions
- % Open figures for above
- Pressure drop for above

- Noise calculations
- Actuator sizing
- Inlet/outlet body velocities
- Stroking time

ESD Valve Calculations

Flow capacity calculations; break out, running and resetting torque figures for valve versus actuator torque figures at minimum supply pressure.

Relief Valve and Burst Disc Calculations

Orifice size calculation to API 520 for all relief valves including maximum relief temperature.

Anti Surge Valve Sizing

System calculations to substantiate valve sizing selection, required response time and noise data.

Pulsation Damper Sizing Calculations

Sizing calculations and holding down locations.

EF. PIPING STRESS ANALYSIS

Piping Stress Analysis documents shall include:

- Piping stress isometric drawing showing the extent of calculations
- Critical Piping List
- Calculations of piping stress of line defined as critical.
- Wall thickness calculations
- Piping stress calculations
- Special piping requirements (e.g. bellows, stops etc)

EG. MECHANICAL EQUIPMENT PERFORMANCE CURVE

Curves to indicate performance of mechanical equipment – in all cases guarantee points shall be clearly identified.

Prime Mover Curves

Curves to indicate power developed at output shaft, steam, fuel and air mass flow over the operating range and ambient temperatures, with specified inlet and exhaust pressure loss and varying speeds. Correction curves for variations in inlet and exhaust pressure drops shall be provided.

Speed/Torque Starting Curves

Curves shall indicate torque versus speed characteristics of both driver and driven equipment on the same graph from zero to rated speed and a statement as to the process condition prevailing at the driven equipment for the curve shown. This shall be carried out for 80% and 100% rated volts.

Combustion Gas Turbine Performance Curves

Curves for turbines for specified site conditions of atmospheric temperature and pressure plus, where appropriate, inlet and exhaust pressure loss. Curve shall indicate firing temperature exhaust temperature, combustion air flow, exhaust gas mass flow, constant heat rate lines and efficiency against power developed for output shaft speeds between 70 and 105% rates speed. Correction curves shall be provided for variations of inlet and exhaust pressure drops.

Centrifugal Pump Performance Curves

As designed performance curves to indicate differential head, efficiency, NPSHR and absorbed power (basis product SG), versus flow, at rated impeller, maximum and minimum. Units driven by variable speed drivers shall show these performance curves to indicate performance from minimum to maximum operating speeds. Curves shall indicate performance from zero to at least 120% BEP flow, with minimum mechanical continuous flow clearly indicated. For fire pumps a shop test curve identified by pump serial number is required showing head to rated and 150% capacities. All curves shall be plotted back to zero flow. These curves will be superseded by test curves.

Rotary Pump Curves

Curves shall indicate discharge pressure, NPSHR and absorbed power, versus inlet flow including velocity corrections.

Centrifugal Compressor Performance Curves

Curves to indicate the discharge pressure, coupling shaft power, polytropic head and efficiency versus inlet capacity for specified inlet pressure temperature and molecular weight for each section (casing) and overall unit. Curves shall indicate performance from surge through to 115% rated capacity. Units driven by variable speed drivers shall be provided with curves for the full range of speed operation. Curves of Mu versus Q/N and quadrant curves will also be provided.

Fan Performance Curves

Curves shall indicate pressure rise, efficiency and power absorbed, versus inlet flow for specified inlet pressure, temperature and molecular weight. Curves shall also indicate performance from surge to 115% rated capacity. Fans with variable pitch screws shall indicate performance for five settings between maximum and minimum.

Reciprocating Pump Performance Curves

Differential, pressure, shaft input power efficiency and NPSHR over the range for variable stroke pumps of operation with stroke length.

Reciprocating Compressor Performance

Expected capacity and horsepower showing the effects due to each stage of unloading.

EH. ELECTRICAL CURVES

Where applicable the following shall be provided:

Electrical Protection Curves

Operating characteristic curves and setting ranges of protective devices, discrimination curves and calculations to illustrate to the correct selection and discrimination of fuses, relays, MCB, etc

Current Transformer Curves

Performance / design curves.

Motor Performance Curves

Current against Speed for both 80% and 100% voltage conditions. For motors 2500 HP and larger chart recordings of the actual starting currents and voltages are required

- Heating curves
- Locked rotor withstand curve for both 80% and 100% voltage conditions and also for hot and cold winding conditions

Lighting Performance Data

Polar Diagrams:

- General performance data for each specific luminaire types.

EI. RELIABILITY AND AVAILABILITY ANALYSIS

VENDOR to present data to demonstrate starting and operating reliability/availability of purchase equipment (for example, mean time between failure data, recommended testing or scheduled maintenance frequencies).

EJ. PULSATION STUDIES

Calculations shall be provided to demonstrate compliance with the nominated design approach in compliance with API 618 & API 674. Results of acoustical simulation studies shall be provided where specified.

EK. HEAT DISSIPATION / CONSUMPTION

Where a high intensity of instrumentation and/or high current carrying conductors, such as DCS I/O cabinets, operator consoles, F & G I/O cabinets, switchgear, bus bars etc., a listing per equipment type of heat output values shall be provided. A total heat output value, per cabinet and per system, shall be provided.

Similarly all heat consumptions values shall be provided per cabinet and per system.

EL. HAZOP STUDY

Hazop study is a report documenting a systematic review of potential hazard and operability problems associated with the VENDOR'S design. Guidelines can be found in "A Guide to Hazard and Operability Studies" - published by the Chemical Industries Association. The review shall consider the P&IDs (CB), equipment layouts (BA / FA), Operating Philosophies (CD), Cause & Effect chart or Safety/Shutdown logics (CC / GF) and Installation Operation and Maintenance Manuals (NB). The review shall be led by

an independent facilitator with a team of the VENDOR'S engineers and may require participations of sub-vendors. The review shall use a set of guidewords to ensure structured review of each of the nodes within the VENDOR'S system. The report shall document the review's findings confirming adequacy of existing safeguards or recommendations for improvements and how VENDOR intends to address them.

EM. SIL ANALYSIS

Details of all Safety Integrity Level analysis if safety functions shall be included.

9.6. CATEGORY F - DETAIL MECHANICAL DRAWINGS

FA. EQUIPMENT DETAIL DRAWINGS

This should preferably be shown on the General Arrangement drawing (BA). Detail drawings are to indicate the method of construction and all features, which are omitted from the GA drawing for clarity. The detail drawings shall cross reference GA drawings Title, Document Number and View.

FB. ANCILLARY PIPING DRAWING

Ancillary piping drawings should only be produced when their inclusion in BA/FA would give unacceptable levels of clarity. The ancillary piping drawings shall cross reference the GA drawing with reference to View, Title and Document Number.

Ducting arrangements can also be included under this category.

FC. CROSS SECTION

Cross section drawings of major items of equipment shall be produced to allow:

- Parts to be identified for material identification in conjunction with FD
- Parts to be identified for spares identification in conjunction with NA

FD. PARTS LIST/BILL OF MATERIAL

To be used in conjunction with documents BA, FA, FB, FC, FE, MA and NA. It shall identify:

- All materials of construction
- Manufacturer's/VENDOR'S part numbers
- Quantity per item and total quantity supplied against the Purchase Order
- Reference to Drawing No. Title and View where part can be located.

FE. SEAL / ROD PACKING DETAIL

Information to be shown on document as a minimum

- Dimensions including clearances
- Parts list, defining materials (see FC &FD)

- Identification of fluid connection points
- Fluid flow rates and stuffing box pressures
- Seal system description (if required)
- Description of operation (if required)

FF. INSULATION/LINING DETAIL

This should preferably be shown on other drawings BA, FA, FB, FC or FE. Drawings to indicate the thickness specification and limit of application. Details shall include anchoring and expansion joint details.

FG. EQUIPMENT LIST

A list (preferably electronic format) of all tagged items within a VENDOR'S scope of supply. This shall include all items tagged by the contractor and in addition include all valves and special piping items e.g. PSV, strainers, special tees or bends, injection points etc. The list as a minimum shall include:

- Tag number
- Description of Service
- Manufacturer and model number.
- Where SKEC provides a format this shall be completed fully.

FH. LINE DESIGNATION TABLE

A list (preferably electronic format) of all piping within a VENDOR'S scope of supply. The list as a minimum shall include:

- Line Number
- Description of Service
- Line Route (to/from location)
- P&ID no,
- Normal Operating and Design Conditions (pressure, temperature)
- Test Pressure and method (hydrostatic / pneumatic)
- Insulation type / Thickness
- Paint code
- Special requirements e.g. chemical cleaning

Where SKEC provides a format, this shall be completed fully. Line numbering shall follow project numbering philosophy.

9.7. CATEGORY G - DETAIL INSTRUMENT DRAWINGS

GA. INSTRUMENT LOCATION DRAWING

Instrument Location Drawings should only be produced when inclusion of all required information in BA/FA would give unacceptable levels of clarity. These drawings will show location and elevation of all instruments, control valves, control panels, etc. and SKEC free issue equipment where applicable. In addition, the drawing will show the routing of all instrument air distribution, pneumatic tubing, signal/power supply cables, and the location of all instrument junction boxes. Location drawings will also be required to show fire detection instrumentation.

GB. INSTRUMENT SCHEDULE

The following is the minimum information required:

- Tag number (in alpha-numeric sequence)
- Instrument description (pressure switch, control valve, level gauge, etc.)
- Manufacturer's name
- Model Number
- Service description (e.g., vessel low level, etc.)
- Location or line (size/number/spec)
- P&ID number (VENDOR'S and OWNER'S)
- Data sheet number
- Hook-up drawing reference
- Wiring diagram number
- Schematic drawing number
- Signal type
- Set point and range (Alarms & Trips)
- Gland sizes
- System that the instrument is connected to
- Junction Box no.

Instrument schedule shall be submitted finally in electronic format per project requirements.

GC. PANEL WIRING SCHEMATIC DIAGRAM

These drawings will show the panel wiring details in ladder or other simplified format. Drawing shall show wiring for all the instrumentation, including relay numbers, terminal numbers, etc.

GD. PANEL / JB TERMINATION DETAILS

Diagrams shall show each of the terminal blocks, which are to be individually numbered, with each terminal numbered and the cores of connecting cables clearly identified. The core identifiers shall be those as ferruled on to the conductors and shall follow the Sellers numbering system.

Drawings shall show segregation between IS and Non-IS signals together with cable and/or core screen terminations. Inputs and outputs shall be identified using their tag numbers. For ease of identification cable destinations shall be shown with any cross-reference drawing numbers.

The diagrams shall also show all earthing requirements along with suggested conductors sizes.

GE. PANEL / CABINET LAYOUT

Drawings required as follows:

- Front of panel layout clearly showing overall size and layout, with a table of instruments showing duty/label engraving/model number
- Back of panel arrangement clearly showing same data as front of panel
- Construction drawing showing main dimensions hinging/opening of doors, door restraints, method of locking, plinths, stiffeners, hold down details (fully dimensioned) anti-vibration methods, materials, panel finish procedure and colours. Also full details of front, rear and side minimum clearances.
- Mimic/annunciator drawing where applicable
- Internal layout of panel showing: lighting, cable entries and terminal strip locations, wiring trays, segregation of voltage level, IS and non-IS equipment, hydraulic, pneumatic layouts (where applicable), Earthing points, Power isolation

GF. LOGIC DIAGRAMS

These will have full details of interlocks and permissives with all status / maintenance overrides and automatic/manual trip requirements being shown for a full understanding of system operation. Logic diagrams shall be supplied to project requirement using project symbology and logic sense.

GG. HOOK UP DIAGRAM

Process and pneumatic hook-up drawings shall be prepared for each tagged instrument that required a process impulse line for sensing purpose. Similarly, a pneumatic hook-up drawing shall be prepared for each tagged instrument air transmission/control signal. Both types of drawings shall include all the necessary mounting details and a schedule of all installation materials used.

GH. LOOP DIAGRAMS / SEGMENT DIAGRAMS

For each loop, the diagrams shall show all details of wiring, termination and inter-connections from primary element to final, including numbering of JB's, cables, cable cores, terminal colour coding of wires and locations and ferruling details, etc. Each loop / segment shall be shown on a separate sheet.

GI. CABLE BLOCK DIAGRAM

The diagram shall show schematically (in single line form) the cables between package and remote systems. The diagram shall clearly identify junction box, cable and marshalling/control panel numbers.

GJ. INSTRUMENT OUTLINE DRAWING

A drawing shall be provided for each tagged instrument, which will contain the following information where appropriate:

- Manufacturer
- Tag number
- Overall height width and depth
- Weight
- Process connection size(s) and ratings
- Inlet and outlet configuration
- Face-to-face dimensions
- Electrical connection size(s)
- Instrument mounting details
- Instrument accessories (positioner, hand wheel, air set, etc.)

GK. SERIAL / ETHERNET / FIELDBUS LINK

Provide details of interface type, device address, all jumper settings, cable and connector types with port pin definitions, protocol, baud rate, simplex, duplex, half duplex and parity bit and data bit. All alarms, analogue variables, diagnostic and status registers, permitted remote commands and timer accumulators shall be stored in contiguous registers and be available for transmission to the DCS. For this data the following details shall be supplied as a minimum for each signal.

- Tag Number
- Engineering units for analogue signals
- Engineering high scale for analogue signals
- Engineering low scale for analogue signals
- For binary signals, 0 and 1 descriptors and operator alarm requirements.
- PLC registers

For clarity examples shall be given, detailing how register and analogue values are represented.

GL. GRAPHICS

1) Graphic layouts with all the details of dynamic data, etc., shall be provided based on typical layouts supplied by the DCS VENDOR.

- Control systems
- Consumer ratings
- Switchgear/control gear ratings
- Busbar ratings
- Equipment descriptions and tag numbers
- Protection devices

2) Configuration details for each loop.

9.8. CATEGORY H - DETAIL ELECTRICAL DRAWINGS

HA. ELECTRICAL SINGLE LINE DIAGRAM

Representation of electrical power, and/or control circuits, electrical major components and their function or instrument control circuits, defining the relationships, to include (as appropriate):

- Control systems
- Consumer ratings
- Switchgear/control gear ratings
- Busbar ratings
- Equipment descriptions and tag numbers
- Protection devices

HB. ELECTRICAL LAYOUT DRAWING

Electrical Layout Drawings should only be produced when their inclusion in BA/FA would give unacceptable levels of clarity. Drawings shall show all cable routes (via tray or conduit), transits and electrical equipment orientation (with tag numbers).

HC. SCHEDULE OF ELECTRICAL EQUIPMENT

Schedule shall include control station schedules. Equipment to be listed by tag number and include the following data:

- Description
- Phase/Number of phases, category (Normal, Emergency, Uninterruptible)
- Voltage and frequency
- Rating (in kW)

- Load currents (Rated, Normal, Peak)
- Duty (Running, Standby or Intermittent)

HD. CABLE SCHEDULE

All electrical, instrument and telecom cables shall be listed, both internal to the VENDOR'S package and identification of the SKEC installed cables between components of the VENDOR'S package, listing:

- Number of cores
- Cable size and type
- Cable number
- Gland size and type
- To and from location
- Inter-connection diagram cross reference
- Cable length, in metres (inter-connecting cables only)
- Voltage grade

Cable numbering shall be to project standards unless otherwise agreed with the EPC CONTRACTOR.

HE. INTERCONNECTION DIAGRAM

Diagrams shall display, in block form, the items of electrical equipment and the cables connecting them. The terminal block reference for each item shall be stated, along with the number of size of the conductors in the cables.

HF. TERMINAL BLOCK DIAGRAMS

Diagrams shall show each terminal block with the terminals numbered individually and the cores of the connecting cables identified. The core identifiers given shall be those ferruled onto the conductors and shall follow any numbering system advised by SKEC. Terminal block diagrams may be incorporated with interconnection diagrams - if the complexity of the system permits.

Drawings must show AC/DC segregation, IS and non-IS segregation (where applicable) and cable screen terminations, together with duty description/tag against input and output. For ease of identification, destination 'to and from' is to be shown, with cross-referenced drawing numbers and earthing requirements clearly shown.

Electrical cable termination details shall show gland plate size and location, together with its distance from associated terminals. Motor terminal boxes shall be shown, particularly HV motors, which shall be full dimensioned and sectioned so that HV cable termination can be designed by others.

HG. DISTRIBUTION BOARD SCHEDULE

Schedule shall list the lighting and small power loads connected to a distribution board. Description shall include fuse sizes, terminal sizes and switching arrangements, cable size and number.

9.9. CATEGORY J - MANUFACTURING PROCEDURES

JA. WELD PROCEDURES (WPS AND PQR)

Provide all shop, field and repair welding procedures (WPS & PQR) together with cross-referenced Weld Maps in accordance with SKEC'S requirements. PQR records describe parameters used in qualification of weld procedure specifications (WPS) together with mechanical testing and results in accordance with SKEC'S requirements. PQR test records are to be cross-referenced to the WPSs and when applicable stamped by the third party inspection authority. Fabrication shall not commence before the appropriate weld procedure has been reviewed and accepted by SKEC.

JB. NDE PROCEDURES

Define all proposed NDE procedures (Radiography, ultrasonic, dye penetrant, magnetic particle, PMI or similar) to be utilised in accordance with the SKEC'S requirements. Cross-reference with Weld Map to determine procedures to be used.

JC. HEAT TREATMENT PROCEDURES (INC PWHT)

Detailed procedures for compliance with SKEC'S specification including:

- Drawing number, diameters, thickness, materials
- Heat soak and cooling parameters, temperature ranges, type of heat source, e.g. furnaces or electric resistance heaters, temperature control procedures
- Number & spacing of thermocouples, type of thermocouple & cable, method of attachment & removal
- Protection of machined surfaces
- Indication of NDE (PT) upon removal of thermocouples
- Equipment calibration

JD. SURFACE PREPARATION, PAINTING AND COATING SCHEDULE

The schedule shall include the following information for each equipment item and panel/cabinet:

- Surface cleaning
- Preparation
- Shop or field painting
- Paint/Coating composition
- Linings (where applicable)
- Anti-rodent/insect treatment

- Repairs to damaged finishes
- Quality System in place

9.10. CATEGORY K - TEST PROCEDURES

KA. FUNCTIONAL AND PERFORMANCE TEST PROCEDURES

Test shall be defined on equipment specifications and indicated on Contract Inspection & Test Plan (AA). Procedures shall indicate:

- Purpose of the test
- P&ID or diagram with written description of test set-up (if applicable)
- Definition of all equipment to be used for testing, including tag numbers for SKEC'S equipment
- Description of the method of testing, readings to be taken and instruments to be used
- Acceptance criteria for the test
- Sample log for the readings to be taken
- Full description of the method of calculating the results and their accuracy

KB. HYDROSTATIC/ PNEUMATIC TEST PROCEDURES

Detailed procedures for compliance with SKEC'S specifications and shall indicate:

- Details of test medium (temp, chloride content, etc.)
- Procedure shall include or reference acceptance criteria
- Rejection procedure
- Procedure shall include sample copy of certificate
- Drying procedure
- Calibration of instruments

KC. MATERIAL TEST PROCEDURES

To include all chemical, hardness, strength, composition and other tests performed to establish suitability for use and compliance with end performance criteria.

The VENDOR shall list the specification of all materials to be used, which are different to or not listed in the SKEC'S specifications

KD. FACTORY ACCEPTANCE TEST PROCEDURE

Procedures used for final acceptance testing prior to packing. Procedure should define order of sequential tests and include all elements defined in KA above.

KE. SITE ACCEPTANCE TEST PROCEDURE

Procedures required to prove on site pre-commissioning and commissioning complete prior to handover. Procedure should define order of sequential tests and include all elements defined in KA above.

9.11. CATEGORY L - CERTIFICATION

LA. MANUFACTURING RECORD BOOK INDEX

Index / list of contents shall be submitted to SKEC for review prior to compilation of the manufacturing record book.

LB. MANUFACTURING RECORD BOOK

The record book shall include documentation as indicated in the project specifications. This shall include but not be limited to those documents listed in Section 3 of Material Requisition "VENDOR Document Requirements" where indicated by the reference to LB.

Where an inspector has signed off documents, the original documents with wet signature shall be kept together in one of the manuals as the original file.

All certificates shall indicate Tag No. and Purchase Order Number.

LC. MATERIAL CERTIFICATES

Material certificates as identified by the relevant attachments to the material requisition shall be provided. Certificate types are as identified in Section 2 of the Material Requisition.

These shall be reviewed by the OWNER's local representative, and submitted with the MRBs.

LD. HAZARDOUS AREA CERTIFICATES

Certificate issued by a CENELEC approved authority indicating that a type test has satisfied the specified standards, e.g., BASEEFA, PTB etc…. Certification not in English language shall be supplied with a verified translation. With each Certificate submitted, the VENDOR shall include a statement identifying which items of equipment the Certificate applies, together with full details of any restrictions that apply.

LE. CODE/STANDARD/COMPLIANCE CERTIFICATES

Certificate issued by a recognised independent authority indicating that the item/equipment has been manufactured in accordance with code/standard. For fire test certification the certificates are to be complete and as issued by the testing authority. Certificates are to state the SKEC'S purchase order number, item number and identification to permit traceability to the fire tested item or material. Certificates not in the English language shall be supplied with a verified translation. Type approval certificates are normally acceptable for proprietary items.

LF. TEST RESULTS

Performance Test Results Report

Description of how test was conducted and procedures used, Method of calculating results, Acceptance criteria, Log of test readings signed by the SKEC'S representative

and third party inspection authority (where applicable), Calculations of results, taking into account the accuracy of the results, Problems encountered during the test, and corrective actions taken, As Tested performance curves as detailed for VENDOR Document category codes beginning with 'E'.

Factory Acceptance Test Report

Report on performance/functional tests carried out in the factory to demonstrate the equipment suitability to fulfil the duty specified. This report to include certificates as appropriate, tests for over speed, balancing, shaft mechanical and electrical run out, and vibration.

Reports on electrical and instrument control equipment shall include high voltage pressure tests, heat soak testing and insulation resistance certificates.

Routine Type Test Certificate for Electrical Equipment

Certificate of routine or type tests carried out.

Proof Load Certification

Test certificates for all lifting equipment, i.e., hoists, cranes, wire ropes, shackles, hooks, pulleys and lifting beams. Certification to be to the SKEC'S requirements and approved by the third party inspection authority, when applicable.

Pressure Test Certificate

Certificate and/or chart of hydrostatic and/or pneumatic tests carried out. Certificate shall state specification/standard procedures, actual pressure and duration of test. When applicable, low temperature test results and/or leak test results shall be included. Instrument calibration certificates also to be included.

Dimensional Report

Report to verify all critical dimensions, including the SKEC interconnection points are in accordance with the VENDOR'S approved drawings.

Painting/Insulation Inspection Report

Certificate to state the SKEC'S Purchase Order number; item number, tag number and shall verify that painting and/or insulation is in accordance with the SKEC'S specifications or the SKEC approved specifications, as applicable, showing anchor pattern measurements, temperatures, humidity, intermediate coat checks, final DFT and signed by the painting/insulation coating operatives and inspector.

Production Test Results (Inc. Welding)

Results of tensile, ductility, hardness, bend and impact tests etc. carried out on production and qualification tests.

- Includes production weld test results
- Procedure qualification results
- Visual inspection results

- Certificates to state the SKEC'S purchase order number, tag number (or other unique identification) to permit traceability of tested equipment, item or piping system. Supplementary marked-up piping isometrics shall be included when necessary to define extent of testing, those being verified by SKEC, when required

NDE Records

All NDE for final acceptance shall be performed after PWHT where applicable.

- Radiography. Results of radiography tests interpreted and signed by a qualified technician. Detailed reports are to state the SKEC'S order number, and to include the procedure used, acceptance level and results obtained in accordance with the SKEC'S specified standard. Reference shall be made to applicable operator qualification and RT film Interpretator certificates, and approvals by third party inspection authority shall be gained when necessary.

- Ultrasonic Examination. Certificate confirming that acceptable results have been obtained on examinations carried out to the specified standard and stating the equipment used, calibration standard and procedure adopted. The certificate shall be signed by a qualified operator. Reference shall be made to applicable qualification level. NDE operator qualification certificates, and approvals by third party inspection authority shall be obtained when necessary.

- Magnetic Particle Inspection Details as in Ultrasonic Examination above

- Dye Penetrant Inspection Details as in Ultrasonic Examination above

- Positive Material Identification Details as in Ultrasonic Examination above

Note: When applicable, NDE Records shall be supplemented with weld history drawings verified by SKEC (and the third party inspection authority, when necessary).

Heat Treatment Certificate

Certificate and/or chart of Heat treatment carried out. Certificate shall state specification/standard procedures, actual temperatures and durations. Instrument calibration certificates also to be included.

LG. SPECIFICATION WAIVERS

The VENDOR shall include in the Manufacturing Record Book copies of specification waivers granted by the OWNER / SKEC. These shall be a copy of OWNER approved specification waivers.

LH. TYPE TEST CERTIFICATE

Certificates as appropriate to demonstrate proof of equipment performance and characteristics.

LI. INSPECTION RELEASE NOTE

For inspected items standard form SQ-231 will be completed by SKEC'S Representative and a copy handed to the VENDOR. For non-inspected items a release note shall be raised by PSQR or the Project Expediter and transmitted to the VENDOR.

9.12. CATEGORY M - HANDLING & SITE INSTALLATION

MA. DOCUMENTS TRAVELLING WITH GOODS

Packing Schedule

For equipment shipped in more than one piece, a schedule is to be submitted which identifies each loose component of the package for use as a Check List at the receiving point. This is to confirm all items have been received. The schedule shall include overall bill of materials. Where components are part of an assembly, then reference to the assembly item is sufficient, providing there is reference to the drawing, showing the assembly, e.g. isometric drawing, or general arrangement. Where items are supplied loose, they shall be specified loose, with drawing reference for identification within package.

The Packing Schedule shall include the following columns.

- Box No.
- Equipment/ Component Description
- Item/ Tag No.
- Qty
- Document Reference (i.e. refer to assembly drawing, or drawing showing component. If loose then refer to drawing that component can be located)
- Shipping reference. (e.g. SCN no. to be completed when equipment is released for shipment)
- Material Safety Data Sheets (MSDS)

Erection Fastener Schedule

Schedule to indicate number off, type, size, length, grips and material of all fixing bolts/fastener required and the members that they connect. Where temporary bolts are required to withstand transportation forces, these shall also be indicated with suitable note of explanation.

Copy of category MB and MD documents to accompany shipment.

MB. PACKING, SHIPPING, HANDLING AND STORAGE AND PRESERVATION PROCEDURES.

VENDOR to detail techniques to be used to meet the Purchaser's requirements as specified in the PO. Indicate size of container, number off, weight, identification and contents. Include details preservation procedure detailing inspection periods, materials required, etc., both prior to installation and post installation but prior to commissioning. Any special unpacking/handling requirements shall be stated. This should be placed in LB when NB is not required.

MC. FIELD FABRICATION ITEMS

List of all items requiring field fabrication. May be combined with MB.

MD. TRANSPORTATION DRAWING

VENDOR shall provide detailed drawing as specified in the Purchase Order, drawn 1:50 scale in metric, to obtain transport permits and approvals, and to enable safe lifting and shipment of equipment from VENDOR'S works to jobsite. Such drawing shall show:

- Three views of cargo – top, side and front
- Critical points (outermost points of cargo)
- Length, width, height and weight
- Centre of gravity (from all views)
- Lifting points
- Position of shipping saddles etc.
- Any special lifting equipment
- Length of lifting strops (if different lengths)
- All securing points
- Footprint of packaged equipment
- Any other information relevant to transport

ME. INSTALLATION INSTRUCTIONS

Procedures for installation of equipment to be supplied for use at the fabrication site. The following information shall be included:

- Construction Method Statement
- Assembly instructions
- Erection drawings
- Lifting points
- Lifting weights
- Shipping break points for panels and switchboard assemblies
- Erection match markings
- Fixing points
- Levelling procedures
- Alignment procedures
- Preservation requirements and procedures
- Erection fasteners summary list
- Details of any special unpacking/handling requirements shall be stated

- The installation instructions shall cross-reference with documents such as Packing List, Erection Drawings, General Arrangement Drawings, Panel / JB Termination Details etc that will facilitate the assembly of the package.

9.13. CATEGORY N - OPERATING INSTRUCTIONS

NA. SPARE PARTS LIST OR DATA PACKAGES.

Where SKEC provides Spare Parts list format or software it shall be completed fully. Spare Parts Data Packages shall indicate VENDOR'S recommended spare parts for each item within his scope of supply. The list shall include spare parts for start-up / commissioning spares (including items already purchased as part of purchase order), consumables (i.e. gaskets / sealant), operation spares and insurance spares

NB. OPERATING AND MAINTENANCE MANUAL

Manuals shall be in accordance with section 8 of this specification, and as follows.

Manual shall include description of equipment, operating procedures for startup, steady state, shutdown, emergency and fault conditions, operating parameters, function of protective devices and controls, copies of fault finding guidelines. Manuals must include the following as appropriate:

- Cause and Effect Charts
- Data sheet for Equipment
- Data sheet for Driver
- Data sheet for Auxiliaries and Components
- Material Safety Data Sheets (MSDS)
- Performance Curves
- General Arrangement drawings
- Outline and cross section drawings including base plate
- Drawings of ancillary equipment such as fans, gearboxes, filters etc.
- Details of lube and seal oil systems
- Complete Parts lists
- Block Diagrams
- Schedule of Packing
- Purchasing specifications
- Piping and Instrumentation Diagrams
- Instructions for Installation, Preservation, Operation, maintenance, disassembly, repair, overhaul and assembly

- Lubrication Schedule
- Recommended spare parts listing
- System of trouble detection and remedy
- Electrical drawing and details including electrical relay / device setting schedule
- Control schematics
- List of special instruments used in the package like programmers for PLCs, hand held Programmers etc
- Details on sub vendors equipment with information on the specific model utilized
- Sub-vendor list with contact details – address, telephone and fax
- SKEC approved drawings as specified in the VENDOR Data Requirements shown in Section 8 of the Material Requisition
- Special Tools List, List shall indicate those tools necessary for removing equipment from transport at site, plus those necessary for installation and maintenance equipment. Against each entry, a brief description shall be given and where necessary for clarity, a drawing shall be provided.
- Computer System Documentation to include full documentation related to both hardware and software as required by the purchase order.

NC. VENDOR'S CATALOGUE

To show details of entire product range from which offered equipment is taken (including that of sub-vendors).

ND. LUBRICATION SCHEDULE

Where SKEC provides a lubrication schedule format it shall be completed fully (preferably electronically). Lubrication schedule shall show all items within the VENDOR'S scope of supply that are lubricated – including items that have bearings sealed for life. Each item requiring lubrication shall confirm oil or grease type (brand and grade – selected to the maximum extent possible from the product range of Owner). VENDOR to indicate recommended lubricants and their Owner equivalents. Schedule shall confirm quantity required for first fill, anticipated replenishment/replacement quantity (with frequency) and any flushing requirements if required in pre-commissioning.

9.14. CATEGORY P – CIVIL/STRUCTURAL/ARCHITECTURAL

PA. STATEMENT OF DESIGN CODES TO BE USED

The VENDOR shall list all design codes and standards to be used for civil, structural, electrical, instrument, mechanical and HVAC design.

PB. LIST OF COMPUTER SOFTWARE TO BE USED

The VENDOR to list all computer software to be used in design of the facility. This shall state the version number of the software and shall be accompanied by the relevant certificates to show the software has been verified.

PC. LIST OF ITEMS TO BE PRECAST

The VENDOR shall provide list of all concrete structural elements to be precast.

PD. LIST OF ITEMS TO BE PRESTRESSED

The VENDOR shall provide list of all concrete structural elements to be prestressed. The method of pre-stressing shall be stated in the list.

PE. UNDERGROUND SERVICES DATA

The VENDOR shall furnish the following for underground services:

- Location, size, material and class of incoming buried utility and process pipes
- Location of power/control cable terminals
- Location of drain points
- Quantity (flow rate), chemical composition, temperature, etc. of waste effluents

PF. BUILDING PLANS

The VENDOR shall show the following details :

Buildings

- Detailed structural plans and elevations of buildings
- Detailed architectural internal plans of buildings
- Detailed architectural external plans and elevations of buildings
- HVAC layout and air flow diagram
- Potable water layout and details
- Sanitary drainage layout and details
- Layout and details for other drainage systems (i.e. laboratory waste)
- Electrical conduit layout and details
- Signs
- Finishes schedules (internal and external)
- Furniture & fixtures schedules

PG. DETAIL FABRICATION DRAWINGS

The VENDOR shall submit shop fabrication detail drawings. These shall show all details required by workshop operatives to manufacture the structural elements, main connections, hand railing, ladders, flooring, cladding and other similar items forming all or part of the Purchase Order.

PH. ERECTION DRAWING

VENDOR to submit written method statement, giving details of the erection sequence and techniques, craneage and other similar items. VENDOR to submit GA drawings identifying erection mark numbers of all elements, including flooring, forming part or the entire Purchase Order. The mark numbers to be related to the relevant shop fabrication drawings.

PI. BILLS OF MATERIALS/QUANTITIES

VENDOR to submit bills of materials including calculated units of measurement of each and every item of material included in its scope, strictly in accordance with the pay items and method of measurement of the purchase order. Bill of materials shall indicate:

- Concrete components
- Structural Steel
- Masonry material
- Floor finishes
- Roof cladding
- Roof light material
- Doors and Ironmongery
- Window frame and glazing
- Sanitary ware
- Fixtures, fittings and furniture
- Electrical conduit and sleeving
- Plumbing materials