أدنـوك
ADNOC

ADNOC GROUP PROJECTS AND ENGINEERING

GENERAL AND SPECIAL PURPOSE STEAM TURBINES (API 611 & 612) SPECIFICATION

Specification

AGES-SP-05-004

شركة بترول أبوظبي الوطنية
Abu Dhabi National Oil Company

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GENERAL TECHNICAL AND CONTRACTUAL REQUIREMENTS FOR ROTATING EQUIPMENT

Appendix 1 – AGES-SP-05-004

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1. PURPOSE

1.1 This Appendix provides the general technical and contractual requirements for rotating equipment and its auxiliaries, as detailed for the COMPANY (ADNOC Group). Unless otherwise stated, these requirements shall apply to all rotating equipment.

1.2 This Appendix should be read in conjunction with: the relevant COMPANY rotating equipment specification and associated appendices and the Equipment Datasheet for the equipment being supplied as listed in the Purchase Order.

2. DEFINED TERMS AND ABBREVIATIONS

Abbreviations means the abbreviations listed in Table 1 or other referred to documents herein**.**

Certified Test or Certified Inspection means an Inspection or test activity which the SUPPLER conducts and certifies without PURCHASER involvement.

Coating MANUFACTURER means the MANUFACTURER of paint coating system to be applied to the equipment to prevent corrosion or surface deterioration to equipment component parts.

"**COMPANY**" means ADNOC Group.

"**Concession Request**" means any request for deviation from the COMPANY requirements, either by the CONTRACTOR or SUPPLIER, usually after receiving the Contract package or Purchase Order. Often, it refers to a request for authorization to use, repair, recondition, reclaim, or release materials, components or equipment already in progress or completely manufactured but which does not meet or comply with ADNOC requirements. A Concession Request is subject to COMPANY approval.

"**Continuous Operation**" means the intended uninterrupted period of operation. Refer to equipment specific specifications for the definition of the duration of uninterrupted period of operation. The CONTRACTOR and SUPPLIER are responsible for highlighting any equipment, auxiliary components or system requirements which shall result in the need to shut down the equipment within this time period.

"**CONTRACTOR**" means the party or parties who undertake(s) all, or part, of the design, engineering, procurement, construction, commissioning or management of the Project.

"**Hazardous Service / Hazardous Fluid**" means any service or fluid as defined within the Process document: Process Design Criteria

"**Intermittent Operation**" means any operation which includes intentional starts and stops, or any irregular / non-routine usage.

Major Weld Repair of a casting is defined as "major" if a repair weld has a depth of more than 50% of the wall thickness or has a length of more than 150 mm (6 in) in one or more directions, or if the total surface area of all repairs on the casting exceeds 10% of the total casting surface area. A weld repair necessitated by a leaking pressure test is also classed as "major".

"**MANUFACTURER**" means the Original Equipment Manufacturer (OEM) or MANUFACTURER of one or more of the component(s) which make up a sub-assembly or item of equipment assembled by the main SUPPLIER or his nominated SUB-SUPPLIER.

"**SUB-CONTRACTOR**" means any party engaged by the CONTRACTOR to undertake any assigned work on their behalf. COMPANY maintains the right to review all proposed Sub-CONTRACTORs; this right does not relieve the CONTRACTOR of their obligations under the Contract, nor does it create any contractual relationship between COMPANY and the SUB-CONTRACTOR.

"**SUB-SUPPLIER**" means the sub-contracted SUPPLIER of equipment sub-components software and/or support services relating to the equipment / package, or part thereof, to be provided by the SUPPLIER. COMPANY maintains the right to review all proposed SUB-SUPPLIERS, but this right does not relieve the SUPPLIER of their obligations under the Contract, nor does it create any contractual relationship between COMPANY and any individual SUB-SUPPLIER.

"**SUPPLIER**" means the party entering into a Contract with COMPANY to provide the materials, equipment, supporting technical documents and/or drawings, guarantees, warranties and/or agreed services in accordance with the requirements of the purchase order and relevant specification(s). The term SUPPLIER includes any legally appointed successors and/or nominated representatives of the SUPPLIER.

Symbols means the symbols which are defined within 'Process Design Criteria'

Table 1 – List of Abbreviations

Abbreviation	Definition
1oo2, 2oo3, 2oo4	1 out of 2 , 2 out of 3, 2 out of 4 etc
BPVC	(ASME) Boiler Pressure Vessel Code
CFD	Computational Fluid Dynamics
CR	Concession Request
CRA	Corrosion Resistant Alloy
DBSE	Distance Between Shaft Ends
DE / NDE	Drive End / Non-Drive End
EDG	Emergency Diesel Generator
EOC	End of Curve
EPC	Engineering Procurement Construction
ESD	Emergency Shutdown
FEA	Finite Element Analysis
H2S	Hydrogen Sulfide
HF	Hydrofluoric Acid
HIC	Hydrogen Induced Cracking
HRC	Measure of Hardness per the Rockwell “C” scale
HSSE	Health, Safety, Security, Environment
Hv	Vickers Hardness
ICSS	Integrated Control & Safety System
IEEE	Institute of Electrical and Electronic Engineers
IPS	Instrumented Protective System
ISO	International Organisation for Standardization
ITP	Inspection & Testing Plan
LO	Lubricating Oil

Abbreviation	Definition
MACWP	Maximum Allowable Continuous Working Pressure
MCS	Maximum Continuous Speed
MSDS	Material Safety Datasheet
MT	Magnetic Particle Examination
NCR	Non-Conformance Report
NDE or NDT	Non-Destructive Examination or Non-Destructive Testing
NGL	Natural Gas Liquid
OEM	Original Equipment Manufacturer
PAUT	Phased Array Ultrasonic Testing
PDCV	Pressure Differential Control Valve
PQR	Procedure Qualification Records
[PS]	Process Safety (Mandatory Requirement)
PSD	Process Shutdown
PSV	Pressure Safety Valve
PT	Penetrant Examination
QA / QC	Quality Assurance / Quality Control
RCC	Reinforced Cement Concrete
REI	Rotating Equipment Initiative
RT	Radiographic Examination
RTJ	Ring Type Joint
SAT	Site Acceptance Test
SPIR	Spare Parts and Interchangeability Record
SPL	Sound Pressure Level (dBA)
SWL	Safe Working Load
UT	Ultrasonic Examination

Abbreviation	Definition
VFD	Variable Frequency Drive
VI	Visual Inspection
WPS	Welding Procedure Specifications
WPQ	Welding Procedure Qualification
WPQR	Welding Procedure Qualification Record

3. NORMATIVE REFERENCES

3.1 The following normative references apply to all COMPANY rotating equipment scope:

Reference Document Number	Reference Document Name
AGES-PH-08-001	Isolation, Vent & Drain Philosophy
AGES-SP-01-002	Structural Steel Works Specification
AGES-SP-01-003	Structural Design Basis Specification
AGES-SP-04-001	Process Control System (PCS) Specification
AGES-SP-04-002	Control Valves Specification
AGES-SP-04-004	Emergency Shutdown System (SIS) Specification
AGES- SP-04-006	Instrument and Control Cables Specification
AGES-SP-02-002	Synchronous Motor Specification
AGES-SP-02-004	Adjustable Speed Drives
AGES-SP-05-001	Centrifugal Pumps (API 610) Specification
AGES-SP-05-002	Centrifugal Compressors (API 617) Specification
AGES-SP-05-003	Reciprocating Compressors (API 618 and ISO 13631) Specification
AGES-SP-05-004	General and Special Purpose Steam Turbines (API 611 and 612) Specification
AGES-SP-05-005	Gas Turbines (API 616) Specification
AGES-SP-06-002	Pressure Vessel Specification
AGES-SP-06-003	Shell & Tube Heat Exchanger Specification
American Gear Manufacturers Association AGMA	**Based upon package scope of supply, additional AGMA specifications may apply**
AGMA 9002	Bores and Keyways for Flexible Couplings
American Petroleum Institute (API)	**Based upon package scope of supply, additional API specifications may apply**
API Specification Q1	Specification for Quality Programs for the Petroleum, Petrochemical and Natural Gas Industry
API 520	Sizing, Selection and Installation Of Pressure-Relieving Devices In Refineries
API 521	Guide For Pressure-Relieving And Depressurizing Systems
API RP 551	Process Measurement Instrumentation

Reference Document Number	Reference Document Name
API 613	Special Purpose Gears for Petroleum, Chemical and Gas Industry Services
API 614	Lubrication, Shaft-sealing and Oil Control Systems and Auxiliaries
API 660	Shell-tube Heat Exchangers for General Refinery Services
API 661	Air-cooled Heat Exchangers for General Refinery Services
API 671	Special-Purpose Couplings for Petroleum, Chemical, and Gas Industry Services
API 670	Machinery Protection Systems
API 676	Positive displacement Pump – ROTARY
API 677	General – Purpose Gear Units for Petroleum, Chemical and Gas Industry Services
API RP 684	API Standard Paragraphs Rotodynamic Tutorial: Lateral Critical Speeds, Unbalance Response, Stability, Train Torsional and Rotor Balancing
API 685	Sealless Centrifugal Pumps for Petroleum, Petrochemical, and Gas Industry Process Service
API 686	Recommended Practice for Machinery Installation and Installation Design
American Society of Mechanical Engineers (ASME)	**Based upon package scope of supply, additional ASME specifications may apply**
ASME B31.1	Power Piping
ASME B31.3	Process Piping
ASME BPVC Section II	ASME Boiler Pressure Vessel Code – Material Specification
ASME BPVC Section V	ASME Boiler Pressure Vessel Code -Non-Destructive Examination
ASME BPVC Section VIII	ASME Boiler Pressure Vessel Code - Rules for Construction of Pressure Vessels
ASME BPVC Section IX	ASME Boiler Pressure Vessel Code - Welding and Brazing
ASME PTC 1	General instructions
American Society for Testing Materials (ASTM)	**Based upon package scope of supply, additional ASTM specifications and Material designations may apply**
British Standards (BS)	**Based upon package scope of supply, additional BS specifications may apply**
BS 3692	ISO metric precision hexagon bolts, screws and nuts

Reference Document Number	Reference Document Name
BS 4082: Part 1	Specification For External Dimensions For Vertical In-Line Centrifugal Pumps
BS EN 1834	Reciprocating Internal Combustion Engines – Safety requirements for the design and construction of engines for use in potentially explosive atmospheres
BS EN 10204	Metallic Products Types of Inspection Documents
BS EN 10241	Steel threaded pipe fittings
BSI PD 5304	Guidance on Safe Use of Machinery
Engineering Equipment & Materials Users Association (EEMUA)	
EEMUA – 140	Noise Procedure Specification
EEMUA – 141	Guide to the use of Noise Procedure Specification
International Organisation for Standardization (ISO)	**Based upon package scope of supply, additional ISO specifications may apply**
ISO 2954	Mechanical Vibration of Rotating and Reciprocating Machinery - Requirements for Instruments for Measuring Vibration Severity
ISO 9000	Quality Management Systems - Fundamentals and Vocabulary
ISO 9004	Quality Management Guidelines for Performance Improvement
ISO 9563	Belt Drives - Electrical Conductivity of antistatic endless synchronous belts – Characteristics and Test Methods
ISO 9906	Rotodynamic pumps – Hydraulic performance acceptance tests, Grade 1, 2, 3.
ISO 10474 / EN 10204	Metallic products — Types of inspection documents
ISO 10816-1	Mechanical Vibration— Evaluation of Machine Vibration by Measurements on Non-rotating Parts
ISO 12944	Paints and varnishes - Corrosion protection of steel structures by protective paint systems
ISO 13050	Synchronous Belt Drives
ISO 15156	Materials for use in H2S-containing environments in oil and gas production
ISO 17782	Petroleum, petrochemical and natural gas industries – Scheme for conformity assessment of manufacturers of special materials
ISO 19011	Guidelines for Quality and/or Environmental System Auditing
ISO 21940	Mechanical Vibration – Rotor Balancing
ISO 21457	Material Selection & Corrosion Control for oil & gas
Manufacturers Standardization Society (MSS)	

Reference Document Number	Reference Document Name
MSS SP-55	Quality standard for steel castings for valves, flanges and fittings and other piping components- visual method
National Association of Corrosion Engineers (NACE)	
NACE MR0175 / ISO 15156	Petroleum and Natural Gas Industries – Materials for use in H2S containing environments in oil and gas production
NACE MR0103 / ISO 17945	Petroleum, Petrochemical and Natural Gas Industries Metallic materials resistant to sulfide stress cracking in corrosive petroleum refining environments

The following normative references are to be considered relevant for use by CONTRACTOR with relevant content to be communicated to SUPPLIERS, on an as-needed basis, within the Purchase Order.

Reference Document Number	Reference Document Name
AGES-GL-07-001	Material Selection Guidelines
AGES-SP-02-006	Electrical Engineering Design Guidelines
AGES-PH-03-001	Layout and Separation Distances Philosophy
AGES-PH-03-003	Fire Detection & Protection Philosophy
AGES- PH-03-002	Emergency Shutdown & Depressurisation Philosophy
AGES-SP-04-005	Emergency Shutdown & Depressurisation Philosophy
AGES-SP-06-001	Design Criteria for Static Equipment
AGES-GL-08-001	Process Design Criteria
AGES-SP-08-002	Flare & Blowdown Philosophy

4. CONTRACTUAL REQUIREMENTS

4.1 DOCUMENTS PRECEDENCE

4.1.1 In the event of any apparent conflict, the Order of Precedence for documents shall be as follows, in descending order of precedence:

(i) UAE Statutory Requirements and/or Regulations, including emissions limits

(ii) ADNOC Codes of Practice

(iii) Equipment Datasheet(s), Drawing(s) and Project Specifications

(iv) COMPANY Specifications

(v) Recognised Industry or International Codes and Standards

4.1.2 Where the requirements of the Equipment Datasheet or Specification are more stringent than UAE statute or regulation, the more stringent requirement shall apply, provided that this still achieves compliance with the law or regulation.

4.1.3 The SUPPLIER shall notify the COMPANY of any apparent conflict between the equipment specification and the equipment datasheet, or the equipment datasheet and local or statutory regulation. Resolution and/or clarification of the apparent conflict shall be obtained from the COMPANY, in writing, prior to proceeding with design or manufacture of the equipment.

4.2 SPECIFICATION DEVIATION AND CONCESSION CONTROL

4.2.1 Deviations

Deviations from the requirements of the Purchase Order are only acceptable where the SUPPLIER has listed in their quotation the requirements they cannot, or do not wish to, comply with and the COMPANY and CONTRACTOR have accepted, in writing, the deviations, before the order is placed.

In the absence of a list of agreed deviations, it will be assumed that the SUPPLIER complies fully with the requirements of the Purchase Order.

4.2.2 Concessions

Any proposed, post award technical deviations to the Purchase Order and its attachments including, but not limited to, the Datasheets and Narrative Specifications shall be sought by the SUPPLIER only through the Concession Request procedure, as set out in Appendix 2 – Quality Requirements – of the relevant equipment specification.

If, in the experience/knowledge of SUPPLIER and/or Sub-SUPPLIER, any requirements of the specification create, or have a potential to create, unsafe (for personnel or plant) or less reliable function during any operation (including start-up, upset or emergency operations), it is solely the SUPPLIER's responsibility to bring, in writing, such situations to the attention of the CONTRACTOR. If no situations have been identified in writing, it will be construed that equipment and services will be provided as per the specification.

Any proposed deviation or exception to the defined Process Safety requirements [PSR], as defined in Section 8 of the equipment specifications, shall require approval from ADNOC's "Ultimate Technical Authority".

4.3 ALTERNATIVE DESIGNS

4.3.1 The SUPPLIER may submit, in their proposal, alternative designs for consideration by CONTRACTOR / COMPANY, provided that this design satisfies all relevant statutory & legislative requirements, as well as all manufacturing, material and operating requirements as per the equipment specification and datasheet.

4.3.2 The SUPPLIER's base proposal shall be as per the requirements of the enquiry package; this proposal may be supplemented by an additional proposal with alternative designs, clearly listing deviations to the enquiry. Proposals with only alternative designs are not acceptable. Alternative designs shall offer either improved reliability of the equipment or process scheme or reduced operational and/or maintenance cost to the COMPANY. Lifecycle cost for alternative designs shall be evaluated accurately by SUPPLIER and provided within their proposal. Reduced lead or delivery time alone shall not be reason to consider alternative designs. Alternative designs are subject to COMPANY approval.

4.3.3 The SUPPLIER shall supply a reference list for the offered equipment as part of their proposal.

4.4 PROTOTYPE DESIGNS

4.4.1 No new prototype, unproven equipment, nor equipment built to unknown manufacturing standards shall be offered. The equipment model incorporating "same as quoted" major components (as an example, impellers, casings, rotor configurations, bearings, shaft seals) shall have been proven in a similar environment (desert sand storms, dusty, hot, humid and salt laden atmosphere) and in similar operating conditions (flows, pressures, temperatures, powers, speeds) and service. The equipment model and its components shall be in the regular production range of the MANUFACTURER.

4.4.2 At least three machines similar in all major respects to those proposed shall have been manufactured and tested by the proposed MANUFACTURER at the proposed manufacturing plant, within the last 10 years and shall continue to be in trouble-free service. These three machines shall each have individually completed 3 years / 25,000 hours of satisfactory operation in a continuous process plant without any major problems or modifications.

4.4.3 The SUPPLIER shall list in their proposal all changes in parts, components or design which are not proven in similar machines produced for the last 10 years or which have not acquired at least 3 years / 25,000 hours in operation. These changes are specifically subject to the COMPANY's approval and proven alternatives may be requested.

4.4.4 SUPPLIER/MANUFACTURER shall declare in their proposal to the COMPANY, their intention to use any unconventional methods to manufacture any item or component or "new" SUB-SUPPLIER whom they are nominating for the subject purpose for the first time. Use of unconventional methods and "new" SUB-SUPPLIERs is subject to COMPANY approval. For qualification of new SUPPLIERS, the SUPPLIER should have supplied at least 3 similar machines and have 3 years / 25,000hr continuous operation in similar operating conditions.

4.5 STANDARDISATION

4.5.1 SUPPLIER shall indicate in their proposal the names, manufacturing addresses and scope of supply of their SUB-SUPPLIERs. The SUB-SUPPLIER list requires COMPANY approval for each Purchase Order. No part of the order shall be sub-ordered without the prior written agreement of the COMPANY. COMPANY shall have the right to substitute a nominated SUB-SUPPLIER for any reason including rationalization, experience in similar service or technical superiority.

4.5.2 SUPPLIER shall standardize as much as possible across the project equipment, auxiliaries and ancillaries. SUPPLIER shall provide all information within their proposal which they feel has the potential to minimize the inventory of spare parts or the reduction of variety of equipment.

4.5.3 All ancillary items such as couplings, filters, seals, instruments etc. shall be in accordance with the individual project's approved SUPPLIER list.

4.6 QUALITY CONTROL (QA/QC) AND CERTIFICATION

4.6.1 The requirements for Quality Control and Quality Assurance shall be specified in the COMPANY equipment specifications 'Quality Assurance, Inspection and Testing Requirements' Appendix 2.

4.6.2 The requirements for Material Identification and Certification shall be specified in the COMPANY equipment specifications 'Quality Assurance, Inspection and Testing Requirements' Appendix 2.

4.6.3 All electrical and instruments, JBs, marshalling cabinets etc., control items shall be IECEx certified (based on respective hazardous area classification requirements). The SUPPLIER is responsible for ensuring the certification. This will enable the CONTRACTOR to obtain ECASEx certificates for those items in UAE by payment of necessary verification fees. ATEX certification not acceptable unless approved by COMPANY. Specific waivers are required in case where items cannot get IECEx certification.

4.7 INSPECTION & TESTING REQUIREMENTS

4.7.1 The requirements for Inspection and Testing Requirements shall be specified in the COMPANY equipment specifications 'Quality Assurance, Inspection and Testing Requirements' Appendix 2.

4.8 SUPPLIER RESPONSIBILITIES

4.8.1 SUPPLIER shall ensure that all equipment, and any free-issue equipment, is properly integrated into the whole installation in order to meet the applied specifications. Their responsibilities shall include, but not be limited to:

- Obtaining information required for fulfilling their obligations
- Ensure relevant integration of the equipment package into the overall plant design. This includes review of the relevant PIDs, equipment layout, and where possible a basic review of other equipment and instrumentation whose interface affects the performance of his equipment.
- Communicating necessary data, specifications and other documents with their Sub-SUPPLIER(s).
- Negotiating physical interfaces, if any.
- Guaranteeing design, stability and performance of the complete equipment installation.
- Dimensional compatibility.
- Shaft system critical speeds and vibration, lateral and torsional analysis.
- Noise level limitations.
- Acceptability of externally imposed loads.
- Arrangement of auxiliary systems shall permit removal of main equipment for maintenance with minimal removal of ancillaries
- Defining static and dynamic loads on foundations and support structures. Design verification of support structures and foundations
- Standardizing all components within the train and its utility requirements (such as oil type/grade, etc.)
- Integration of control systems.
- Advising CONTRACTOR of the firm requirement of utilities (type and quantity) within 2 months or earlier as specified in the Purchase Order.
- Providing all software, software configuration/programming/troubleshooting devices for all controllers such as speed, anti-surge, performance, load sharing, machine control, etc.

- Completion of "Maintenance Management System" datasheets for their and their Sub-SUPPLIERs' equipment.
- Technical assistance to CONTRACTOR in defining control, shutdown and logic requirements to be incorporated by CONTRACTOR in CONTRACTOR's control and emergency shutdown (ESD) system.
- Provide, or arrange to provide, all required assistance during installation, testing and commissioning.
- Ensure that software and communication links shall match and compare with other equipment/systems without any problems.

4.8.2 SUPPLIER shall independently compute, and thereby verify, the physical properties of the process medium as originally defined on the project datasheets and shall take full responsibility for amendment and resolution of any design features affected. SUPPLIER shall state in the equipment datasheets the values of all physical properties of process fluids used in their calculations, indicating the state equations used.

4.8.3 The SUPPLIER shall assist the CONTRACTOR during initial installation, alignment check and start-up. The initial start-up procedure shall be thoroughly documented by the SUPPLIER and supplied in the equipment's installation manual, to be supplied prior to acceptance of the equipment. It shall be the SUPPLIER's responsibility to advise the CONTRACTOR of training requirements needed for COMPANY personnel to safely and most efficiently operate and maintain their equipment.

4.8.4 The SUPPLIER and CONTRACTOR shall mutually agree responsibility for documenting and distributing "Minutes of the Meeting" for all meetings pertinent to the supplied equipment to which they are party. Typed copies of these minutes shall be submitted for mutual agreement, in the agreed format, within the specified duration but not longer than 3 days from the meeting. Following review, the originator of the minutes shall either correct and resubmit the minutes for agreement, or distribute the accepted minutes, within 2 working days.

4.8.5 The SUPPLIER shall provide spare parts as stipulated in COMPANY equipment specification and where listed in the Purchase Order.

4.8.6 The SUPPLIER shall provide special tools as stipulated in this Appendix and where listed in the Purchase Order.

4.9 SUBCONTRACTORS/SUBSUPPLIERS

4.9.1 The SUPPLIER/MANUFACTURER (as appropriate) shall assumer overall unit responsibility and guarantee for the equipment package and auxiliaries.

4.9.2 The SUPPLIER/MANUFACTURER shall transmit all relevant Purchase Order documents, including specifications and subsequent modifications to the specifications to their SUB-SUPPLIER(s).

4.9.3 The SUPPLIER/MANUFACTURER shall ensure all specified requirements are satisfied by their SUB-SUPPLIER(s).

4.9.4 The SUPPLIER/MANUFACTURER shall obtain and transmit all SUB-SUPPLIER(s) warranties to the CONTRACTOR and COMPANY in addition to the overall system / equipment warranty.

4.9.5 On the spare parts list, the SUPPLIER/MANUFACTURER shall include SUB-SUPPLIER's(s') actual part number(s) for any sub-supplied parts, so that the COMPANY may directly source replacements from the SUB-SUPPLIER.

4.10 SPARE PARTS

4.10.1 Pre-Commissioning (i.e. Construction), Start-up (i.e. Commissioning) and Capital Spares, shall be provided in accordance with the requirements of COMPANY equipment specifications and as defined in the Purchase Order. Details of these shall be contained within the SUPPLIER's proposal.

4.10.2 SUPPLIER shall provide the price for two years operational spares offer along with their proposal.

The following minimum requirements shall apply:

4.10.3 Spare parts shall be dimensionally and metallurgically identical to original parts, except that single stage centrifugal pump spare impellers shall be furnished with full diameter. Spare parts shall be subjected to the same level of quality control, inspection and testing as the job parts.

4.10.4 Spare parts shall be readily usable by replacing in the equipment, except that single stage centrifugal pump impellers may need trimming.

4.10.5 Instrument spares shall be readily usable by replacement in the equipment. If special jumpers or address switches need to be changed, those shall be ready-made for the specific application and shall be listed clearly on the spare part, packing documents with reference to the project number and machine contract number.

4.10.6 SUPPLIER shall specify whether or not any electronic chips need to be changed or reprogrammed. If there is a need, the chips (Eproms or others) shall be supplied ready programmed as a separate spare part with full reference to their electronic boards.

4.10.7 Spare parts shall be available for purchase and all manufacturing drawings retained throughout the specified 30 years' service.

4.10.8 Spare parts shall be packaged, preserved and delivered in accordance with the requirements herein and any additional requirements prescribed in the Purchase Order. Furthermore, the SUPPLIER shall provide detailed storage, maintenance and preservation requirements for all supplied spares included specific long-term requirements for Capital Spares

4.10.9 Following award of Purchase Order all spares shall be listed by SUPPLIER under the SPIR submission and SUPPLIER shall indicate delivery, price and details of interchangeability for each part with the supplied equipment.

4.11 SPECIAL TOOLS

4.11.1 SUPPLIER shall provide all special tools required for installation, commissioning, disassembly and reassembly of the equipment. A list of the tools to be provided shall be included within the SUPPLIER's proposal and shall include, but not be limited to, the following items as applicable to the equipment type:

a) Two sets of non-metric tools
b) One set of bundle puller of each type,
c) One bundle cradle and rotor stand for each bundle
d) Tools for removal of gas turbine core engine, gas generator, power turbine & load coupling
e) Mechanical seal removal tools
f) Hydraulic clutch tools
g) Bolt tensioning and torque devices
h) Hydraulic tools for removing and assembling couplings hubs, thrust discs etc.(one set per service is required)
i) Software (including any third-party software) configuration devices for all controllers, I/O modules. Software (including any third-party software) for reconfiguration of operator interface

j) Diagnostic software and hardware for all electronics
k) CONTRACTOR as well as technician level diagnostic software for all machine condition / performance monitoring, machine condition / performance evaluation
l) Borescopes and light sources for all machinery designed to use such facilities
m) Proof load tested spreader bars for all special purpose equipment and as required by CONTRACTOR
n) Any special tools required to dismantle instrument items
o) Special test clamps or leads for electronic / instrument checks, if any
p) Brackets for installation of laser alignment tools (requirement to provide laser alignment tools shall be on a project by project basis)

4.11.2 For two identical units, one set of special tools shall be provided.

4.11.3 For multi-unit installation of three or more identical units, two sets of special tools shall be provided.

4.11.4 Tools provided for use during operation shall be suitable for the specified area classification

4.12 PAINTING

4.12.1 Painting and protective coating(s) shall be applied in accordance with the specified requirements within the relevant COMPANY Business Unit Standard(s).

4.12.2 All exterior component parts, including stainless steel parts, but excluding finished machined surfaces, shall be painted in accordance with the project defined painting requirements as specified in Purchase Order. All protective coating system(s) used shall have a minimum service life of at least 7-8 years based on the specified site environmental conditions. The paint coating type, number of coats and thickness shall be as specified in COMPANY Standards.

4.12.3 Unless otherwise specified, atmospheric conditions in offshore and coastal environments (<50km from the coast) shall be considered to be corrosivity category C5-M, as per Part 2 of ISO 12944, whilst onshore (≥50km from the coast) environments shall be considered as corrosivity category C3, as per ISO 12944.

4.13 PRESERVATION & SHIPMENT

4.13.1 Preparation of equipment for transportation shall conform to the packing, marking, and shipping instructions identified in the Purchase Order. Preservation and shipment requirements will be stipulated in the equipment datasheet and project specification(s). However, as a minimum, the following requirements shall be applied:

The SUPPLIER shall ensure that all equipment is clean, sealed, protected and packed suitably for international shipment to ensure that all equipment will remain undamaged during transit and subsequent outdoor storage at the installation site for a minimum period of twelve (12) months or commissioning. The equipment packaging shall include adequate preservation to ensure that it will not require unpacking or disassembly, nor be subject to any deterioration during site outdoor storage prior to installation. Suitable protection shall be applied, which shall include, but not be limited to:

a) Covering flanged openings with metal cover plates and protecting exposed shaft ends against physical damage
b) Applying adequate bracing
All temporary bracing/supports shall be marked "Remove before Equipment Commissioning and Start-up" and painted in red/white coloured stripes
c) Capping and securing open pipe/tube ends
Female connections shall be plugged with solid metal pipe plugs, male connections shall be protected with full metal pipe caps
d) Boxing separately, all loose and spare parts.

e) Capital spare parts shall be suitable for 4 years storage in metallic containers, open to the sky. *Pieces of equipment and spares shall be identified by item number and service and marked with CONTRACTOR's order number, tag number and weight, both inside and outside of each contained. Spare parts shall also be tagged as "Spare". A bill of materials shall be supplied within each package / container of parts*

f) Covering exposed and machined surfaces, including bolting, with a coating of rust inhibiting compound. Spraying or coating internal metal surfaces with suitable rust preventative prior to shipment, which can be removed with liquid de-greaser.
All openings shall be tagged to indicate the rust preventative applied

g) Mechanical seals, drive couplings, carbon rings, packed glands and other similar rotating seals shall be removed prior to shipment and packed separately, utilising suitable preservation and protection. Packing of mechanical seals and bearing assemblies shall be suitable to ensure these parts are fully protected from ingress of dust, sand, dirt, moisture or other foreign matter.

h) Seal chambers shall be protected from entry of foreign material.

i) Each item, crate, bag, etc., shall be identified in accordance with the marking requirements specified in the Purchase Order.

j) Marking containers clearly to indicate whether they should be stored in the horizontal or vertical position

k) Marking containers clearly to demonstrate requirements for air conditioning

l) Clearly highlighting any equipment requiring re-preservation and the incidence of re-preservation in the packing list and on tags attached to the packaging. A procedure for re-preservation shall be supplied along with the delivery.

m) ADNOC Grade oils shall be specified

4.13.1 Equipment or materials that contain or are coated with any of the following shall be prominently tagged at openings to indicate the nature of contents and precautions for shipping, storage and handling:

- Insulating Oils
- Corrosion Inhibitors
- Antifreeze Solutions
- Desiccants
- Chemical Substances
- Hydrocarbon Substances

4.13.2 Regulated substances shall have a Material Safety Datasheet (MSDS), which shall comply with regulations for MSDS preparation specified by the entity with jurisdiction and shall include a statement that the substance is considered hazardous by regulation. If a product is exempt from regulation, a statement to that effect shall be included. Before shipment, the MSDS shall be forwarded to the receiving facility and at shipment, MSDS in protective envelope shall be attached to the outside of the shipment.

4.13.3 Supplied vapour-phase inhibitor or silica gel crystals shall be easily accessible for removal. The bags shall be attached with stainless steel wire and their locations indicated with corrosion resistant tags fixed with stainless steel wire.

4.13.4 Long term storage instructions shall be prepared for all spare parts. Spare rotors for pumps, compressors and turbines shall be supplied in nitrogen pressurized metallic containers. Such containers shall be fitted with N2 blanketing provision, nitrogen cylinder, pressure indication, safety devices and audio-visual alarm to indicate loss of nitrogen pressure. Rotors shall be stored vertically to avoid sagging issues. However, the container shall have provision to allow support in both vertical and horizontal position.

4.13.5 Bearings and seals shall be removed prior to shipment and stored within separate long-term storage containers.

4.13.6 All Capital spares shall be packaged suitable for long term storage without having to reopen for condition monitoring.

4.13.7 SUPPLIER shall be responsible for the adequacy of preparation for shipment, to ensure that supplied equipment reaches the storage facility or plant (as appropriate) in the same condition as inspected and accepted prior to shipping.

4.13.8 The COMPANY shall reject any equipment received in a lesser condition to that accepted prior to shipping. Any costs associated with the return, repair or replacement of the equipment shall be the responsibility of the SUPPLIER.

4.13.9 Sea Transportation Loads (where applicable) shall be advised on a project by project basis.

4.13.10 Maximum transportation envelope and weight limit shall be advised on a project by project basis.

4.13.11 Packaging for offshore installations shall be applied as follows:-

a) Depending on overall layout, shelters for weather protection may be designed to enclose a number of units or individual units of machinery. For individual units, the shelter may be supplied by SUPPLIER and directly mounted on the machinery skid.

b) Installation and commissioning plans shall minimise the amount of time the equipment is installed offshore before start-up because of susceptibility to corrosion. If the time shall be excessive then long term preservation shall be initiated to protect the equipment.

4.14 DOCUMENTATION/MANUFACTURER DATA RECORDS

The SUPPLIER shall submit the required project documentation and Manufacturing Data Records as specified within the COMPANY 'Information Requirements – Appendix 3 (Ref. 4) and the relevant equipment datasheet. The detailed format of documents shall be specified on a project basis in line with the relevant COMPANY Business Unit Standards.

4.15 GUARANTEES & WARRANTY

4.15.1 Refer to relevant COMPANY equipment specifications and project datasheets for details of the required guarantees and warranties.

5. TECHNICAL DESIGN REQUIREMENTS

5.1 General

Operational Requirements

5.1.1 Equipment, including any auxiliaries, offered and supplied for Continuous Operation or Intermittent Operation shall be designed, manufactured, transported and installed to achieve a minimum service life of 30 years and at least 40,000 hours (5 years) of uninterrupted operation. Any equipment specific requirements relating to required years of uninterrupted operation, are defined in the relevant equipment specifications. If additional features are necessary to satisfy this requirement, the SUPPLIER shall list these in their offer. All replacement parts such as wear rings, throat bushes and seals shall have a minimum service life of 5 years to meet these criteria.

5.1.2 Equipment shall be sufficiently robust to withstand, without damage, the results of occasional abnormal conditions of limited duration.

5.1.3 Equipment specified for either continuous or intermittent service shall be capable of 3000 starts in 30 years unless otherwise specified on the equipment datasheet.

5.1.4 Equipment shall be suitable for the specified operation across the whole of the specified operating range, without the use of bypass, recirculation, venting or flaring.

5.1.5 Standby equipment- The requirements for standby equipment will be specified on the equipment datasheet.

5.1.5.1 All standby units shall be capable of quick, full-load start-up on demand – whether manual or automatic – without jeopardizing safety or plant operation. This requirement shall also apply to restarts from a shutdown, following resolution of the shutdown conditions.

5.1.5.2 Running and standby equipment shall be designed to start the stand-by before stopping the main equipment. System pressure, piping and process shall be designed to cater for both master and standby equipment running at the same time for a short period at changeover or test. Standby equipment shall have master/slave changeover facilities at field and remotely from the central control system.

Layout and Maintenance Requirements

5.1.6 All equipment shall be designed to permit rapid and economical maintenance, with all left-handed threads being clearly marked.

5.1.7 As far as practicable SUPPLIER and CONTRACTOR shall ensure the equipment layout, shall be arranged to avoid dismantling of suction and discharge pipework, steel support structures, or accessories (e.g. seal pots, exchangers, cable trays, junction boxes, etc.) during equipment maintenance and/or overhaul activities.

5.1.8 Couplings shall have unhindered access from both sides for their removal, alignment and for condition monitoring of machine bearings etc.

5.1.9 Equipment baseplates or skids shall be sized and designed, as much as possible, to provide safe and easy operation and maintenance access. Overly compact designs which do not permit safe access shall not be accepted. Minimum walk space within the skid for packaged equipment shall be at least 0.7 m. Baseplates / skids / flooring shall be fabricated with a non-slip surface and capable of withstanding loads associated with operation and maintenance.

5.1.10 Site equipment local manual trip mechanism(s) shall be safely and easily accessible with direct approaches without any hindrance or step overs. Where electric motor driven auxiliaries are provided as part of the equipment package local emergency stop stations shall be installed adjacent to each electric motor.

5.1.11 All major rotating equipment will have a dedicated facility for lifting by electrically operated cranes. All other rotating equipment shall have provision for safe and free access to appropriate lifting equipment (cranes, forklifts, etc.). EOT (electric overhead travelling) crane SWL shall be sized for 150% of maximum values, to allow for slings and other attachments. CONTRACTOR, with input from SUPPLIER, shall prepare a material handling study, which shall include detailed mechanical handling drawings, including capacity of crane, crane location, lifting methods, accessibility, paved areas etc.

5.1.12 Any maintenance item heavier than 15 kg shall be provided with lifting lugs or similar fixed lifting point(s). Screw-in eyebolts are only acceptable for internal components where other lifting arrangements are impractical. Lifting equipment will be provided for all items over 15 kg.

5.1.13 All medium/large filter housings and small knockout drums shall have self-supported covers over hand/manway access and/or filter element removal openings.

5.2 Reliability

5.2.1 Equipment and its auxiliaries shall be conceived, configured, designed, manufactured, transported, installed and commissioned to achieve the specified overall plant availability throughout the specified life of the installation. Equipment reliability shall be at least 99%.

5.2.2 The SUPPLIER shall provide an estimate of their equipment's reliability, based upon their design, as part of their proposal.

5.3 Location & Site Conditions

5.3.1 Unless specified for offshore use, equipment will be located in a desert environment with high ambient air temperatures, sand and dust storms, highly humid salt laden atmosphere, near to coastal areas. Equipment specified for offshore use will be located in a marine, saliferous environment with high ambient air temperatures.

5.3.2 All equipment shall be tropicalized and capable of operating unattended and in the open, including in direct sunlight, unless otherwise specified.

5.3.3 The SUPPLIER shall provide specific written confirmation of compliance with the specification for outdoor sun-exposed equipment.

5.3.4 The SUPPLIER shall recommend in the proposal any additional provisions not specified by the COMPANY that are required to satisfy the operating conditions.

5.3.5 Roofing shall not be considered as an indoor environment.

5.3.6 Local gauge boards and instruments shall be fitted with sunshades.

5.4 Noise Control

5.4.1 The SUPPLIER shall submit guaranteed maximum sound pressure and sound power level data for the equipment at each octave band, together with any other relevant information as required. The sound pressure level (SPL) from the driven equipment, gearbox, driver and associated auxiliaries shall not exceed the value specified in the equipment datasheet or a maximum of 85dBA at 1 metre in all directions, whichever is less.

5.4.2 The SUPPLIER shall indicate any special noise attenuation measures required to meet the noise limits specified on the equipment datasheet. ISO 3740[7], ISO 3744[8] and ISO 3746[9] may be consulted for guidance." Furthermore, the COMPANY Business Unit specific noise insulation material specifications shall apply.

5.4.3 If acoustic attenuation treatment is required to satisfy the specified noise limit, the SUPPLIER shall confirm full details of any measures proposed the predicted treated and untreated noise levels, together with associated cost impact(s). The supply of noise enclosures may also require the provision of associated fire extinguishing system(s) and additional fire and gas detection instrumentation, inside and/or outside the enclosure. This is subject to COMPANY approval.

5.5 Casings

5.5.1 Pressure retaining casings shall not be fabricated in any form of cast iron.

5.5.1 For large and/or high-speed turbo-machinery, provisions shall be made by the SUPPLIER for verification of hot alignment during operation using optical instruments. SUPPLIER shall ensure that there is sufficient space available for installing benchmark 5/16-inch (8.0 mm) dowel pins on each side of bearing housings and casings, as close to the shaft centerline as possible and that observation of the optical measurement scales is unobstructed. SUPPLIER's representative shall participate in final alignment in the field Refer to Appendix 2 of equipment specifications for details of SAT requirements.

5.5.2 Internals of casings shall be positively locked in place, such that on failure or coming loose they cannot fall into and damage the equipment.

5.5.3 Connections on the upper half of the casing of axially split machinery are not acceptable without the approval of COMPANY.

5.5.4 Casing openings for pipe or auxiliary connections shall be not less than ¾" NPS and shall be flanged. Threaded connections shall not be used. Where flanged openings are impractical on weldable casings, openings of 1" NPS or larger shall be full penetration butt weld connections, not socket weld connections.

5.6 Main Process Connections

5.6.1 When the main process connections are flanged, they shall be fully drilled. No threading in the flanges is allowed. As a minimum, where API standards are specified, all process connection flanges shall be ANSI Class 300# rating.

5.6.2 Flat-faced flanges shall not be accepted.

5.6.3 Where flanged openings are impractical due to space limitations or process conditions, such as Hazardous Service(s), openings of 1" NPS or larger shall be full penetration butt weld connections, not socket weld connections.

5.6.4 A pipe nipple, preferably not more than 150 mm (6 inches) long shall be used, minimum Schedule 80, and provided with a weld-neck flange. Connection to the outer pressure casing shall be by butt-welding.

5.6.5 Tapped openings on casings containing process streams that are not connected to piping shall be flanged or plugged, using solid round-headed steel plugs per ANSI B16.11, and seal-welded.

5.6.6 RTJ flanges shall be used for hydrogen and all sour service applications on flange ratings of PN 110 (ASME Class 600) and above

5.7 Auxiliary Pipework & Instrument Connections

5.7.1 All SUPPLIER auxiliary pipework interface connections including all drains, vents and utility supply/return lines shall be located at the edge of the baseplate(s) and shall include an isolation valve and blind flange. Unless approved otherwise, a single connection is required for each category of fluid service.

5.7.2 All instrument and control connections shall comply with instrument connection standards for their fittings and glands. They shall be located in a safe place away from rotating, hot and hazardous parts. They shall have easy and safe access for individual operation and maintenance purposes.

5.8 External Forces and Moments

5.8.1 Specific values for allowable forces and moments on main process nozzles shall be included in individual equipment specifications and the equipment datasheet and these will be used during bid evaluation.

5.8.2 For packaged equipment with SUPPLIER piping and with CONTRACTOR tie-in connections, SUPPLIER's allowable loads and moments shall be followed. SUPPLIER shall anchor their pipework on skids close to battery limit connections. SUPPLIER shall carry out stress analysis within their skids and reports shall be submitted as part of their package documentation.

5.8.3 If SUPPLIER's stress analysis indicates that loadings will exceed the allowable limits, the SUPPLIER shall consider rerouting, rearrangement and/or support of their equipment. The SUPPLIER shall notify the COMPANY prior to undertaking any modification. If these remedial measures do not sufficiently reduce the expected loadings, the SUPPLIER shall approach the CONTRACTOR and COMPANY to establish whether the additional loading can be absorbed into the tie-in connections, without causing loss of integrity or performance.

5.8.4 All equipment shall be capable of safely withstanding, without reduction in performance, all anticipated forces and moments acting across the whole of the operating range of equipment as defined on the datasheet.

5.9 Rotating Elements

5.9.1 SUPPLIER shall, jointly with driver MANUFACTURER (driven machine MANUFACTURER if generator application), establish the maximum transient torque that will occur in all rotating components under start up, running, and fault conditions. Detailed requirements shall be stipulated in the COMPANY equipment specifications. In the event that meeting this requirement requires an increase to the equipment frame size, the COMPANY shall be informed and confirm their acceptance prior to undertaking any amendments to the design.

5.10 Bearings and Bearing Housings

5.10.1 Cooling coils shall not be provided as means of bearing oil cooling.

5.10.2 Bearing housing shall be fitted with adequate bearing guards to minimize ingress of atmospheric dust and sand. Labyrinth seals alone are not considered adequate. On large machines, capability for air/nitrogen purge at bearing housing labyrinths shall be provided.

5.10.3 Unless anti-rotation devices are provided in accordance with 7.1.5 of this Appendix, sleeve or tilting-pad radial and thrust bearings shall be capable of withstanding reverse rotation for a short period of time without damage. The SUPPLIER shall advise in the proposal the estimated duration and maximum speed the bearing can withstand without damage in a reverse rotation mode.

5.10.4 Bearing rating shall be based on the highest oil temperature conditions resulting from continuous operation at the maximum ambient temperature specified. Hydrodynamic bearings shall be sized to limit babbitt temperature at the location of the temperature sensors. The maximum bearing metal temperatures under

any load conditions and at the maximum specified oil inlet temperature and worst specified ambient and cooling conditions, is defined in the relevant COMPANY rotating equipment specification.

5.10.5 Permanently sealed bearings shall not be acceptable for any equipment.

5.11 Shaft Seals

5.11.1 Seals shall be capable of removal on site without moving the driving or driven equipment, including gear boxes.

5.11.2 Unless anti-rotation devices are provided shaft seals shall be bi-directional. The SUPPLIER shall comment in the proposal the estimated duration and maximum speed the seals can withstand without damage in a reverse rotation mode.

5.12 Vibration and Balancing

5.12.1 The SUPPLIER shall demonstrate, by appropriate calculation, that the design does not suffer harmful resonance excited by any harmonic speed. If this is not available, a frequency test shall be performed to demonstrate that the equipment is free from harmful resonance.

5.12.2 Balancing procedures shall be such that rotor and coupling interchangeability can be achieved without the need for rebalancing. This will require rotors to be first balanced without couplings, and then to be check balanced with coupling hubs mounted.

5.12.3 Relative radial position of the coupling hubs with respect to shaft to be clearly marked to avoid assembly errors.

5.12.4 Standards for balance and vibration are specified in applicable COMPANY equipment specifications. For other rotating equipment types, the requirement within the applicable API standard shall take precedence.

5.12.5 Balance procedures shall be such that balance repeatability can be ensured. Balance procedures and results are subject to COMPANY approval.

5.12.6 Unless more stringent values are specified elsewhere, vibration amplitude at any non-synchronous speed at any operating condition shall not exceed 10% of the allowable vibration at synchronous speed.

5.12.7 Where non-contact vibration probe system are installed, the SUPPLIER shall indicate in their proposal the permissible alarm and trip values for the safe running of the machine.

5.13 Lube Oil Systems

5.13.1 Details of the lubrication system design requirements for specific equipment types are defined in the relevant COMPANY equipment specifications.

5.13.2 Grease lubricated bearings shall not be accepted unless otherwise indicated on the equipment datasheet, with the exception of electric motors, air cooler fans and pumps with power ratings up to 100kW, where grease lubricated bearings can be accepted subject to COMPANY approval.

5.13.3 All bearing lubrication systems shall be capable of operating in extreme site conditions without loss of bearing system reliability or integrity. Reliable and well proven bearing guards / isolators are required.

5.13.4 Oil mist lubrication shall not be used, with the exception of applications within the ADNOC Refinery Business Group where oil mist lubrication can be offered and can be used if approved by the COMPANY.

5.13.5 Grades of lubricating and sealing oils/grease shall be minimized and compatible with existing COMPANY plants / equipment. Utilisation of ADNOC Grade lubricating oil and grease is mandatory unless the specific grade is not manufactured by ADNOC. Lubricant type shall be stamped or etched on the equipment nameplate.

5.13.6 If the driver and driven equipment both require pressure lubrication, then a common pressure lubrication system shall be provided.

5.13.7 Lube oil coolers shall be designed in accordance with the relevant COMPANY static equipment specifications and referenced standards.

5.14 Materials

5.14.1 SUPPLIER may offer alternative materials to those specified in the requisition if, based on his experience, these would be better suited for the application. The use of any alternative materials is subject to the written approval of COMPANY metallurgist. Following placement of a Purchase Order by COMPANY, any proposed deviations to the specified requirements must be submitted to CONTRACTOR/COMPANY by means of a formal Concession Request identifying full technical details of the proposed deviation together with the associated cost and schedule impact.

5.14.2 All pressure retaining castings shall have the material designation embossed or engraved on each part.

5.14.3 SUPPLIER shall select materials suitable for the process fluid composition(s) given in the data/requisition sheets for all cases.

5.14.4 For equipment handling fluids containing aqueous hydrogen sulfide in concentrations of 50 ppm H2S or greater, all components including associated systems and ancillaries in contact with the fluid as well as the external bolting on the casing and seal glands shall conform to the requirements of MR0175/ISO 15156 or NACE MR0103/ISO 17945 as applicable. Ferrous materials not covered by MR0175/ISO 15156 or NACE MR0103/ISO 17945 shall have a maximum hardness of 248 Hv10. This hardness limitation also applies to the heat affected zone of welds. Steel plate materials shall comply with through-thickness tensile test per ASTM A770 S3 and shall have a minimum reduction of area of 35 percent.

5.14.5 Copper and copper alloys shall not be used in the presence of hydrocarbons containing H2S, acetylene, ammonia or ammonium chloride.

5.14.6 The use of internal weld overlays or internal coatings on equipment, pipework, tanks or pressure vessels, shall be subject to agreement by COMPANY and/or CONTRACTOR. If used, internal coatings shall be applied according to the coating MANUFACTURER's recommended preparation method and coating application procedure in accordance with the specified requirements within the relevant COMPANY business unit standard(s). An integrity pull test shall be performed to ensure correct adhesion of the internal coating.

5.14.7 The minimum quality bolting material for pressure joints shall be ASTM A193, Grade B7 for carbon steel and A193 Grade B8M for stainless steel. For NACE/sour service, bolting shall be ASTM A193 B7M. Specific external and internal bolting material requirements as required to suit the environmental conditions or fluid service will be specified within the equipment datasheets.

5.14.8 Close tolerance mating parts, such as shaft sleeves, that are made from galling materials and that cannot be disassembled by hydraulic or thermal expansion techniques shall not rely on anti-seizure compound. These items shall have a suitable thin metal plating to prevent galling. In the proposal, the SUPPLIER shall fully describe the type of plating and the method of deposition.

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5.14.9 For all instrument and control items provided with the equipment package, SUPPLIER shall select materials suitable for the process fluid composition(s) given in the data/requisition sheets. Material shall also fit with the process temperature and pressure ratings. Instrument tubing materials shall comply with following parameters

a. For non sour service (instrument air, hydraulic oils, lube oil, Nitrogen etc. and process fluids falling under non sour criteria): SS316L tubes and fittings.

b. For sour service without chlorides: Inconel 825 with SS316L fittings.

c. For sour service with chlorides: Inconel 625 with SS316L fittings

d. Any other metallurgy shall be defined during FEED phase of project (based on respective project philosophy and process conditions) and requires COMPANY approval

5.14.10 For further requirements relating to Materials certification, traceability and testing refer to Appendix 2 “Quality Assurance Inspection and Testing Requirements” within each of the COMPANY equipment specifications.

5.14.11 Neither grey cast iron nor nodular (ductile) cast iron shall be used for pressure containing parts but nodular (ductile) cast iron may be offered for non pressure retaining parts, subject to COMPANY approval.

5.15 Thermal Insulation

5.15.1 Thermal Insulation shall be applied to equipment and pipework in accordance with the project agreed philosophy and relevant COMPANY business unit standard(s).

5.15.2 Personnel protection shall be provided for all equipment and piping operating at 60°C or above, where there is potential for contact between personnel and hot surfaces

5.16 5.16

6. ACCESSORY REQUIREMENTS FOR ROTATING EQUIPMENT

6.1 Drivers

6.1.1 All expected combinations of operating conditions shall be considered in defining the maximum power requirement for the driven machine. Maximum power shall be defined at the driver coupling, and shall include all transmission losses.

6.1.2 Detailed startup procedures shall be jointly developed by COMPANY, CONTRACTOR and SUPPLIER. The SUPPLIER shall define restricted speed ranges and allowable rates of loading and ensure that adequate driver torque is available and the control system is fine-tuned. Unless agreed otherwise, it shall be assumed that starting will be with rated conditions specified on the datasheets.

6.1.3 Electric motors shall comply with the relevant specification and the equipment datasheet. However, where there is no margin specified, a margin of 10% over the end of curve power absorbed shall be employed.

6.1.4 The complete unit shall be able to withstand, without damage, the effects of a fully loaded shutdown of the unit (against safety relief valve set pressure, including accumulation and/or maximum continuous speed). In case of an electric motor driver (either fixed or variable speed), the complete unit shall be able to withstand, without damage, the effects of a 2 or 3 phase short circuit.

6.1.5 Anti-rotation devices shall be provided if reverse rotation is not acceptable for the driver or driven equipment as per original design.

6.1.6 Motorized barring devices shall be provided for heavy duty and critical machinery, according to equipment types and as defined in the COMPANY equipment specifications.

6.2 Gears

6.2.1 SUPPLIER shall strive to eliminate the need for gearing systems by offering proven direct driven machinery. Gear box bearings and casings shall be provided with vibration and temperature monitors. Job gearboxes shall be used during shop tests of driver and/or driven machinery where complete unit test is requested.

6.2.2 Where proposed, gearing systems shall conform to the requirements of the individual rotating equipment and gearing specification.

6.2.3 Epicyclic units shall not be supplied without the prior approval of COMPANY and will only be considered where epicyclic units form an integral or standard feature of the equipment.

6.2.4 Gear units located between two items of driven equipment shall have a rating of at least 110% of the maximum power required by the driven equipment

6.2.5 Gears for use with variable speed electric motor drivers shall have service factor increased by at least 20% to allow for the effects of pulsating torque. Service factor shall be above motor nameplate rating.

6.2.6 Gear units shall safely withstand any transient torsional loads imposed during start-up, during re-acceleration after power interruption or short circuit, or due to mal-synchronisation of the driver or driven equipment.

6.2.7 Gearboxes shall be adequately sealed to prevent ingress of contaminants.

6.2.8 Gearboxes shall be fitted with an adequately sized filter-breather such that oil vapours shall not condense or accumulate on the gearbox casing.

6.2.9 All special purpose gearbox oil drains shall be provided with connections for on-line oil analysis and monitoring.

6.2.10 When integral thrust collars are provided, the design shall be arranged such that, if necessary, they can be replaced by separate shrunk-on thrust collar.

6.2.11 Gearboxes shall be dowelled under the high-speed pinion. SUPPLIER shall provide any special tools necessary for dowelling to be carried out on site.

6.3 Couplings, Guards

6.3.1 Couplings shall be selected with a minimum service factor of 1.5 applied to the SUPPLIER's rating, with the understanding the coupling rating may be subject to further review because of torsional and lateral studies.

6.3.2 Couplings shall safely withstand any transient torsional loads imposed during start-up, during re-acceleration after power interruption or short circuit, or due to non-synchronisation of the driver and driven equipment.

6.3.3 Standards for balance and vibration are defined in the individual COMPANY equipment specifications. Where no standard is specified, couplings shall be balanced to ISO 21940 Grade G1 or better.

6.3.4 Couplings for special purpose machinery shall comply with API 671 latest edition where this is a required within the COMPANY equipment specification or the relevant API. These couplings shall be used during equipment shop tests.

6.3.5 All flexible couplings shall be of a design in which the spacer piece is positively constrained from flying out in the event of failure of the flexible elements. All coupling components shall be of non-sparking type and in brass.

6.3.6 All moving parts shall be guarded in accordance with BSI PD 5304 or an appropriate national standard. The coupling guard shall be permanently fixed and shall be sufficiently rigid to ensure that rubbing cannot result from deflection caused by normal body mass (90 kg) applied horizontally or vertically.

6.3.7 No section of the transmission shall be left unguarded. Where ventilation or need to observe the guarded area dictates the use of perforated sheet or wire mesh, the design and construction of the guard shall prevent manual contact with moving parts.

6.3.8 Transmission guards shall be weatherproof. Guards shall be made of brass. Coupling guard temperatures, measured on the outside surface, shall not exceed 70°C. The use of oil spray to achieve this temperature limit is not allowed.

6.4 Baseplates

6.4.1 Unless otherwise specified, the baseplate shall be common for the complete train - comprising of driver(s), gear(s) and the driven equipment and shall be continuously welded.

6.4.2 No equipment, junction boxes or control panels - or their supporting structure - shall overhang the base plate. Motor junction boxes may overhang to the extent needed for cable entry.

6.4.3 Deflection of the baseplate while lifting shall not exceed the figures quoted in the COMPANY equipment specifications.

6.4.4 Shims shall be stainless steel and shall conform to the recommendations of API RP 686, Part VII: 5.4.2.

6.4.5 Requirements for a grouted or non-grouted type design are defined in the COMPANY equipment specifications. Where grout is to be used, it shall not be filled within the base frame and grout shall be applied only under baseplate bottom flange. The Installation CONTRACTOR shall take responsibility for filling grout without any air pockets. Quality selection of grout shall be such that for the entire design life of the equipment (i.e 30 years) it will not crack of loosen up or deteriorate during pump operation, causing vibration issues in pumps.

6.4.6 Baseplates for packaged equipment specified for offshore mounting shall be designed in accordance with Z0-TS-S-06010 – Steel Work for Mounted Equipment Packages.

6.5 Controls & Instrumentation

6.3.9 Except where unsuitable due to system limitations (speed of response, complexity of calculation etc.), control of rotating equipment shall be incorporated within the installation’s Integrated Control and Safety System (ICSS). Equipment shall be provided with a local emergency stop button and a display panel for duplication of key data sent to control system.

6.3.10 Where equipment control cannot be fully integrated into the ICSS: equipment shall be integrated into ICSS system as much as possible and shall have access to a Fire & Gas system, Machine Monitoring system, Performance / Anti-surge and Load Sharing system as applicable. Any standalone systems shall transmit redundant data to the plant control system.

6.3.11 SUPPLIER and CONTRACTOR shall mutually agree the integration of package control system (ICSS) including review of the following documentation.

- CONTRACTOR's P&IDs
- Control and protection systems throughout operating conditions (including startup and shutdown, all normal operation and emergency shutdowns)
- Anti-surge and reverse rotation protection
- Over-pressure protection
- Differential pressure protection

6.3.12 All electronic instrumentation (except transmitters, I/P converters) shall be suitably protected from the environment (all outdoor instrumentation shall be adequately protected by sunshade(s) and installed far from heat, vibration, liquids and noise source) or located in the main control room(s). If electronic instrumentation is required to be located in the field, these shall be used in local panels with dual air conditioners rated for the area classification.

6.4 Wiring/Cabling

6.4.1 Instrument and power wiring or cabling, with the exception of power supply to electric motors, shall be connected to terminal strips installed in terminal boxes. Instrument signals and wiring or cabling with different voltages shall be connected to separate terminal boxes. The terminal boxes shall preferably be mounted in one skid edge location on a baseplate. The location of the terminal boxes shall be shown on the layout drawing. Design shall allow for easy access for construction cables and junction box termination, maintaining cable / junction box segregation throughout.

6.4.2 Instrument cables shall be of the metal armoured or braided type. Cables shall be secured with stainless steel cable ties at suitable intervals and cable trays provided with cover.

6.4.3 The cable trays within the equipment package/baseplate/skid shall be extra heavy-duty type, hot dip galvanized and painted to prevent corrosion of the protective zinc coating. Cable trays shall be covered. Cables shall be installed in cable trays properly supported to minimize vibration and be segregated such as to prevent interference between voltage levels.

6.4.4 All instrument tubing shall be routed in a safe way, not obstructing any other equipment or operation access. Extension wires or cables shall be run inside a metal conduit suitable for the environmental conditions.

6.4.5 Junction boxes, gauge boards and field instrument panels shall be located at the skid edge in a safe place, easily accessible from back and front, away from vibration and heat sources. They shall also be fitted with stands / brackets and sunshades.

6.4.6 Instrument in direct contact with the process fluids (gases, oils, etc.) shall have proper sealing to prevent any leaks at the most severe operating conditions. They shall have the proper isolation valves and logic override (if it is required) to remove them and replace/calibrate at running conditions.

6.4.7 Changing individual instrument items shall not require changing or removal of any other mechanical parts (e.g. changing bearing pad for faulty impeded temperature element).

6.4.8 Instrument panels and field equipment shall have a protective coating applied in accordance with the relevant COMPANY Business Unit Standards for painting and coating.

6.4.9 Machine control package shall maximize graphic presentation within the ICSS system. Graphics shall include but not be limited to seal and lube oil loops, buffer and fuel gas systems, cooling water and air paths, start-up and shutdown steps, anti-surge control, etc.

6.4.10 Control system shall maximize field equipment redundancy (transmitters, switches, servos, etc.). Redundancy is required for trip and shutdown items as detailed in the COMPANY equipment specifications and wherever felt critical by SUPPLIER and CONTRACTOR.

6.5 Condition & Performance Monitoring

6.5.1 Requirements for condition and performance monitoring shall be specified in the COMPANY equipment specification and datasheets.

6.5.2 All wire entries into the equipment casing(s) or bearing housing(s) shall be provided with proper sealing against leakage.

6.6 Piping & Appurtenances

6.6.1 Valves shall not be installed without piping spools in between.

6.6.2 All interconnecting piping and valves shall be arranged such that all equipment is safely accessible for maintenance and/or removal (or removal of valve internals) without dismantling of the piping.

6.6.3 All isolation valves 2" and above (including battery limit valves), control valves and ESD valves shall have free and safe access by mobile crane and shall have platform access for operation and maintenance.

6.6.4 All piping systems connected to equipment or a piping system of a higher design class shall match the higher class for all connecting components, up to and including the first block valve, mating flange or spool piece.

6.6.5 Piping into equipment / equipment vessels shall be adequately supported to ensure that no nozzle will be subjected to any stress that could disturb the proper alignment, the internal clearances, or otherwise in any way impact the equipment to an extent that could jeopardize its efficiency, its trouble-free operation or the equipment's monitoring.

6.6.6 Auxiliaries associated with the equipment, such as seal pots, pressure control valves, pressure gauges, thermal gauges etc. shall be freely accessible.

6.6.7 System auxiliaries shall be arranged such that the dismantling of one shall not necessitate the removal of any other items of equipment and shall not affect alignment of the machine.

6.6.8 Temporary strainers/blinds etc., if used, shall be tagged "temporary".

6.6.9 All joints in auxiliary piping shall be flanged.

6.6.10 Unless impractical, accessories shall not be placed on the machine skid and shall be self-supported.

7. BUSINESS UNIT SPECIFIC CROSS REFERENCE

The following references apply to equipment supplied to specific ADNOC Business Unit

7.1 ADNOC Gas Processing

Reference Document Number	Reference Document Name
DGS 00 001	Basic Engineering Design Data
DGS 0000 001	Positive Material Identification Of Equipment And Piping
DGS 0000 003	Minimum Shop Inspection and Certification Requirements
DGS 0000 007	Field Services Installation Of Rotating Equipment

Reference Document Number	Reference Document Name
DGS 0000 008	Requirement Of Manufacturing Record Books For Non-Pressure Vessel Equipment
DGS 0000 009	Spare Parts Requirements
DGS 0180 001	Flare Details – (Amendments/Supplements to API STD 537)
DGS 0180 002	Flare System Design Basis
DGS 0710 001	Air Cooled Heat Exchanger (Amendments And Supplements To API Std. 661)
DGS 0710 002	Air Cooled Heat Exchanger – Design Criteria
DGS 1000 001	Rotating Equipment - Minimum General Requirements
DGS 1000 002	Rotating Equipment - System Integration
DGS 1000 005	Heavy duty couplings
DGS 1000 006	Amendments, Supplements to API-682 (Shaft sealing systems for Centrifugal and rotary pumps)
DGS 1180 001	Special Purpose Gear units
DGS 1300 030	Process and Utility Field / Shop Pressure Testing
DGS 1300 040	General Piping Process and Utility Design, Layout & Drawing
DGS 1300 060	Piping Flexibility Analysis
DGS 1300 175	Galvanizing
DGS 1300 185	Fabrication, Handling and Installation of Process and Utility Piping
DGS 1300 190	Traceability of Shop and Field Fabricated Piping Materials
DGS 1510 001	DCS Operating and Control Philosophy
DGS 1510 006	Instrument Numbering Rules
DGS 1511 001	Alarm Philosophy
DGS 1511 021	Distributed Control System
DGS 1511 032	Instrumentation Design Criteria
DGS 1511 033	Instrumentation Furnished with Packaged Equipment
DGS 1511 036	Instrument and Thermocouple Cables
DGS 1511 041	Flow Elements and Meter Runs
DGS 1511 042	Flow Instruments
DGS 1511 043	Instrument Installation Design
DGS 1511 044	Instrument Storage and Calibration
DGS 1511 045	Instrument – Field Pressure Testing
DGS 1511 046	Inspection and Testing of Instrument and Instrument Systems
DGS 1511 050	Programmable Logic Controllers (PLC)
DGS 1511 062	Machine monitoring Control System
DGS 1511 070	Anti-surge and Performance Control
DGS 1511-076	Safety Instrumented Function (SIL Classification and Implementation)
DGS 1541 001	Control Valves
DGS 1543 002	ESD and On/Off Valves
DGS 1545 001	Pressure Relief Devices
DGS 1550 001	Functional Loop Diagrams
DGS 1630 013	Electrical items on Packaged Equipment
DGS 1630 025	D.C. UPS System
DGS 1630 027	Electric Motors Cage-Induction and Synchronous (Cage-Induction requirements are applicable and Synchronous motor requirements are superseded by AGES-SP-005)
DGS 3335 001	Lubrication, Shaft-Sealing And Control Oil Systems for Special-Purpose Application (Amendments/Supplements to API Std 614)
DGS 6000 002	Equipment Noise Control
DGS 6300 001	Welding, NDE of Piping Systems
DGS 1783 004	Grouting

Reference Document Number	Reference Document Name
DGS 1883 001	Structural Steel Fabrication
DGS 1884 001	Structural Steel Erection
DGS 6000 002	Equipment Noise Control
DGS 6300 003	Welding, NDE for Pressure Vessels and Heat Exchangers
DGS 6500 010	Hot Insulation for Piping and Equipment
DGS 6600 010	Painting Part A (Painting Of New Metallic Structure)
DGS 6710 001	Preservation and Export Packing
DGS MX 001	Painting
DGS MN 001	Insulation
DGS MU 010	Acoustic Insulation for Pipes, Valves and Flanges
OEX ST 002	Maintenance Standard
DGS PU 018	Steam Tracing for Equipment, Instruments and Piping
DGS-PE-010/011	Basic Engineering Design Data
STD 1781-002-001	Anchor Bolts Material-Fabrication-Marking
STD 1781-002-002	Anchor Bolt Type T
STD 1781-002-003	Anchor Bolt Type R
STD 1781-002-004	Anchor Bolt Type S
STD 1781-002-005	Anchor Bolts Material-Fabrication-Marking
5295 PS 1511 85	Safeguarding and Instrumented Protective Functions for Rotating Equipment

7.2 ADNOC LNG

Reference Document Number	Reference Document Name
EP GIS 36-250	Specification for Material Requirements for Sour Service in Exploration and Production Operations
GIS 06-601	Specification of Coating for Metal Surfaces
GIS 06-602	Specification for Coating and Painting of SUPPLIER Equipment
GIS 12-101	Specification for Low Voltage Switchgear and Control gear (IEC)
GIS 12-102	Specification for Low Voltage Metal Enclosed Switchgear (IEEE C37.20.1)
GIS 12-151	Specification for Low Voltage Power and Control Cable (IEC)
GIS 12-152	Specification for Low Voltage Power and Control Cable (NEMA)
GIS 12-153	Specification for High Voltage Power Cable (IEC)
GIS 12-154	Specification for High Voltage Power Cable (NEMA)
GIS 12-155	Specification for Instrumentation Cable (IEC)
GIS 12-156	Specification for Instrumentation Cable (NEMA WC 57)
GIS 12-157	Specification for Optical Fibre Cable (IEC)
GIS 12-158	Specification for Optical Fibre Cable (ANSI)
GIS 12-201	Specification for Low Voltage Induction Motors (IEC)
GIS 12-202	Specification for Totally Enclosed Fan Cooled Squirrel Cage Induction Motors up-to 500 HP (IEEE 841)
GIS 12-203	Specification for High Voltage Induction Motors (IEC)
GIS 12-204	Specifications for Medium Voltage Induction Motors (API 541)
GIS 12-206	Specification for Synchronous Motors (API 546)
GIS 12-801	Specification for Power Generators (IEC)
GIS 12-802	Specification for Power Generators (API 546)
GIS 14-011	Guidance on Practice for Noise Control
GIS 15-011	Noise Control
GIS 26-102	Double Pipe Heat Exchangers

Reference Document Number	Reference Document Name
GIS 26-103	Specification for Air-Cooled Heat Exchangers (ISO 13706 or API 661)
GIS 30-251	Specification for Instrument Tubing and Fittings - Metric units
GIS 30-252	Specification for Instrument Tubing and Fittings - Customary units
GIS 30-253	Specification for Field Instruments
GIS 30-351	Specification for Actuators for On/Off Valves (IEC)
GIS 30-352	Specification for Actuators for On/Off Valves (ANSI)
GIS 30-651	Specification for Control Panel Design
GIS 31-016	Specification for Analysers
GIS 34-305	Specification for Diesel engines
GIS 34-306	Specification for Natural gas engines
GIS 34-501	Specification for Special Purpose Gear Units (API 613)
GIS 34-502	Specification for General Purpose Gear Units (API 677)
GIS 34-503	Specification for Special Purpose Couplings (ISO 10441 or API 671)
GIS 34-504	Specification for General Purpose Couplings. (ISO 14691)
GIS 34-701	Specification for Lubrication, Shaft Sealing, and Oil Control Systems and Auxiliaries (ISO 10438 or API 614)
GIS 34-705	Specification for Machinery Protection Systems API 670
GIS 34-801	Machinery Installation and Installation Design (API 686)
GIS 36-250	Specification for Material Requirements for Sour Service in Exploration and Production Operations
GIS 36-102	Hardness Testing, Post Weld Heat Treatment, Stress Relief, and Pickling for Pressure Vessels, Piping, and Other Components
GIS 36-103	Specification for Positive Materials Identification (PMI)
GIS 40-103	General Engineering Specification for Packaged Equipment (Excluding US Requirements)
GIS 40-104	General Engineering Specification for Packaged Equipment (US)
GIS 42-103	Specification for Fabrication, Assembly, Erection, and Inspection of Pipework (ASME B31.3)
GIS 46-010	Specification for Pressure Vessels
GP 12-45	Electrical for Packaged Equipment
GP 30-65	Control Panels
GP 30-70	Control and Instrumentation in Vendor Packaged Equipment
GP 32-12	Quality Management for Manufacturing – Rotating Equipment
GP 36-26	Materials for Sour Service in Petroleum Refining Environments
GP 42-10	Piping Systems (ASME B31.3)
GP 50-10	Quality Management

7.3 ADNOC OFFSHORE

Reference Document Number	Reference Document Name
API RP 552	Transmission Systems
API RP 553	Refinery Valves and Accessories for Control and Safety Instrumented Systems
ASTM A923	Standard Test Methods for Detecting Detrimental Intermetallic Phase in Duplex Austenitic / Ferritic Stainless Steels
ASTM E562	Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count
ASTM G48	Standard Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution

Reference Document Number	Reference Document Name
BS EN 10204	Metallic Products – Types of Inspection Documents
Standard Norge (SN) NORSOK M-650	Qualification of manufacturers of special materials
A0-IG-P-SP-003	Specification for Spun Hot Dip Galvanization & Polytetrafluoroethylene (PTFE) Coating of Nuts/Bolts and Fasteners
A0-ENG-N-SL-001	Status List for ADNOC Offshore Technical Standard Documents
CP-102	Inspection & Testing Requirements for New Equipment and Materials in Manufacture
GDL-003	Integrity & Safety Assurance of Temporary Equipment prior to Mobilization
GDL-008	Guidelines for Spare Parts Management
GDL-009	Project Deliverables
GDL-040	Concession Request
GDL-058	Management of Third Party Agencies (TPA) Services
GDL-070	Management of Change (MOC - Applications)
MNL-01	ADMA-OPCO Painting Manual
PRO-104	Magnetic Particle Inspection Procedure
PRO-108	Procedure for Liquid Penetrant Inspection
PRO-110	Part 1 Procedure for Pressure Testing of Piping Systems
PRO-110	Part 2 Procedure for Pressure Testing of Pressure Vessels
PRO-151	Material Preservation
SP-1002	Preservation of New Materials & Equipment
SP-1009	Specification For Requirements for Projects Contractor Quality System
SP-1020	General Specification for Protective Coating
SP-1031	Quality Control Personnel for Fabrication & Construction
SP-1050	Part 3 Specification for Mechanical Design Criteria Part 3: Rotating Machineries
STD-00 Part-1	Measurement Units
STD-00 Part-2	Site Condition and Data
STD-100	Approval of Materials of Manufacture Mechanical Equipment
STD-126	Bolting for Piping
STD-127	Gaskets for Flanged Joints
STD-148	Low Voltage Motors
STD-149	High Voltage Induction Motors
Z0-TS-Z-01010	General Data on Environmental and Climatic Conditions at ZADCO Facilities
Z0-TS-M-01010	General requirements for Skid Mounted Equipment Packages
Z0-TS-S-06010	Specification for Structural Steelwork for Skid Mounted Equipment Packages
Z0-TS-E-01040	General Electrical Requirements in Package Unit Equipment (Skid Mounted)
Z0-TS-E-01050	General Procedures for Inspection, Testing & Commissioning of Electrical Equipment for Offshore Facilities
Z0-TS-E-01060	General Procedures for Inspection, Testing & Commissioning of Electrical Equipment for Onshore Facilities
Z0-TS-E-07010	AC Electrical LV Motors for Onshore Facilities
Z0-TS-E-07020	AC Electrical LV Motors for Offshore Facilities
Z0-TS-E-07030	AC Electrical HV Motors for Onshore Facilities
Z0-TS-E-07040	AC Electrical HV Motors for Offshore Facilities
Z0-TS-J- 01030	Package Unit Instrumentation

Reference Document Number	Reference Document Name
Z0-TS-K-02010	General Process and Utility Data for offshore facilities
Z0-TS-K-02020	General Process and Utility Data for onshore facilities
Z0-TS-M- 02010	Unfired Pressure Vessels: Design
Z0-TS-M- 02020	Unfired Pressure Vessels: Fabrication
Z0-TS-M- 02030	Pressure Vessels Details
Z0-TS-M-06020	Centrifugal Pumps Package
Z0-TS-P-03010	Specification for Piping Design and layout
Z0-TS-P- 03020	Specification for Piping Details
Z0-TS-P- 04010	Specification for Fabrication, Erection & Testing of Pipework C.S.
Z0-TS-P- 04020	Specification for Fabrication, Erection & Testing of Pipework S.S.
Z0-TS-P- 05010	Piping Material Specification
Z0-TS-U-01010	Vendor Document Requirement Schedule for Packaged Equipment
Z0-TS-Y-02010	Specification for Protective Coating System
GIS 14-011	Guidance on Practice for Noise Control
GIS 34-501	Specification for Special Purpose Gear Units (API 613)
GIS 34-503	Specification for Special Purpose Couplings (ISO 10441 or API 671)
GIS 34-701	Specification for Lubrication, Shaft Sealing, and Oil Control Systems and Auxiliaries (ISO 10438 or API 614)
GIS 34-705	Specification for Machinery Protection Systems API 670

7.4 ADNOC ONSHORE

Reference Document Number	Reference Document Name
EM 30.99.95.0006	ADCO Guidelines for Submission of Electronic Documentation
EP 30.99.90.0024	Preparation of Supplier's/Vendor's Engineering Drawings and Documents
EP 30.99.90.0001	Drawing Design and Numbering Systems
ES 30.99.00.0001	Tag plates for Field and Indoor Equipment
ES 30.99.37.0013	ADCO Engineering Specification – Painting & Coating of New Equipment
EP 30.99.97.0006.1	Projects Quality System Requirements (Manufacturing, Construction & EPC)
31.10.00.31-Gen	Noise Control (Amendments /Supplements to ISO 15664)
31.21.70.31-Gen	Air Cooled Heat Exchangers (Amendments/Supplements to ISO 13706)
31.29.00.10-Gen	Installation of rotating equipment
31.29.00.11-Gen	Condition Monitoring of Rotating Equipment
31.29.00.32-Gen	Petroleum and natural gas industries - High-speed special-purpose gear units (amendments / supplements to ISO 13691)
31.29.00.36-Gen	Flexible Couplings for Mechanical Power Transmission – Special Purpose Applications. (Amendments / Supplements to ISO 10441)
31.29.60.32-Gen	Lubrication, Shaft-Sealing and Control Oil Systems and Auxiliaries for Petroleum, Chemical and gas Industry Services (Amendments / Supplements to ISO 10438)
32.31.00.32-Gen	Instruments for Measurement and Control
32.31.09.31-Gen	Instrumentation for Equipment Packages
32.29.20.10-Gen	Safeguarding and Instrumented protective functions for rotating equipment

Reference Document Number	Reference Document Name
33.66.05.31-Gen	Electric Machines – Cage induction Types (Amendments/Supplements to IEC 60034-1 and IEC 60034-14)
70.10.70.11-Gen	Preservation of New and Old Equipment Standing Idle
70.10.80.11-Gen	Cleaning of Equipment
70.10.90.11-Gen	Spare Parts
S 68.004	Earthing boss for steel structures, tanks, vessels etc.
31.29.02.11-Gen	Pumps – Type Selection

7.5 ADNOC REFINING

Reference Document Number	Reference Document Name
ANSI B4.1	Preferred Limits & Fits for Cylindrical Parts
ASME B46.1	Surface Texture
BS PD 5304	Guidance on Safe Use of Machinery
ISO 2954	Mechanical Vibration of Rotating and Reciprocating Machinery - Requirements for Instruments for Measuring Vibration Severity
ISO 9906	Rotodynamic pumps – Hydraulic performance acceptance tests, Grade 1, 2, 3.
ISO 19011	Guidelines for Quality and/or Environmental System Auditing
DGS-EE-009	D.C. UPS System
DGS-EU-002	Electric Items On Packaged Equipment
DGS-IS-011	Machine Condition Monitoring
DGS-IU-007	Instrumentation Furnished With Package Units
DGS-MA-001	Oil Mist Lubrication System
DGS-MD-001	Vessel Design Basis
DGS-MG-003	Centrifugal Pumps for General Service (non API)
DGS-MG-004	Positive Displacement Rotating Pumps (Amendments/Supplements To API 676)
DGS-MM-001	Electric Motors – Cage – Induction And Synchronous Type (Cage-Induction requirements are applicable and Synchronous motor requirements are superseded by AGES-SP-005)
DGS-MP-001	Air Cooled Heat Exchangers Design Criteria
DGS-MP-002	Air Cooled Heat Exchange Equipment
DGS-MU-001	General Equipment Requirements
DGS-MU-002	Preservation And Export Packing
DGS-MU-003	Spare Parts
DGS-MU-004	Lubrication Requirements
DGS-MU-006	Minimum General Requirements
DGS-MU-007	Minimum Requirements for Integration of equipment
DGS-MU-009	Equipment Noise Control
DGS-MU-010	Acoustic Installation for Pipes, Valves and Flanges
DGS-MU-011	Installation of Rotating Equipment
DGS-MU-012	Requirements For Manufacturing Data Report for Non-Pressure Vessel Equipment
DGS-MU-013	Criticality Rating System
DGS-MU-014	Minimum Shop Inspection And Certification Requirements
DGS-MU-016	Special Purpose Couplings
DGS-MU-017	Shaft Sealing Systems for Centrifugal and Rotary Pumps (Amendments/Supplements to API 682)

Reference Document Number	Reference Document Name
DGS-MU-018	Overrunning Clutches
DGS-MV-001	Lubrication, Shafting-Sealing And Control Oil System (Amendments/Supplements to API 614)
DGS-MV-002	Special Purpose Gear Units (Amendments/Supplements To API 613)
DGS-MV-004	Synchronous AC Generators 1250 kVA and above
DGS-MV-006	General Purpose Gear Units (Amendments/Supplements to API 677)
DGS-MW-004	Material and Fabrication Requirements for Carbon Steel Piping and Equipment in Severe Service.
DGS-MW-006	Positive Material Identification Of Equipment And Piping
DGS-MW-007	Welding and Inspection requirements for equipment not covered by recognised standards and/or codes
DGS-MX-001	Painting
DGS-PE-010	Basic Engineering Design Data for Abu Dhabi Refinery
DGS-PE-011	Basic Engineering Design Data Ruwais Refinery East
DGS-PU-001	General Piping - Process and Utility Design, Layout and Drawing
DGS-PU-003	Technical Specification for Piping Systems

7.6 BOROUGE

Reference Document Number	Reference Document Name
EEMUA Publication 107	Recommendations for the Protection of Diesel Engines Operating in Hazardous Areas
BGS-EU-002	Electrical Items on Packaged Equipment
BGS-IS-011	Machine Condition Monitoring
BGS-IU-007	Instrumentation Furnished with Packaged Units
BGS-IU-023	Local Control Panels
BGS-ME-002	Shell and Tube Heat Exchangers
BGS-MU-002	Preservation and Export Packing Procedure
BGS-MU-003	Spare Parts
BGS-MU-006	Rotating Equipment – Minimum General Requirements
BGS-MU-007	Rotating Equipment – System Integration
BGS-MU-009	Equipment Noise Control
BGS-MU-013	Criticality Rating System
BGS-MU-014	Minimum Shop Inspection and Certification Requirements
BGS-MM-001	Electric Motors Cage-Induction and Synchronous (Cage-Induction requirements are applicable and Synchronous motor requirements are superseded by AGES-SP-005)
BGS-MV-001	Lubrication, Shaft-Sealing and Control Oil Systems for Special-Purpose Application (Amendments/Supplements to API Standard 614)
BGS-MV-002	Special Purpose Gear Units
BGS-MV-003	Diesel Fuel Compression Ignition Engines
BGS-MX-001	Painting
TID-PR-028	Concession and Waiver Procedure

QUALITY ASSURANCE, INSPECTION AND TESTING REQUIREMENTS

FOR

GENERAL & SPECIAL PURPOSE STEAM TURBINES (API 611 & 612) SPECIFCATION

Appendix 2 – AGES-SP-05-004

ص ب 898، ابوظبي، الامارات العربية المتحدة
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شركة بترول أبوظبي الوطنية
Abu Dhabi National Oil Company

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1. SCOPE

To specify quality management, materials selection and certification, welding and NDT, manufacturing inspection and testing requirements for the supply of steam turbines to AGES-SP-05-004, 'General & Special Purpose Steam Turbines (API 611 and 612) Specification' comprising:-

a) SECTION I – QUALITY ASSURANCE AND CONFORMITY ASSESSMENT
b) SECTION II – INSPECTION AND TESTING REQUIREMENTS
c) SECTION III – SHOP FABRICATION AND NDT
d) SECTION IV – SHOP TESTING AND SITE ACCEPTANCE TESTS
e) SECTION V – API 611 & API 612 TECHNICAL AMENDMENTS

2. NORMATIVE REFERENCES

For the purposes of this document, the documents referenced in KBR-23-SPE-0001 and those listed below, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) at the time of award applies.

Table 1 – Normative References

Ref.	Document No.	Title
1.	ISO 9001:2015	Quality Management Systems - Requirements
2.	API Specification Q1	Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry
3.	ASME B31.1	Power Piping
4.	ASME B31.3	Process Piping
5.	ASME Section II.A:2019	Materials – Part A – Ferrous Materials Specifications
6.	ASME Section II.B:2019	Materials – Part B – Non-Ferrous Materials Specifications
7.	ASME VIII Division 1	ASME Boiler and Pressure Vessel Code, Section VIII Division 1 Rules for Construction of Pressure Vessels
8.	ASME Section IX:2019	Welding, Brazing and Fusing Qualifications
9.	30-99-00-8517-1, Rev 0	COMPANY Specification – Equipment/Materials Criticality Rating
10.	ISO 10005: 2018	Quality Management – Guidelines for Quality Plans

3. TERMS AND DEFINITIONS

For the purpose of using this document, the terms and definitions given in API Standard 611 5th Edition, 'General Purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services', API Standard 612 7th Edition, 'Petroleum, Petrochemical, Natural Gas Industries Steam Turbines – Special Purpose Applications' and AGES-SP-05-004, General & Special Purpose Steam Turbines (API 611 & API 612) Specification shall apply.

The term **INSPECTION CLASS** where used within this document shall be taken to mean the same as **INSPECTION LEVEL** as used within 'COMPANY Specification – Equipment/Materials Criticality Rating' (Ref. 9).

4. ABBREVIATIONS

4.1 Abbreviations

The following abbreviations are only used within this document.

All other noted abbreviations used herein are defined within Appendix 1 - General Technical and Contractual Requirements for Rotating Equipment.

Abbreviation	Definition
ASNT	American Society of Non-Destructive Testing
AWS	American Welding Society
CAS	Conformity Assessment System
C of C	Certificate of Conformity
FCAW	Fluxed Cored Arc Welding
GTAW	Gas Tungsten Arc Welding
MCAW	Metal Cored Arc Welding
MDMT	Minimum Design Metal Temperature
HRC	Measure of Hardness
iFAT	Control System Factory Acceptance Test (Simulated)
MRB	Manufacturing Record Book
PIM	Pre-Inspection Meeting
PTC	Performance Test Code
RFI	Radio Frequency Interference

SECTION I – QUALITY ASSURANCE AND CONFORMITY ASSESSMENT

5. QUALITY ASSURANCE AND QUALITY CONTROL

5.1 Quality Management

5.1.1 The SUPPLIER and SUB-SUPPLIERs shall operate a quality management system established for the supply of products or services which shall conform to ISO 9001, API Specification Q1 or equivalent quality management system standard agreed with the purchaser.

5.1.2 The SUPPLIER's quality management system shall clearly identify the established lines of authority and responsibility of those responsible for the SUPPLIER's quality management system. Those persons responsible for quality management shall have ultimate authority to enforce quality assurance within the SUPPLIER's organisation and to identify, assess and implement corrective actions (CA) to deficiencies identified in the quality management system and to monitor the continued effectiveness of all corrective actions.

5.1.3 The SUPPLIER shall submit a copy of his corporate Quality Plan and valid ISO 9001 or equivalent certificate to the CONTRACTOR/COMPANY with his quotation for review prior to award. If the SUPPLIER'S facility is not ISO 9001 certified, the CONTRACTOR may at his discretion conduct a QA audit in accordance with ISO 9001 audit requirements, unless the SUPPLIER can provide evidence that he is operating a quality management system in accordance with ISO 9001 or equivalent quality management system international standard.

5.1.4 ISO 9001 Clause 8.1 and ISO 10005 may be used as a basis for the development of quality plans for specific applications, processes or products. API Spec Q2 may be used as a basis for the development of Service Quality Plans.

5.1.5 Quality control and associated inspection activities by the SUPPLIER on his SUB-SUPPLIER's will address both internally and externally sourced processes, products and services.

5.1.6 The SUPPLIER's inspection and test plan(s) shall include provisions for COMPANY/CONTRACTOR inspection; see Section 0, as specified in the datasheet or purchase order.

5.1.7 Irrespective of the **INSPECTION CLASS** defined within the purchase order, the SUPPLIER shall remain fully responsible for the operational planning and control of the supplied documentation, material sourcing, fabrication, manufacturing, inspection and test activities in order to ensure full conformity of the supplied products and services with the specified requirements. Refer to ISO 9001, sub-sections 8.1 and 8.2.

5.1.8 The SUPPLIER shall ensure that all applicable QA/QC, inspection and test requirements specified by the CONTRACTOR are included within the sub-orders to his SUB-SUPPLIERS to ensure full compliance to the purchase order requirements. If requested by COMPANY/CONTRACTOR, the SUPPLIER shall provide clear evidence of the required QA/QC surveillance of SUB-SUPPLIER activities.

5.1.9 The SUPPLIER shall submit certified reports of production tests as soon as the tests are completed satisfactorily.

5.1.10 The COMPANY/CONTRACTOR reserve the right to inspect materials and workmanship at all stages of manufacture and to witness any or all tests at the SUPPLIER's and/or SUB-SUPPLIER's premises. A dedicated inspection and test plan (ITP) shall be developed by the SUPPLIER as outputs to operational planning and to ensure quality control of the products or services to be provided by the SUPPLIER and his SUB-SUPPLIERs.

5.1.11 The SUPPLIER shall provide the CONTRACTOR with a copy of the manufacturing Inspection and Test Plan (ITP) for review and inclusion of any mandatory COMPANY/CONTRACTOR required witness points no less than 30 days after contract award or prior to the Pre-Inspection Meeting (PIM), whichever comes first. The inspection and test plan (ITP) shall specify the individual tasks to be performed, the procedures used and associated acceptance criteria to be applied by the SUPPLIER, SUB-SUPPLIER and/or MANUFACTURER to ensure that the materials or services are delivered in full conformity with the specified requirements.

5.2 Criticality Assessment

A criticality assessment shall be carried out by the CONTRACTOR prior to order placement to determine the Criticality Rating of the equipment package or materials to be purchased. The applicable Criticality Rating (CR) shall then be assigned by CONTRACTOR to each piece of equipment and identified within the purchase order issued by COMPANY or CONTRACTOR.

The method used by COMPANY or CONTRACTOR to determine the Criticality Rating (CR) will be in accordance with COMPANY Specification 'Equipment / Materials Criticality Rating' (Ref. 9) which shall be stated in the equipment Purchase Order. The criticality rating assigned by COMPANY or CONTRACTOR shall be used by the SUPPLIER to determine the required INSPECTION CLASS for the equipment. There are TWO different inspection classes (I and II), which relate to the criticality rating of the equipment.

Based on the stated **INSPECTION CLASS**, the SUPPLIER shall ensure that the minimum required level of inspection and testing identified by Table 7 – Inspection and NDT Minimum Requirements shall be reflected within the SUPPLIER's Inspection and Test Plan (ITP) to be submitted to COMPANY.

5.3 Quality Control Requirements

Based on the specified INSPECTION CLASS, the SUPPLIER shall ensure that the required level of inspection and testing is implemented in accordance with "Table 2 – Inspection Requirements" and that the minimum requirements for material certification and non-destructive examination are implemented according to "Table 7 – Inspection and NDT Minimum Requirements" throughout all stages of manufacture and testing. All related verification, inspection and testing activities shall be reflected within the SUPPLIER's Inspection and Test Plan (ITP) to be submitted to COMPANY.

5.4 Quality Audits

COMPANY or CONTRACTOR reserves the right to audit the QA/QC system and manufacturing processes operated by the SUPPLIER or his SUB-SUPPLIER(s) and that such processes are being applied to the equipment/package in accordance with Quality Management Systems – Requirements (Ref. 1) and Quality Management – Guidelines for Quality Plans (Ref. 10). The COMPANY may at their discretion employ their own expertise or a nominated third party employed by the COMPANY for this purpose. Usually such an audit will be limited to major rotating equipment rated at 1 MW and above, or which has been assessed to be **INSPECTION CLASS I**.

The timing of such an audit will be mutually agreed but normally when SUPPLIER has completed the aerodynamic or rotor dynamic design and following submission of piping and instrumentation diagrams (P&IDs) and major equipment General Arrangement (GA) drawings. During such an audit, the SUPPLIER shall make available all relevant in-house fabrication and/or component drawings, data, design studies, analyses, and any other information the auditors feel is necessary to complete their task.

In the event of a conflict between any clarification, analyses or recommendations made by the audit team and the corresponding calculations, analyses, etc., made by SUPPLIER, every effort shall be made to resolve such a conflict and arrive at a mutually acceptable solution. Where mutual agreement cannot be

reached, COMPANY reserves its right to insist that the SUPPLIER implements the recommended corrective action(s) identified during the audit. SUPPLIER shall implement the action whilst retaining full technical responsibility for any corrective actions taken which shall be to his own cost.

5.5 Control of Non-Conforming Products and Services

Any non-conformance with specified requirements identified by or to the SUPPLIER prior to or during the delivery of the products and services shall be corrected by the SUPPLIER in order to satisfy the minimum specified requirements, except where the PURCHASER's formal acceptance of the non-conformance is agreed in accordance with purchase order conditions. See ISO 9001, 8.2.3, 8.2.4, 8.5.6 and 8.7.

5.6 Evidence and Records

Inspection and test plan(s), procedures, methods and inspection/test records shall be provided in accordance with Sections 5 through to Section 7 of this document and according to the agreed timing stipulated in the Information Requirements, Appendix 3.

5.7 Non-Conformance Records

Details of non-conformances raised by COMPANY or CONTRACTOR against the technical requirements prior to or during the delivery of the products or services will be identified as a Non-Conformance Record (NCR). Each NCR shall be managed by the SUPPLIER or his SUB-SUPPLIERs in accordance with ISO 9001 Clause 8.7. The associated records typically include; description of non-conformance, analysis and disposition, method of correction and implementation and full details of any retesting or inspection taken to demonstrate subsequent conformance to the specified requirements.

5.8 Concession Requests

In some cases, with prior agreement by COMPANY, a non-conforming condition may be submitted to COMPANY/CONTRACTOR in the form of a Concession Request (CR) in accordance with the concession management procedure defined within the Contract. The formal submission of a Concession Request seeking COMPANY agreement to accept a deviation from the contracted scope or technical requirements may be raised as a result of material or service availability, obsolescence, innovation or beneficial non-conformance.

Concession Requests may typically be raised by the SUPPLIER during the contract execution. A summary with a summary report detailing concessions raised, submission date, status (i.e. in progress, rejected or accepted), together with related impact on cost and delivery shall be provided with SUPPLIER monthly progress reports and finalised at contract closeout to ensure that final contract stage payment is adjusted accordingly.

5.9 Sub-Suppliers

The SUPPLIER shall assume unit responsibility and shall provide all required material and performance warrantees and guarantees for the completely assembled package and auxiliary equipment.

The SUPPLIER shall be held solely responsible to ensure that all applicable QA/QC, inspection and test requirements and other technical requirements specified by the CONTRACTOR within the Purchase Order are included within the sub-orders to his SUB-SUPPLIERS to ensure full compliance to the purchase order requirements. If requested by COMPANY/CONTRACTOR, the SUPPLIER shall provide clear evidence of the required QA/QC surveillance of SUB-SUPPLIERS activities.

The SUPPLIER shall submit all relevant SUB-SUPPLIER drawings and engineering data to the CONTRACTOR in accordance with the Information Requirements – Appendix 3.

6. CONFORMITY ASSESSMENT SYSTEM

6.1 General

6.1.1 Conformity assessment includes but is not limited to documentation review, factory inspection and testing, and design validation activities.

6.1.2 Assessment activities may be undertaken at the SUPPLIER or SUB-SUPPLIER's premises, virtually by video link, desktop sharing or by review of information formally submitted for acceptance or for information. The type of conformity assessment (W, O, S or R) is defined in sections 6.2 to 6.5 inclusive is indicated against the required **INSPECTION CLASS** as indicated in Table 2 – Inspection Requirements in Section 7.

6.1.3 The SUPPLIER's ongoing performance and ability to satisfy the specified requirements will be routinely monitored and assessed during execution of the scope of works and where appropriate, corrective action requested and conformity assessment activities increased or decreased consistent with pre-defined criticality and risk to the project.

6.1.4 The SUPPLIER is required to demonstrate that the requirements relating to quality control of the supplied materials, software and associated documentation to the PURCHASER are fulfilled.

6.1.5 There are two different levels of assessment of the SUPPLIER's quality control activities by the purchaser (second party) or independent body (third party) which are based on a defined 'Criticality Assessment' of the supplied equipment and an evaluation of the SUPPLIER's experience and capability to provide the product or service in accordance with the applicable specifications, codes and standards. The applicable INSPECTION CLASS specified by the purchaser in the purchase order will be either INSPECTION CLASS I or II. INSPECTION CLASS I reflects the highest risk and associated extent of verification. INSPECTION CLASS II is the lowest.

6.1.6 The SUPPLIER shall ensure that the required information is submitted to the PURCHASER where required "For Acceptance" or "For Information" and by the agreed time(s) specified within the 'Information Requirements' Appendix 3. The submission of the required information shall be managed in a timely manner by the SUPPLIER to reflect the information review period(s) agreed with PURCHASER. The SUPPLIER shall allow sufficient time within the manufacturing/fabrication schedule for review of all submitted information and incorporation of client comments so as not to incur delay to the agreed contractual delivery dates.

6.2 Witnessed Test or Inspection (W)

Inspection or test for which the purchaser is notified of the timing of the inspection or test and a hold is placed on the inspection or test until the PURCHASER or his representative is in attendance (API Std 611 5th Edition, clause 3.44 & API Std 612 7th Edition, clause 3.61).

6.3 Observed Inspection or Test (O)

Inspection or test where the purchaser is notified of the timing of the inspection or test and the inspection or test is performed as scheduled, regardless of whether the PURCHASER or his representative is present (API Std 611 5th Edition, clause 3.24 & API Std 612 7th Edition, clause 3.37).

6.4 Surveillance (S)

Observation or monitoring by the PURCHASER or PURCHASER's representative of the SUPPLIER's or SUB-SUPPLIER's manufacturing or fabrication activities, associated operations, coating processes, material certification or other associated product design information.

Assessment activities may be undertaken at a SUPPLIER or SUB-SUPPLIER's premises, virtually by video link, desktop sharing etc. or by review of information formally submitted for acceptance or for information.

6.5 Information Review (R)

Review of the SUPPLIER's product design information by the PURCHASER or PURCHASER's representative to determine conformity to the specified requirements.

SECTION II – INSPECTION AND TESTING REQUIREMENTS

7. INSPECTION AND SURVEILLANCE REQUIREMENTS

This section defines the required minimum level of inspection for the supplied equipment in terms of two levels of inspection termed INSPECTION CLASS. INSPECTION CLASS I shall apply to the following equipment categories:-

a. Steam Turbines with a steam inlet pressure of 100 barg and above
b. ALL special purpose steam turbines (API 612 7th Edition)
c. Unspared (single train) steam turbines

INSPECTION CLASS II shall apply to ALL General Purpose Steam Turbines (API 611 5th Edition) except for those units included in the aforementioned categories.

The SUPPLIER shall include the required design validation, manufacturing controls, materials inspection and testing in accordance with the specified INSPECTION CLASS when developing the relevant quality plans and inspection and test plans. The level of inspection required for each INSPECTION CLASS shall be in accordance the minimum levels of inspection defined within Table 2 – Inspection Requirements.

The SUPPLIER shall submit certified reports of production tests and shop tests as soon as the tests are completed satisfactorily.

The COMPANY or CONTRACTOR reserves the right to inspect materials and workmanship at all stages of manufacture and to witness any or all tests. The SUPPLIER shall provide the COMPANY/CONTRACTOR with a copy of its Inspection and Test Plan (ITP) for review and inclusion of any mandatory COMPANY/CONTRACTOR inspection and witness points no later than 30 days after award and prior to the Pre-Inspection Meeting (PIM).

Table 2 – Inspection Requirements

Item No.	WORK, MANUFACTURING OR TEST ACTIVITY	Governing Document	INSPECTION CLASS		
			I	II	III
1	Planning and Control Activities				
1.1	Quality Plan Review	(ISO 9001, 8.1 and ISO 10005)	R	R	
1.2	Inspection and Test Plan (ITP)	(ISO 9001, 8.1 and ISO 10005, API 611 8.1.1 or API 612 16.1.4)	R	R	
1.3	Kick-off and Pre-Inspection Meeting	(API 611 8.1.5 or API 612 16.1.5)	W	O	
2	Design and Development Activities				

Item No.	WORK, MANUFACTURING OR TEST ACTIVITY	Governing Document	INSPECTION CLASS		
			I	II	III
2.1	Design verification review as required Review that manufacture is against accepted revision of documents.	(ISO 9001, 8.3)	R	R	
2.2	Weld procedure specification and procedure qualification records	(API Std 611 6.12.2, 6.12.3, 6.12.4 or API 612 11.3.1, Table 4) or as specified in New Standard. Note: *For INSPECTION CLASS I only, “W” witnessed activity shall apply for Super Duplex Stainless Steel (SDSS) and high nickel alloys.	R*	R	
2.3	Non-destructive examination procedures	(ASME BPVC V, Non-destructive examination in accordance with Appendix 2, Section 8.7. Note: *For INSPECTION CLASS I only, “W” witnessed activity shall apply for Super Duplex Stainless Steel (SDSS) and high nickel alloys.	R*	R	
2.4	Selection of raw materials used in the construction of pump parts. Compile Bill of Materials (BOM) for complete assembled unit.	(API Std 611 6.12 or API 612 Section 11 or as specified in New Standard.	R	R	
3	Control of External Supply				
3.1	External supply scope, risk assessment and controls	(ISO 9001, 8.4)	R	R	
4	Materials and Component Manufacturing				
4.1	Material certification and traceability	(API 612 Section 16.2.1.1a, 17.3.2.2 and Appendix 2, Section 9.1)	S	R	
4.2	Surfaces of castings	(API Std 611, 6.12.2 or API 612, 11.2)	O	S	
4.3	Compliance of welding materials	(ASME BPVC.II Part C)	S	S	

Item No.	WORK, MANUFACTURING OR TEST ACTIVITY	Governing Document	INSPECTION CLASS		
			I	II	III
4.4	Fabrication				
4.4.1	Baseplate manufacture	(API 611, 7.3.2 & 7.3.3 and API 612 11.1.15, 11.3.2, 15.2.2) flatness and coplanarity of baseplate equipment mounting pads	O	S	
4.5	Inspection, testing and verification activities	(ANSI/API Std 611/612, 8.2 and 8.3 and New Standard, 8.2 and 8.3)			
4.5.1	All welders have been qualified on approved welding procedures	(ANSI/API Std 611/612, Table 11) or as specified in New Standard, 6.12.3.1.	R	R	
4.5.2	Weld repair procedure (excluding major weld repairs)	(ANSI/API Std 611/612, 6.12.2 and New Standard, 6.12.2)	R	R	
4.5.3	Weld repair procedure (major) maps and other specified documentation	(ANSI/API Std 611/612, 6.12.2.5 and New Standard, 6.12.2.5)	W	W	
4.5.4	Inspection of major weld repairs	(ANSI/API Std 611/612, 6.12.2.3 and New Standard, 6.12.2.3, 6.12.2.5)	W	O	
4.5.5	Non-destructive examination personnel performing non-destructive examinations are qualified and certified	in accordance with the requirements of Article 1, Section V of ASME BPVC and New Standard, 8.2.2.5, 8.2.2.9	R	R	
4.5.6	Pressure casing inspection including all welds associated with the casing	(ANSI/API Std 611/612 Table 14 and New Standard, Table 14). Inspection timing (ANSI/API Std 611/612, 8.2.2.3)	O	S	
4.6	Non-destructive examinations of component parts	(ANSI/API Std 611/612, 6.12.1.5 and 8.2.1.3)	O	R	
4.7	Positive Material Identification (PMI)	(ANSI/API Std 611/612, 8.2.2.8 and New Standard, 8.2.1.5, 8.2.2.8)	O	S	
4.8	Verify that the heat treatments, including PWHT, have been performed	(ANSI/API Std 611/612, Table 11, New Standard 6.12.3.4b, 6.4.3.10)	R	R	

Item No.	WORK, MANUFACTURING OR TEST ACTIVITY	Governing Document	INSPECTION CLASS		
			I	II	III
4.9	Shaft and rotors	(ANSI/API Std 611/612, 6.6, 9.3.3.1 and 9.3.12.2 d, Tables 17 and 19) and New Standards 6.6, 9.3.3.1.	O	O	
4.10	Rotating component balancing	(ANSI/API Std 611/612, 6.9.4, 9.1.3.7 and 9.2.4 and New Standards, 6.9.4, 7.2.2f, 9.2.4, 9.2.2.5 and 9.3.5)	W	O	
4.11	Wear rings and running clearance verification	(ANSI/API Std 611/612, Table 6 and New Standards, 6.6.15, 6.7.1, 6.7.4, 6.7.5, 6.10.1.2, 6.14.5)	R	R	
4.12	Cleanliness check prior to final assembly	(ANSI/API Std 611/612, 8.2.2.6 and New Standards 8.2.2.6)	O	S	
4.13	Inspection and test equipment calibration certificates		R	R	
4.14	Hydrostatic testing activities	(ANSI/API Std 611/612, 8.3.2 and New Standards, 8.3.2)	W	W	
4.15	Auxiliary equipment testing	(ANSI/API Std 611/612, 8.3.4.6 and New Standard 8.3.4.6)	W	O	
4.16	Performance testing	(ANSI/API Std 611/612, 8.3.3 and New Standards, 8.3.3)	W	W	
4.17	NPSH or submergence testing	(ANSI/API Std 611/612, 8.3.4.3 and New Standards, 8.3.4.3)	W	O	
4.18	Mechanical run testing	(ANSI/API Std 611/612, 8.3.4.2 and New Standards, 8.3.4.2)	W	O	
4.19	Sound level testing	(ANSI/API Std 611/612, 8.3.4.5 and New Standard 8.3.4.5)	W	O	
4.20	Complete unit testing	(ANSI/API Std 611/612, 8.3.4.4 and New Standard 8.3.4.4)	W	W	
4.21	Bearing housing resonance test	(ANSI/API Std 611/612, 8.3.4.7 and New Standard 8.3.4.7)	W	O	
4.22	Structural resonance test	(ANSI/API Std 611/612, 9.3.9.2 and New Standard 8.3.4.4)	W	O	

Item No.	WORK, MANUFACTURING OR TEST ACTIVITY	Governing Document	INSPECTION CLASS		
			I	II	III
4.23	Disassembly after testing	(ANSI/API Std 611/612, 8.3.3.8 and New Standard 8.3.3.8)	W	O	
4.24	Hydrodynamic bearing inspection after testing	(ANSI/API Std 611/612, 9.2.7.5 and New Standard, 9.2.7.5)	W	O	
4.25	Surface preparation and painting	(ANSI/API Std 611/612, 6.12.2.1, 7.3.12, 8.4.2.4 and New Standards,7.3.12, 8.4.2.4, 9.3.8.3.3)	O	O	
5	Release of Product or Service				
5.1	Final Inspection. Verify conformity to PO including as applicable				
5.1.1	Complete skid overall dimensions including holding down bolt hole and connection sizes and locations	Equipment General Arrangement Drawings and P&IDs (Accepted by COMPANY)	W	W	
5.1.2	Couplings and guards	(ANSI/API Std 611/612, 9.3.8.2.1, 7.2.1.3 and 7.2.3 and New Standards, 9.3.8.2.1)	W	W	
5.1.3	Pump nameplate and rotation arrows	(ANSI/API Std 611/612, 6.13 and New Standards, 6.13)	W	W	
5.2	Loose ship items, spares and special tools as applicable	(ANSI/API Std 611/612, 7.6)	W	W	
5.3	Test moments My and Mz to be applied in combination to pump Suction and Discharge Nozzles (but not both nozzles simultaneously)	(ANSI/API Std 611/612, 7.3.21)	W	O	
5.4	Preparation of preservation, packing and storage (including loose ship items, spares and special tools)	(ANSI/API Std 611/612, 8.4 and New Standards, 8.4)	W	O	
5.5	Final documentation review	New Standards Appendix 3 “Information Requirements”	R	R	

Item No.	WORK, MANUFACTURING OR TEST ACTIVITY	Governing Document	INSPECTION CLASS		
			I	II	III
5.6	Inspection release note	Purchase Order	W	W	
Note: W is witness point, O is observed point, S is surveillance and R is review of documentation. Full definitions are provided in 6.2, 6.3, 0 and 6.5.					

SECTION III – SHOP FABRICATION AND NDT

8. MATERIALS

8.1 General

8.1.1 Refer to 'General Technical and Contractual Requirements' (ref 2) for general requirements relating to materials for all rotating equipment.

8.2 Manufacturing Data Records

8.2.1 The SUPPLIER shall keep the manufacturing data available for examination by the CONTRACTOR or his representative upon request. The manufacturing data shall be kept for at least 30 years.

8.3 PMI Testing

8.3.1 Positive Material Identification (PMI) testing is required for all alloy pressure-containing materials, piping components, and heat exchanger tubes.

8.3.2 The extent of PMI testing for all alloy parts shall be 100%, unless otherwise agreed with COMPANY. Any proposed reduction to the extent of PMI is subject to COMPANY approval.

8.3.3 Positive material identification shall be carried out in accordance with relevant COMPANY business unit standards. The SUPPLIER shall submit a report including copies of test instrument calibration certificate(s) to provide verification that the alloying element percentages of materials are in accordance with the proposed recognised material specification.

8.4 Pressure Containing Parts

8.4.1 All cast steel casings shall meet the requirements of ASME Section VIII, Division 1, Appendix 7.

8.4.2 Plates from which pressure-containing components are to be cut, forged, rolled or formed in any other manner, shall be subject to systematic ultrasonic inspection for laminations in accordance with ASTM A578-S9.

8.4.3 All welds in the casing, including those in piping attached to the casing, shall be examined radiographically or ultrasonically. Radiographic examination (RT) shall be performed in accordance with ASME V, Part. 2 and acceptance criteria shall be according to ASME VIII Div. 1, UW-51. UT shall be in accordance with ASME V, Part. 4 and acceptance criteria shall be in accordance with ASME VIII Div. 1, UW-53". All non-destructive examination(s) shall be carried out after PWHT has been completed.

8.4.4 Permanent weld backing bars are unacceptable. Temporary backup bars must match the chemical composition of the base metal being welded. Welding filler metal shall be similar with respect to the chemistry, corrosion resistance, and physical properties of the base metal being welded. Temporary backing bars shall be removed before performing RT.

8.4.5 The ASME Welding Procedure Specifications (WPS), Procedure Qualification Records (PQR), and Welder Qualifications Records shall be available to the CONTRACTOR for review upon request or submitted for review and approval to CONTRACTOR as specified in the requisition. Welding of piping shall conform to relevant COMPANY business unit standard. Review of WPS, PQR, NDE procedures is mandatory for all equipment under INSPECTION CLASS I, duplex stainless steel and other superior CRA materials.

8.4.6 Destructive mechanical tests, including impact tests if required, shall be carried out on test blocks after all heat treatments have been performed, including those for possible repairs.

8.5 Welding Consumables

8.5.1 Welding consumables should be stored in their original unopened packaging in an area shielded from the elements. The SUPPLIER shall follow the MANUFACTURER's recommended procedures relating to storage, handling and re-conditioning of electrodes according to type. The following summary below provides guidelines as to the proper storage of stick electrodes, flux-cored wires, metal-cored wires, and solid wires (MIG wire and TIG cut length).

8.5.2 Low Hydrogen Electrodes (stick electrodes) shall be classified per AWS as EXX15-X, EXX16-X, and EXX18-X. These electrodes must be dry to perform adequately. MANUFACTURERs typically supply these electrodes in hermetically sealed containers which provide proper protection under good storage conditions. Open containers of low hydrogen electrodes must be stored in a cabinet at 120°C – 150°C.

8.5.3 Moisture resistant coatings ("R" designation) have higher resistance to moisture pick up, but should be stored in the same manner. The "R" designation allows for more exposure time before the electrode needs to be re-dried. It is recommended that low hydrogen electrodes without the "R" designation be supplied twice per shift to stay below the permissible 4 hours of exposure. AWS D1.1 Structural Welding Code specifies allowable atmospheric exposure in Table 5.1 which can be seen below.

8.5.4 Low hydrogen electrodes may be re-dried if they exceed exposure limits following the MANUFACTURERs recommended procedures. It is critical to avoid drying electrodes at temperatures above those recommended. Also, longer hold times at lower temperatures is not equivalent as holding the right temperature for the specified time. For additional information on storing and re-drying low-hydrogen electrodes read Storing and Re-drying Low Hydrogen Electrodes.

8.5.5 Where non-low hydrogen electrodes are exposed to humid air for long periods of time the welding characteristics may be affected. If moisture is present, it is recommended to store open containers in cabinets heated to 38°C – 49°C.

8.5.6 The MANUFACTURERs shall supply metal cored and fluxed wires in packages that provide proper protection when stored indoors with a relative humidity not higher than 70%. It is important to store in areas that minimize temperature variations to avoid condensation on the consumables.

8.5.7 Materials shall be stored in the original, unopened packaging in a covered dry location until it's time to use. For applications in which the weld metal hydrogen must be kept under a specific amount (usually 8mL/100g H2 or lower) only use product supplied in hermetically sealed packaging.

8.5.8 For storage of FCAW and MCAW wires that have been opened the recommendations below shall be followed:-

a) Use within a week of opening original packaging
b) Do NOT expose open wires to damp conditions or extreme temperature changes
c) When not in use place wire back in its original packaging (bag and box) and seal as best as possible
d) Discard any wire that has been exposed to moisture and shows signs of rust.

e) Flux-cored wire should not be left out in the open when not in used as it is prone to moisture pick up.

8.5.9 Solid wires and GTAW electrodes are not as susceptible to moisture pick up, however they shall be stored in similar fashion as noted in above. Store in unopened container until it is time to use. Store in areas protected from rain and snow, avoid severe fluctuations in temperature and protect from condensation. Discard if wire shows rust on its surface.

8.5.10 Reference shall be made to AWS D1.1/D1.1M: 2015 Structural Welding Code – Steel.

8.6 Weld Procedure Specifications, Weld Procedure Qualification Records and Weld Maps

8.6.1 Welding

Fabrication and welding shall be carried out in accordance with ASME BPVC, Section IX. The minimum requirements relating to shop fabrication including WPS, WPQR and welder qualifications, PWHT, NDT procedures, NDT operator qualifications, impact testing, sour service requirements and weld repairs are detailed in the following sections 8.6.2 to 8.6.6.

8.6.2 Weld Procedure Specification and Weld Procedure Qualification Records

The SUPPLIER shall submit a WPS and associated WPQR for each different weld type forming part of the fabricated sections of the equipment or package. The SUPPLIER shall provide detailed weld map(s) to clearly identify each weld and to show the location and type of the proposed weld referencing the Weld Procedure (WPS) and associated Weld Procedure Qualification Record (WPQR) in each case.

8.6.3 Welder Qualification

Each welder shall be qualified to perform the required welding process using a qualified and approved Weld Procedure Specification (WPS). The welder's name, welder identification no., WPS number, weld location and NDT method used shall be recorded on a separate weld map for each fabricated item in accordance with the applicable code requirements. Shop fabrication procedures including WPS, WPQRs, WQs, NDE procedures, NDE reports and associated weld maps will be subject to approval by a nominated third-party inspection authority when specified in the purchase order.

8.6.4 Post Weld Heat Treatment

Post Weld heat Treatment (PWHT) shall be carried out in accordance with the applicable WPS and WPQR. Heat treatment records shall be submitted within the Manufacturing Record Book (MRB) which shall identify the time chart of measured temperature and duration of heat treatment.

8.6.5 NDT Operator Qualifications

Qualification and certification of all NDT operators shall be according to Recommended Practice No. SNT-TC-1A & CP-189 Personnel Qualification and Certification in Non-Destructive Testing or EN ISO 9712. Operators shall be ASNT Level 1, 2 or 3 in accordance with the ASME V Article 1 requirements for each NDE process, material/weld thickness, weld location and type of weld under examination.

8.6.6 Major Weld Repairs

Prior to performing any weld repair on wrought material or any major weld repair on cast material, the SUPPLIER shall submit details of the proposed weld repairs for COMPANY approval, along with the relevant WPS and PQR. In the event of major weld repairs being required, weld repair maps showing location and major dimensions of weld repair cavities, applicable qualification records, drawings,

photographs, heat treatment procedures, further NDE procedures and detailed records of all repairs shall be submitted to COMPANY for review and approval.

No repairs/modifications of any type (minor or major) shall be done after equipment has been released for shipment. Both major and minor repairs shall be reported to COMPANY.

a) For weld repairs on pressure containing parts, the following shall apply:

1. COMPANY approval shall be obtained before any major weld repair is carried out.

2. All repairs shall meet the inspection requirements and acceptance standards of the original material. Major repairs shall be inspected by the COMPANY which shall be notified at least one week in advance of starting the repair.

3. Repair procedures for major* weld repairs are subject to approval of the COMPANY. Repair welder qualifications shall be reviewed and approved by CONTRACTOR.

4. The total quantity of weld metal deposited shall be less than 10% of the mass of the casing. This shall be determined by weighing the casing before and after weld repairs. Where the quantity of weld repair exceeds 10% of the mass of the casting, the repair shall not be acceptable.

5. Weld repairs shall be suitably heat-treated if this is specified in the relevant material specification and/or manufacturing standard. A major* weld repair shall always be followed by a heat treatment.

6. Details of all major* weld repairs and the heat treatment shall be recorded and reported to the COMPANY.

*NOTE: A weld repair of a casting is defined as "major" if a repair weld has a depth of more than 50% of the wall thickness or has a length of more than 150 mm in one or more directions, or if the total surface area of all repairs on the casting exceeds 10% of the total casting surface area. A weld repair necessitated by a leaking pressure test is also classed as "major".

b) The repair of leaks and defects in pressure-containing castings is not allowed by peening or burning-in, or by impregnation with plastics or cement compounds. Repair by welding or by plugging shall be undertaken only when permitted by the material specification and/or manufacturing standard, and then, only in accordance with the procedures detailed in this and relevant specifications (see d below).

c) Weldable grades of castings may be repaired by welding subject to the following criteria:

1) Criteria as per a. above.

2) The repair welding procedures and the repair welder's qualifications shall be in accordance with ASTM A488 or ASME Section IX.

3) Other criteria may exist in applicable Specifications.

d) Repair by Plugging

1. The need for repair by plugging shall be reported to COMPANY before any repair is carried out.

2. Nodular iron may be repaired by plugging within the limits specified in ASTM A395. The drilled holes for plugs shall be carefully examined by dye penetrant to ensure removal of all defective material.

3. All necessary repairs by plugging not covered by ASTM shall be subject to approval by COMPANY.

4. Details of all repairs by plugging shall be recorded and included in the manufacturing report.

e) When defects are found which necessitate a major* weld repair, the casting shall be inspected to the next more severe inspection class unless the initial inspection was already the highest.

8.7 Non-Destructive Examination Methods

The extent of Non-Destructive Examination (NDE) to be applied to the equipment/package is defined in Table 7 – Inspection and NDT Minimum Requirements included in Section 10. The procedures and acceptance criteria are given in the following paragraphs.

Prior to starting fabrication activities, the SUPPLIER shall submit NDT procedures to COMPANY for approval.

8.7.1 Radiographic Examination (RT)

a) RT of castings shall be performed in accordance with ASME Section VIII, Division 1, Appendix 7. Critical sections of each casting (including regions of abrupt section changes, weld ends, areas adjacent to feeders and raisers) shall be fully radiographed. Where such sections cannot be radiographed, UT shall be substituted (also in accordance with ASME Section VIII, Division 1, Appendix 7). Acceptance standards for castings shall be in accordance with Table 3 below.

The SUPPLIER shall submit, for COMPANY'S approval, details of the critical sections proposed to receive RT/UT. All personnel performing and interpreting the results of the various NDE techniques shall possess appropriate nationally recognized qualifications.

b) RT of welds shall be in accordance with ASME Section VIII, Division 1, UW-51. Coverage shall be 100 percent.

Table 3 – Acceptance Criteria for Castings

SECTION THICKNESS (mm)		<25	25 TO 50	51 (and above)
Defect Category		Degree of Severity		
A	Gas Porosity	2	3	3
B	Sand and Slag	2	3	3
C	Shrinkage (All Types)	2	2	2
D, E	Cracks and Hot Tears	Not Acceptable		

8.7.2 Ultrasonic Examination (UT)

a) UT of welds shall be in accordance with ASME Section VIII, Division 1, Appendix 12. Coverage shall be 100%. Phased Array Ultrasonic Test (PAUT) or Time of Flight Diffraction (TOFD) method shall be employed for all casing and nozzle welds.

b) UT of wrought material shall be in accordance with ASME Section V, Article 5. The Acceptance Criteria shall be as follows:

1) Austenitic forgings (Reference ASME Section V, SA-745)

QL-1 for straight beam, t = 0 to 75 mm.
QL-2 for straight beam, t = 76 to 200 mm.
QA-2 for angle beam, all thicknesses

2) Non-austenitic forgings (Reference ASME Section V, SA-388)

For straight beam examination, back reflection method, no areas shall have a loss of 95% for more of the reference back reflection.

For straight beam examination, reference block method, there shall be no indications equal to or larger than the indication received from the reference block constructed with the following flat-bottomed holes:

- 1.5 mm for t = 0 to 37 mm.
- 3 mm for t = 38 to 150 mm.
- 6 mm for t = 151 mm and greater.

For angle beam examination, there shall be no indications equal to or larger than the indication received from the reference notch or amplitude reference line.

3) Plate Material

Acceptance criteria in accordance with ASME Section V, SA-435 and SA-577, depending on the purpose.

4) Tubular Material

Acceptance criteria in accordance with ASME Section V, SE-213, in which the calibration notch shall take the following form:

- Shape shall be rectangular.
- Depth shall be maximum 5 percent of the nominal wall thickness.
- Length shall be 25 ± 5 mm.
- Width shall be no greater than twice the depth.

5) Castings

Castings shall be UT examined in accordance with SA 609. Manual UT and RT may be substituted by AUT (TOFD and Phased Array) subject to approval by COMPANY.

8.7.3 Magnetic Particle Examination (MT)

MT shall be applied to all accessible surfaces, including those exposed by machining. Indications shall be investigated by light grinding (1 mm maximum depth).

MT of castings shall be performed in accordance with ASME Section VIII, Division I, Appendix 7.

MT of welds and wrought material shall be performed in accordance with ASME Section VIII, Division 1, Appendix 6.

8.7.4 Penetrant Examination (PT)

PT shall only be performed when specified MT is not possible; in which case it shall be done in accordance with ASME Section VIII, Division 1, Appendix 7 (castings) or Appendix 8 (welds and wrought material - all services to be examined).

8.7.5 Visual Inspection (VI)

VI shall be performed in accordance with ASME V, Article 9. All surfaces (including welds) shall be inspected. Acceptance criteria for pressure-containing steel castings shall be in accordance with MSS SP-55. Acceptance criteria for other parts shall be in accordance with the material specification and the MANUFACTURER'S documented procedures. VI acceptance criteria of welds shall be in accordance with ASME VIII Division 1.

8.8 Allowable Linear Defects

The maximum size of liner defects permitted within forgings and castings is defined by Table 4 below.

Table 4 – Maximum Size of Linear Defects

Criteria	Maximum linear defect - mm (in)		
Thickness	**Less than 13mm (0.5in)**	**13mm to 25mm (0.5 to 1in)**	**Greater than 25mm (1in)**
QL1 forgings and castings machined surfaces	5mm (0.2in)	5mm (0.2in)	5mm (0.2in)
QL2 and QL3 forgings and castings	5mm (0.2in)	10mm (0.4in)	15mm (0.6in)

8.9 Repair Techniques

The following repairs (whether at shop or site) need prior approval of COMPANY. If CONTRACTOR and/or SUPPLIER proceed with the repair without obtaining prior COMPANY approval, the subject part/item/component shall automatically be rejected by the COMPANY'S inspector.

- Major weld repairs
- Repairs to leaking pressure-containing parts.
- Straightening of shafts
- Rectification of fits/tolerances/clearances by the application of metal coatings or overlays.
- Repairs (of any type) to rotating parts.
- Repairs necessitated by internal rubs for any reason.
- Repairs/alterations to bearings.
- Repairs/alterations to shaft sealing systems.
- Alterations to control system and/or its software.

8.10 NDE Acceptance Criteria

NDE Acceptance Criteria for each type of inspection shall be applied in accordance with the methods defined by Table 5 below.

Table 5 – NDE Acceptance Criteria

Inspection	Methods	Acceptance Criteria	
		Fabrications	Castings
RT	ASME Code Section V, Article 2	ASME Code Section VIII, Division 1, UW-51 (for 100% radiography) and UW-52 (for spot radiography)	Procedure and acceptance standards shall conform to ASME VIII Division 1, Appendix 7.
UT	ASME Code Section V, Article 5 & Article 23	ASME Code Section VIII, Division 1, Appendix 12	ASME Code Section VIII, Division 1, Appendix 7. Procedure and acceptance standards shall conform to ASME VIII Division 1, Appendix 7
MP testing[1]	ASME Code Section V, Article 7 & Article 25	ASME Code Section VIII, Division 1, Appendix 6	Procedure shall conform to ASME VIII Division 1, Appendix 7. Acceptance standard shall conform to ASME VIII Division 1, Appendix 7, except that maximum size of linear indications shall conform to Table 4
LP testing	ASME Code Section V, Article 6 & Article 24	ASME Code Section VIII, Division 1, Appendix 8	Procedure shall conform to ASME VIII Division 1, Appendix 7. Acceptance standard shall conform to ASME VIII Division 1, Appendix 7, except that maximum size of linear indications shall conform to Table 4
VI	ASME BPVC, Section V, Article 9	In accordance with the material specification and the MANUFACTURER's documented procedures and ASME VIII Division 1	Cast surfaces of component pressure boundaries shall conform to MSS SP 55, except that: -Type 1 defects will not be permitted -Defects in excess of plates “a” and “b” for type II through type XII will not be permitted[2]

[1] LP testing may be substituted for MP testing, if MP testing is not feasible
[2] Refer to ASME B16.5, paragraph 5.1.4

8.11 NDE Records

Detailed non-destructive examination reports shall be included in the MRB describing the procedure used, results obtained for visual, radiographic, ultrasonic, magnetic particle, and dye-penetrant examinations. All inspection and test reports shall be signed and dated by an authorized operator and identify components tested, location, heat-treated condition, and other requirements per Project specifications. The above reports shall be available for inspection at the SUPPLIER’s works by CONTRACTOR or by COMPANY upon giving due notice of inspection at each stage of manufacture/fabrication.

9. MATERIAL CERTIFICATION AND TRACEABILITY

9.1 Material Certificates

9.1.1 The SUPPLIER shall furnish material certification for individual components of Steam Turbines in accordance with the minimum requirements specified in Table 6 – Material Certification for Steam Turbine Parts. Material inspection certificates shall be provided in accordance with Table 1 of ISO 10474:2013 or Table A.1 of EN 10204:2004.

Table 6 – Material Certification for Steam Turbine Parts

EQUIPMENT COMPONENT / MATERIAL	CERTIFICATE TYPE required as per BSEN10204:2004
All pressure retaining and stress bearing parts including attachments (casing, casing covers, main process nozzles & casing bolts)	3.1
Rotating components (shaft, rotor, rotor blades), Internals (diaphragms, blades, nozzles, labyrinths, etc.)	3.1
Shaft, discs, shaft sleeves, bearings, bearing housings and retainers, bolting, All other auxiliary piping, valves, flanges & connections	3.1
Non-pressure parts	3.1
Structural steelwork, baseplates	3.1
Casing gaskets	2.2
Non-metallic materials	2.2

Notes

1) If specified on equipment datasheets, Type 3.2 certification shall be provided for special metallurgy such as SSDS, Inconel, Monel, Hastelloy, etc. or where application is considered critical.

2) For other metallic parts including base plates and structural steel components, Type 3.1 certification is acceptable.

3) Type 2.2 certification acceptable for non-metallic components.

9.1.2 The SUPPLIER shall provide either original material certificates or true verified copies of the original material certificate(s) or mill certificates which shall contain the original “date stamp” and verifying signature of the SUPPLIER’s QA/QC inspector. Unverified copies of certificates are not acceptable.

9.1.3 Stockist certificates are not acceptable unless they are accompanied by copies of the original works certificate.

9.1.4 The certificates shall be in English language or shall include an English translation. Metric units shall be used. The certificates shall be complete, legible and suitable for subsequent microfilming and photocopying. The certificates, combined if necessary, shall represent the material in the final condition.

9.1.5 The different types of material certificate are defined in accordance with BSEN 10204:2004 or ISO 10474:2013.

9.2 Material Traceability and Marking

9.2.1 All pressure retaining castings shall have the material designation embossed or engraved on each part.

9.2.2 Marking is required for all pressure casings and for component parts requiring Type C material certificates. Parts with a wall thickness in excess of 5 mm, except those items manufactured from austenitic stainless steel or from nickel alloys, shall be legibly marked by hard-die stamping on to a painted background at a place clearly visible later. Pipes should be marked at a point approximately 250 mm from one end.

9.2.3 Only low-stress stamps (dot-type or round-nosed with minimum radius of 0.25 mm) shall be used for hard-die stamping.

9.2.4 For items manufactured from austenitic stainless steel or nickel alloys, and for items with a wall thickness of 5 mm or less, the marking shall be applied by stencil using a water-insoluble ink which contains no injurious substances such as metallic pigments, sulfur, sulfides or chlorides which could attack or harmfully affect the material.

9.2.5 The stamping/marking shall include:

- Material MANUFACTURER'S symbol and, where applicable, the independent inspector's symbol; these symbols shall be identical to the symbols on the material certificate.
- Material identification.
- Heat, charge or batch number to relate to the material certificate.
- Heat treatment symbol or code, where applicable.
- Non-destructive testing symbol or code, where applicable.
- Size and schedule, where applicable.
- Hydrostatic test pressure, where applicable.

Note: Where the size of the item does not permit complete marking, the above identification marks may be substituted by a unique code which is fully traceable to the material certificate for the item.

10. NDT AND MATERIAL CERTIFICATION REQUIREMENTS

The minimum levels of NDT that shall apply to the components of API 611/612 Steam Turbines are defined in Table 7 below.

Table 7 – Inspection and NDT Minimum Requirements

Equipment Component	Required Inspection (Notes)
Casing (cast), Casing – forged / wrought, guide channels and other pressure retaining parts, static components including diaphragms, blades, nozzles	VI, RT or UT and MT or PT (Notes 2 & 4)
Welds - full penetration welds including aux. pressure piping RT	VI, RT or UT and MT or PT (Note 3)
Welds - fillet welds, flange surfaces, gasket sealing surfaces	VI, MT or PT, spot RT
Shaft	VI, UT and MT or PT (Note 2 & 4)
Rotor, rotor blades	VI, RT or UT and MT or PT (Note 2 & 4)
Shaft sleeves, retainers, bearing housing, bearings	MT or PT, and VI
Shaft seals, labyrinths	VI

Notes

1. VI = Visual Examination; MT = Magnetic Particle Examination; PT = Liquid Penetrant Examination (fluorescent); RT = Radiographic Examination; UT = Ultrasonic Examination (phased array). Hardness testing, impact testing as applicable. All Radiographs shall be digitized and cross reference to part numbers and NDE records shall be ensured while submitting manufacturing data book.

2. Both raw material and finished component requires inspection (as applicable).

3. For LO and utility auxiliary systems, RT shall be 10%. For process connections RT/UT shall be 100%.

4. 100% RT or UT shall be applied for casing, full penetration welds, shaft and other rotating parts.

SECTION IV – SHOP TESTING AND SITE ACCEPTANCE TESTS

11. FACTORY INSPECTION AND TESTING

11.1 General

11.1.1 Inspection and testing shall comply with this specification, datasheets and requisition. COMPANY reserves the right to assign a third-party inspector to attend/observe/witness any or all the inspection and testing activities at SUPPLIER'S or SUB-SUPPLIER'S works. Testing requirements shall be construed to apply for each item. No sample or random testing is allowed.

11.1.2 Only measuring equipment that can be demonstrated to have been previously calibrated satisfactorily and still be within its documented calibration period (interval) shall be used for inspection and testing.

11.1.3 The SUPPLIER shall notify all his SUB-SUPPLIERS of inspection and testing requirements in accordance with the submitted ITP and related controlling specifications.

11.1.4 Tests other than witnessed and observed may also be attended by CONTRACTOR or his representative. COMPANY and/or CONTRACTOR or their representatives shall not be barred from attending a "Non-Witnessed" test and evaluating its outcome. Any test noted as "Required" without any further definition shall be understood to be "Non-Witnessed".

11.1.5 Sub-orders issued by SUPPLIER to SUB-SUPPLIERS shall include the relevant specifications provided by the PURCHASER where applicable to the materials and equipment to be purchased.

11.2 Pre-Inspection Meeting

11.2.1 A Pre-Inspection Meeting shall be held at the SUPPLIER's works prior to start of manufacturing of all compressors. Additional PIMs may be held at the SUB-SUPPLIER's works where necessary dependent on scope of work of the package. The purpose of the Pre-Inspection Meeting (PIM) is to review the extent of the SUPPLIER's quality assurance, design activities, shop inspection and testing, which shall be confirmed prior to manufacture. As a minimum it shall include, but need not be limited to the following main items in accordance with Table 2 – Inspection Requirements:-

a) Planning and Control Activities
b) Design and Development Activities
c) Control of External Supply
d) Materials and Component Manufacturing
e) Fabrication
f) Inspection, Testing and Verification Activities
g) Release of Product or Service
h) Final Inspection. Verify conformity to PO including as applicable

The test procedures to be used for each test shall be submitted for review by COMPANY at least 6 weeks prior to the scheduled test activity.

11.3 Hydrotest

11.3.1 For cast pressure components, the duration of the hydrostatic test shall be a minimum of 30 minutes or time suitable for performing inspection whichever is higher.

11.3.2 For all stainless steels, the chloride content in the test water shall not exceed 30ppm.

11.3.3 For carbon and alloy steels, the chloride content of water used for hydrostatic test shall not exceed 50 ppm chlorides. If water with a chloride content of between 30ppm and 50ppm is used, the component shall be drained and rinsed with water containing no more than 2ppm chlorides and thoroughly dried.

11.4 Control System Simulated Test (iFAT)

Control system panels containing operator HMI, controls software (PLCs), power supplies (PSUs), ventilation fans and associated 19" equipment racks shall undergo simulated iFAT prior to main equipment performance test.

This test shall include but not limited to:-

- Simulate all alarms and trips
- Start-up sequence
- Shutdown sequence
- Different modes of operation
- Mimic displays (HMI)
- All peripherals (printers, servers, etc...)
- Control functions
- Protection and ESD logic

11.5 Performance Test

11.5.1 A performance test shall be carried out on each supplied steam turbine in accordance with COMPANY approved job specific test procedures. During performance testing original internal clearances and tolerances shall be maintained.

11.5.2 The SUPPLIER shall guarantee the performance of the equipment in accordance with AGES-SP-05-004, General & Special Purpose Steam Turbines (API 611 & 612) Specification and according to the test tolerances specified within API 611 5th Edition or API 612 7th Edition.

11.5.3 Performance testing shall be carried out in accordance with ASME PTC 6.

11.6 Mechanical Running Test

11.6.1 The mechanical run test (MRT) shall be carried out for each steam turbine over a minimum duration of four (4) hours after temperature stabilization. A test bed oil sample shall be taken before and after each mechanical run test as applicable. An analysis of each oil sample shall be included in the test report.

11.6.2 During this test, the lubricating oil and seal oil temperature shall be held for a minimum period of 60 minutes at the temperature corresponding to the minimum allowable viscosity, and for 60 minutes at the temperature corresponding to the maximum allowable viscosity. Oil pressures and temperatures and bearing temperatures shall be measured and recorded throughout the test.

An overspeed test shall be carried out in accordance with API 612, clause 16.3.3.2b and 16.3.3.2c. During the overspeed test, the speed shall be held for three (3) minutes according to Table 8.

Table 8 – Steam Turbine Overspeed Test Requirements

Definitions (Set and Trip Point)	Steam Turbine (%) of rated speed
Overspeed Trip Set Point	115% (rated)
Overspeed Trip Test	121% (rated)

Note : Many over speed accidents occur if turbines are run uncoupled. It attracts more people to the turbine than normal, and as such, the risk of serious injury increases. With electronic over speed protection and electronic governors, the need for an uncoupled or unloaded run should be strongly challenged.

11.6.3 Internal rubs causing clearances that exceed 50% of the tolerances specified by the SUPPLIER'S design documents shall be cause for design review, rectification of reasons causing rubs and re-test.

11.6.4 Spare coupling, seals and bearings shall be installed during the mechanical run test of the spare rotor.

11.7 Complete Unit Test

11.7.1 A complete unit test is to be carried out for each steam turbine (or for one machine per type) when the steam inlet pressure exceeds 100 barg or when the steam turbine rated capacity exceeds 10 MW, providing steam and adequate shop facilities are available.

11.7.2 The complete unit test shall be performed on the fully assembled unit including all ancillary components and systems such as, gearbox, contract lube oil system, shaft seals, couplings, instrumentation and control panel(s) shall be used during the complete unit test and the machinery train should be run for test purposes. Such a test, if done at MANUFACTURER's facility, shall be declared to be a string test.

11.7.3 Unless Otherwise Specified, a complete unit test for first unit (for identical units) shall be performed and, if successful, then turbine (shaft line) only to be tested for the other identical units.

11.7.4 If first unit complete unit test was not satisfactory (i.e. fails in terms of operating and mechanical performance) then all units shall undergo a complete unit test. This test is in addition to the individual equipment/component test.

11.8 Sound Level Test

Sound level test shall be performed on the equipment in accordance with ISO 3744 and ISO3746 to meet the limits specified in the equipment datasheets. A sound level test shall be performed for first of each type.

11.9 Auxiliary Equipment Tests

11.9.1 All auxiliary equipment shall undergo a full functional test prior to integration with the steam turbine package.

11.9.2 All control panels shall undergo shop radio frequency interference (RFI) and "burn-in" tests.

11.9.3All lube systems shall undergo a 4 hours mechanical run test.

12. SITE ACCEPTANCE TESTING

The EPC CONTRACTOR shall carry out site acceptance test (SAT) generally based on following guidelines under the supervision of the SUPPLIER. The SUPPLIER shall develop various operating scenarios and agree the acceptance procedures and acceptance criteria during project execution. All such criteria must be fulfilled during SAT.

A preliminary version of the proposed SAT procedure shall be issued by the SUPPLIER with the Proposal. Agreement on a formal list of SAT acceptance criteria shall be established between SUPPLIER, CONTRACTOR and COMPANY PRIOR to Purchase Order Award. This agreed list of criteria will form part of the Purchase Order Agreement. The details of the SAT Procedure can be developed post-award but the list of acceptance criteria parameters shall not be revised without written mutual agreement between SUPPLIER, CONTRACTOR and COMPANY.

The site acceptance test (SAT) must fully demonstrate that the equipment performs at site in a satisfactory manner and is able to meet all specified contractual requirements. The site acceptance test procedure shall be submitted for COMPANY review/comments in advance of commencement of test program.

Prior to overall plant performance/reliability/acceptance test, an uninterrupted 72 hours STRING TEST is to be performed for each complete machinery package and its auxiliary system(s). During this test, CONTRACTOR and SUPPLIER shall demonstrate that the system including driven machinery, drivers, control and auxiliary systems (lube, seal systems) functions (meeting the contractual performance requirements including vibrations, bearing pad temperatures etc.) throughout the agreed operating range.

During the above tests, no control systems shall be bypassed and no alarm and/or trip conditions shall arise. If such a condition arises, the tests shall be considered as not successful and shall be repeated at a time agreed with COMPANY.

The intention of the test is to verify the equipment performance at site against the original expected and factory tested performance. The measured power, steam flow and pressures shall be within agreed tolerances based on the specified design parameters and all required utilities. After collection of field data, the OEM shall verify site performance against certified / rated conditions and provide as-built performance curves. If performance falls short, SUPPLIER shall make good and resolve deficiencies to satisfaction of COMPANY.

CONTRACTOR shall submit Site Acceptance Test (SAT) procedures for COMPANY review prior to commencement of the tests.

At the time of the above tests, all insurance/capital spares and commissioning spares shall be available at site. Equipment shall not be released for testing/operation unless these spares are available at site. Any spare parts issued by COMPANY to the CONTRACTOR shall be replaced with new spares by the CONTRACTOR.

The available steam quality available prior to Trip Throttling Valve will be specified on the equipment datasheet. This is a SAT requirement and the SUPPLIER shall guarantee the performance of the steam turbine against the steam quality defined by COMPANY on the project datasheet.

- The SUPPLIER’s representative must be available on site during the SAT period to coordinate and resolve any unplanned deficiencies. During this, OEM shall be present (gearbox supplier, LO system supplier. etc. when required and where applicable, etc.)

- Duration for SAT shall be 72 hours of smooth running, after obtaining confirmation from the COMPANY that the machine has attained a steady and stable operation conditions following the commissioning and prior to starting the test run. It is imperative that the steam turbine components, auxiliaries, calibration of all instruments, setting of vibration probes is done satisfactorily during this period. This shall be in SUPPLIER scope. Machine monitoring system and data gathering system shall be in place and SUPPLIER shall ensure functional requirements of the same. Calibration records of all the measuring instruments meeting with norms of the test shall be in place. If a permanent machine monitoring system is not applicable, portable instruments shall be used to record the vibration parameters.

- Performance evaluation: The analysis of the guarantee point(s) shall be done through the capture of three (3) test points (including one at the rated conditions, one at the normal operating condition and one at the maximum continuous rating. If permanent flow instruments are not available at site, CONTRACTOR shall make necessary arrangements (such as clamp type ultrasonic flow meters to avoid modifications at site).

- SAT is expected to be carried out in an uninterrupted manner. Any failure/trip will result in restarting the train ignoring the earlier clocked hours. During site acceptance tests:

  a. Operate the steam turbine at the rated conditions for at least 4 hours.
  b. If multiple operating points are indicated (such as normal, minimum etc.), operate at those points for 2 hours each as allowed by operations.
  c. Operate the steam turbine for one hour with maximum oil temperatures where forced lube oil system is supplied (by adjusting TCV/stopping fans in LO system, as possible)
  d. Mark the site operating points on the performance curve as FINAL as-built.

SUPPLIER shall prepare procedures indicating description of test, data collection points and their acceptance criteria and shall include various scenarios such as starting, normal stop, emergency shutdown, control system functionality and auxiliary systems functionality.

The following tables summarize the mechanical acceptance criteria for the steam turbine, the gearbox (if any) and the base plate which are applicable to the whole complete unit string test (including site acceptance test). Any project specific requirements must be agreed as part of site acceptance test procedure.

Table 9 – Steam Turbine and Gearbox Vibrations

Steam Turbine Radial Vibrations (µm pk to pk unfiltered)	Gearbox High / Low speed shaft radial Vibrations (µm pk to pk unfiltered) where used	Driven Equipment Radial vibrations (µm pk to pk unfiltered)
As per ISO 10816-3 Zone boundary A/B OR 50 OR 66% of alarm values whichever is less	25.4 x √(12000/N) x √2 OR 38.1 OR 66% of alarm limit chosen based on ISO 7913 / ISO 10816	50 OR 66% of alarm limit chosen based on ISO 7913 / ISO 10816

Any stable discrete, non-synchronous vibration exceeding 20% of the allowable vibration as defined in Table 9 above shall be cause of rejection of the package. Any unstable non-synchronous vibration shall be cause of rejection of the package. SUPPLIER shall conduct root cause for such vibrations and necessary permanent corrective actions shall be undertaken after COMPANY approval.

Table 10 – Acceptable Limits for Absolute Vibrations

Equipment	On Bearing Housings mm/s RMS	On Connecting Points Of Equipment To Base Plate mm/s RMS
Steam Turbine	3.5	3.5
Gearbox (if any)	3.5	
Driven Units	3.5	
	In all directions and from 10Hz up to 1000 Hz	

Table 11 – Steam Turbine, Gearbox Journal and Thrust Bearing Temperatures

		Bearing Metal Temperature °C						
Oil Inlet Temp °C	ΔT On Bearing Return Lines	Steam Turbine		Gearbox (if any)		Driven Unit Bearing Housing With Ring Oil)		Electric Motor
		Journal	Thrust	Journal	Thrust	Journal	Thrust	Journal
50	25	<85						
68 (Note*)	25	<100						

Note *: Considering maximum ambient of 58°C, LO supply temperature is expected to be between 65-68°C for air cooled LO cooler. In any case, 115°C shall be set as alarm and 125°C shall be set a trip. For self-contained bearing housings, max. oil temp. shall be limited to 85°C.

After successful SAT, a reliability run shall be performed as stipulated in the CONTRACT.

After satisfactory completion of SAT, the COMPANY representative shall sign the 'System Acceptance Note', which shall mean acceptance of the system for operation and the subsequent sustained performance test.

SECTION V – API 611 & API 612 TECHNICAL AMENDMENTS

13. TECHNICAL AMENDMENTS TO API 611 5TH EDITION & API 612 7TH EDITION

The information contained below in Table 12 and Table 13 details the technical amendments to API 611 5th Edition and API 612 7th Edition relating specifically to QA/QC, Welding, NDT, Inspection and Testing of Steam Turbines.

Table 12 – API 611 Technical Amendments

API Clause No.	Description of Change
6.9.4.1 (Add)	For multistage turbines, each thrust disc shall be dynamically balanced prior to being assembled on the shaft. COMPANY reserves the right to observe rotor assembly, calibration of the balancing machine and rotor balancing.
6.9.4.3 (Add)	COMPANY reserves the right to observe rotor assembly, calibration of the balancing machine and rotor balancing.
6.12.1.15 (New)	The MANUFACTURER, SUPPLIER and/or SUB-SUPPLIER shall furnish material certificates in accordance with BS EN ISO 10204 and ISO 10474, of the type indicated for each component as listed in **Error! Reference source not found.**."
6.12.2.3 (Modify)	Replace sub-clause (a) with…. 1 Approval by the Contractor shall be obtained before any major weld repair is carried out. NOTE: A weld repair shall be "major" if one or more of the following criteria apply: - More than 50% of the wall thickness needs repair; - Length of repair is more than 150 mm in one or more directions; - Total surface area of all repairs exceeds 20% of the total casting surface area. 2. All repairs shall meet the inspection requirements and acceptance standards for the original material. 3. For steel castings, the repair welding procedure and the repair welder's qualifications shall both be in accordance with ASTM A 488. Repair procedures are subject to approval by the Contractor. 4. The total quantity of weld metal deposited shall be less than 10% of the mass of the casting. 5. After weld repair, castings shall be suitably heat-treated if this is specified in the relevant material specification. A major weld repair shall always be followed by a suitable heat treatment. 6. Details of all major weld repairs, and of the heat treatment where applicable, shall be recorded and reported to the Contractor [Add] to b) Gray Cast Iron is not acceptable.
6.12.4.1 (Add)	Qualified welding procedures and welder performance qualification records shall be subject to review by the Contractor prior to commencement of welding work. Tungsten inert gas (TIG) welding shall be applied for all welds in the fabrication of stainless-steel piping.

API Clause No.	Description of Change
6.12.4.5 (Add)	Add the following new sub clauses…. e. Welding on case shall be completed prior to heat treatment of case. This includes temporary connections, such as lifting lugs or clips for handling or lagging. f. Areas where temporary lugs or clips are removed after heat treatment shall be ground flush and subjected to same NDT as required for the case, with visual inspection as a minimum. g. Temporary connections shall not be hammered off.
6.12.4.8 (New)	No casting repairs are allowed on turbine blades or casings without written approval from ADNOC. SUPPLIER shall submit a detailed list of all casting defects, supported by photographs, for ADNOC review and decision. A casing defect shall be considered as “Major”, if any of the following criteria apply: a. In the repair weld preparation if the excavation exceeds 25% of the wall thickness or 25 mm in one or more directions, whichever is smaller. b. Any of the repair area is more than 65 cm2. c. The total surface area of all repairs on the casting exceeds 10% of the total surface area of a particular casting piece. d. A weld repair necessitated by a leaking Hydro-test is also classified as "major". In case of a minor casting defect is approved for repair by ADNOC, a detailed procedure for repair shall be submitted for review and approval. Proper heat treatment shall be carried out after the weld repair. Proper control of heat input during the weld repair process shall be ensured, to prevent degradation of the parent metal properties. All minor casting repairs and heat treatments, those have been approved by ADNOC Offshore, shall be detailed, recorded, documented and submitted to ADNOC. For Duplex/Super duplex units, where the casing is made from Duplex or super duplex stainless steel, refer to API 611,Annex-H or APi 612, Annex J. Casting repairs carried out at Foundry level shall be documented with photos/sketches. Type of defect (minor or major), size of defect, excavation depth and size, and acceptance criteria shall be provided. Complete defect mapping is required. For all types of repairs, foundry shall require COMPANY approval. Photographic records shall be provided before and after repair. Any further repairs carried out at pump MANUFACTURER shop shall be reported and documented (on the Inspection and Test Plan for the pump by the pump MANUFACTURER) and require COMPANY approval.

API Clause No.	Description of Change
	Note: ADNOC approval for minor repairs will not relieve the SUPPLIER of the responsibility and accountability for the delivered unit to comply with the applicable technical Specifications/Requirements.
8.1.1 (Modify)	Replace this clause with…..“The SUPPLIER shall make arrangement to ensure that:- a. Company and the Company appointed representative shall at all times have access to the workshops and testing facilities, including workshops of sub-suppliers engaged in supplying material or in fabricating the equipment for the purpose of inspecting the purchased equipment. b. Company and the Company appointed representative shall be granted permission to photograph the equipment in the scope of the Purchase Order during manufacturing, assembly and test.”
8.1.2 (Modify)	Replace this clause with…. “Prior to the pre-inspection meeting and prior to the start of manufacture the SUPPLIER shall:- a. Submit an ITP for approval by COMPANY responsible engineer. b. Ensure that the ITP includes all required inspection and testing activities to be performed, including those at sub-SUPPLIERs’ works and shall make reference to all testing procedures, control documents, and resulting records and reports."
8.1.5 (Add)	The SUPPLIER shall submit an Inspection and test plan (ITP) for approval by COMPANY prior to any pre-inspection meeting and prior to the start of manufacture. The SUPPLIER shall ensure that:- a. The ITP meets the surveillance requirements determined by the criticality rating established by the criticality assessment and quality requirements. b. The ITP includes all inspection and testing activities to be performed, including those at each SUB-SUPPLIER’s works and shall make reference to all testing procedures, control documents, and resulting records and reports. c. Each supplied unit shall be tested in accordance with the approved ITP.
8.1.6 (Modify)	Replace this clause with…. “The SUPPLIER shall provide advance notification of witnessed (W) or observed (O) inspection activities by COMPANY of at least ten (10) working days.”
8.2.1.1 (Modify)	Delete the words “If specified” in sub-clause f.
8.2.1.5 (New)	Material traceability and marking is to be applied in accordance with Section 9.2 of this document (Appendix 2).
8.2.2.1.3 (Modify)	Replace this Clause with…. “After final machining, all casting surfaces shall be visually inspected in accordance with ASME V, Article 9 and shall be free of adhering sand, scale, cracks and hot tears. Acceptance criteria for pressure-containing steel castings shall be in accordance with MSS SP-55. Acceptance

API Clause No.	Description of Change
	criteria for other parts shall be in accordance with the material specification and the MANUFACTURER's documented procedures.”
8.2.2.2 (Modify)	Replace this clause with…..“Radiography shall be carried out in accordance with Section 8.7.1 of this document (Appendix 2). Where material sections cannot be radiographed and/or for wall thicknesses above 50 mm (2 in), ultrasonic examination shall be performed. The Vendor shall submit, for the COMPANY approval, details of the critical sections proposed to receive radiographic / ultrasonic examination.”
8.2.2.3.2 (Modify)	Replace this clause with…..“Ultrasonic Examination shall be carried out in accordance with Section 8.7.2 of this document (Appendix 2).
8.2.2.4 (Modify)	Replace this clause with…..“Magnetic Particle Examination shall be carried out in accordance with Section 8.7.3 of this document (Appendix 2).
8.2.2.5 (Modify)	Replace this clause with…..“ Liquid Penetrant Examination shall be carried out in accordance with Section 8.7.4 of this document (Appendix 2).
8.2.4 (New)	Component Marking All parts that have been specified with material certificates to ISO 10474 Type 3.1 shall be marked. Parts with a wall thickness in excess of 5 mm (0.200 in), except those items manufactured from austenitic stainless steel or from nickel alloys, shall be legibly marked by hard-die stamping on to a painted background at a place clearly visible later. Pipes should be marked at a point approximately 250 mm (10 in) from one end. Only low-stress stamps (dot-type, or round-nosed with a minimum radius of 0.25 mm (0.010 in) shall be used for hard-die stamping. For items manufactured from austenitic stainless steel or nickel alloys, and for items with a wall thickness of 5 mm (0.200 in) or less, the marking shall be applied by stencil using a water-insoluble ink which contains no injurious substances such as metallic pigments, sulphur, sulphides or chlorides which could attack or harmfully affect the material. The stamping/marking shall include: - material MANUFACTURER's symbol and, where applicable, the independent inspector's symbol; these symbols shall be identical to the symbols on the material certificate; - material identification; - heat, charge or batch number to relate to the material certificate; - heat treatment symbol or code, where applicable; - non-destructive testing symbol or code, where applicable; - size and schedule, where applicable;

API Clause No.	Description of Change
	- hydrostatic test pressure, where applicable. NOTE: Where the size of the item does not permit complete marking, the above identification marks may be substituted by a unique code which is fully traceable to the material certificate for the item."
8.2.5 (New)	Plating shall not be used to correct manufacturing errors.
8.2.7 (Modify)	Replace this clause with…. “Plating, coating or High Velocity Oxygen Fuel (HVOF) sprays shall not be used to correct manufacturing errors.
8.3.1.4 (New)	Unless specified otherwise on the datasheets, the following tests shall be witnessed: a. Hydrostatic tests. b. Mechanical running tests of all turbines rated above 74 kW (99 hp). c. Gear axial stability test. d. Combined running tests of all units that include reduction gear and/or pressurized lube oil system, including the following: 1. Gear teeth shall be blued before test. 2. Gear shall be disassembled after test for inspection of tooth and bearing contact. 3. Operation of switches and other components of lube oil system shall be checked. e. Running tests of contract turbine rotors and gears and if ordered spare turbine rotors and spare gear sets."
8.3.1.4.1 (New)	Each rotor shall be subjected to an over speed test of at least 116% of operating speed (trip condition) for a minimum duration of 3 minutes. After the over speed test, the rotor shall be checked for cracks and defects by magnetic particle inspection and shall then be rebalanced.
8.3.1.5 (New)	Immediately following both hydrostatic and performance testing, pump wetted parts shall be drained and dried to avoid corrosion or concentration of chlorides.
8.3.2.1 (Modify)	Replace this clause with… “After machining pressure containing parts shall be hydrostatically tested with water at 1.5 times the maximum design pressure corresponding to 100ºF (38ºC) for the material of construction used.”
8.3.2.2 (Add)	All pressure casing components shall be tested to the same pressure.
8.3.2.3 (Add)	Pressure castings shall be hydro tested for duration not less than 30 minutes minimum or to complete the inspection of the tested parts.
8.3.2.5 (Add)	If pressure parts require welded connections, such as drains, the connections shall be in place at time of hydrostatic test.
8.3.2.6 (New)	Water used for the hydrostatic test shall not contain chlorides of more than 50 ppm.

API Clause No.	Description of Change
8.3.2.7 (New)	The wetting agent to be used shall be subject to the approval of the COMPANY.
8.3.2.8 (New)	To prevent deposition of chlorides as a result of evaporative drying, all residual liquid shall be removed from the equipment by flushing with chloride-free water, alcohol, petroleum distillate or suitable flushing solution.
8.3.2.9 (New)	All pressure-casing components SHALL [PS] be tested to the same pressure.
8.3.2.10 (New)	Cooling passages and components, including jackets for bearings, seal chambers, oil coolers and seal coolers, shall be tested at 1.5 times the cooling water design pressure.
8.3.2.11 (New)	Cooling water piping shall pass a leak test for 30 minutes. No leaks or seepage will be accepted.
8.3.2.12 (New)	Parts shall not be coated or painted until after successful hydrotesting. Any repairs to the pressure casing components shall require a repeat of the hydrostatic test.
8.3.3.1 (Modify)	Add to sub-clause a) … "The test shall be carried out with the half coupling and idling adaptor in place (resulting in a moment equivalent to that of the contract half coupling plus one half of the coupling spacer)." In sub-clause h), delete the words….."or if the purchased probes are not compatible with the shop readout facilities".
8.3.3.2 (Add)	Add to sub-clause e)… "Multistage turbines shall be no load tested for at least 2 hours at maximum continuous speed."
8.3.3.3 (Add)	Add to sub-clause b)… "Internal rubs causing clearance changes that exceed new component tolerances shall be cause for retest."
8.3.3.4 (New)	The contract coupling hub and idling adaptor shall be in place (resulting in a moment equivalent to that of the contract half coupling plus one half of the coupling spacer) during the test. See above??
8.3.3.5 (New)	Unless otherwise specified, turbines equipped with gland eductor systems shall be tested. The performance test of the eductor system shall be conducted as specified in clause 8.3.3.5.1 and 8.3.3.5.2.
8.3.3.5.1 (New)	All operating parameters and acceptance criteria for the Mechanical FAT shall be mutually agreed upon prior to the FAT. The following conditions shall be maintained during the test: a. Maximum condenser cooling water temperature b. Minimum condenser cooling water flow c. Minimum ejector steam conditions d. Minimum ejector steam flow e. Maximum ejector discharge pressure f. Maximum allowable turbine exhaust pressure g. Maximum leak steam header pressure

API Clause No.	Description of Change
8.3.3.5.2 (New)	The system shall be considered acceptable if a pressure of not less than 10 kPa (1.45 psi) below atmospheric pressure is maintained at each gland during the full duration of the mechanical running test. The pressure shall be measured directly at the gland lantern or at the gland steam piping immediately adjacent to the gland. The seal leakage rates needs to be mutually agreed upon before the testing (actual versus predicted comparisons).
8.3.4.1 (Add)	If a performance test is to be conducted, the “details subject to negotiation” should include the location of the test (factory or at site) and the acceptance criteria (e.g., speed control, steam rate at rated power).
8.3.4.2 (Modify)	Replace this ISO/API clause with…. “A complete unit test (string test) is required when:- 1) Specified in the equipment datasheets or 2) The steam inlet pressure exceeds 100 bar(g) or 3) The steam turbine rating is 10MW or more. If a complete unit test is specified, it shall be performed with the job lube oil system, job seals and seal system. Unless Otherwise Specified, a complete unit test for first unit (for identical units) shall be performed and if successful then turbine (shaft line) only to be tested for the other identical units. If first unit complete unit test was not satisfactory (i.e. fails in terms of operating and Mechanical performance) then all units shall undergo a complete unit test. This test is in addition to the individual equipment or component test.”
8.3.4.4 (Modify)	Replace this ISO/API clause with…. “A noise test shall be carried out in accordance with Section 11.8 of this Appendix. The noise test at SUPPLIER’s works is considered to be indicative only. Actual sound pressure levels will be verified during the site acceptance test (SAT).”
8.3.4.5 (Modify)	Replace the second sentence of this ISO/API clause with… “The SUPPLIER shall submit detailed test procedures for all auxiliary equipment items which shall be submitted to COMPANY/CONTRACTOR for review at least four weeks prior to each individual test. Refer to ‘Appendix 3 – Information Requirements’ for minimum required content of submitted test procedures.
8.4 (Modify)	For details of ‘Preservation and Shipment’ requirements, refer to Appendix 1 – General Technical and Contractual Requirements for Rotating Equipment.

Table 13 – API 612 Technical Amendments

API Clause No.	Description of Change
12.3.4.8 (New)	The Supplier of the TTV shall provide the Historical Failure Data on their valve design so that the CONTRACTOR can complete a risk assessment for the various modes of failure for these valve(s) to determine redundancy requirements for any failure encountered.
16.1 (New)	The steam turbine shall be subject to inspection by the Contractor's inspection representative in accordance with the requirements specified in the ITP.
16.1.1 (Add)	The SUPPLIER's ITP shall be submitted prior to the PIM for review by CONTRACTOR/COMPANY. The relevant observed (O) and witness (W) inspection points will be agreed between COMPANY and SUPPLIER during the PIM.
16.1.4 (Modify)	Replace this clause with…. "The SUPPLIER shall provide advance notification of witnessed (W) or observed (O) inspection activities by COMPANY of at least ten (10) working days."
16.1.7 (Modify)	Delete the words "If specified" in the first sentence. Add…. "The initialed and dated checklist shall be submitted by Vendor before shipment. The Inspectors Check List shall be as per Annex H with additional requirements as specified in Appendix 2."
16.1.9 (New)	Correction of manufacturing errors resulting in design changes shall be recorded. Any modifications that may change the turbine's dynamic behavior shall be submitted for review within one week of occurrence and shall be subject to the approval of the COMPANY.
16.1.10 (New)	Plating shall not be used to correct manufacturing errors.
16.2.1.1 (Modify)	Replace sub-clause (a) with….."The MANUFACTURER, SUPPLIER and/or SUB-SUPPLIER shall furnish material certificates in accordance with BS EN ISO 10204 and ISO 10474, of the type indicated for each component as listed in Table 6 of this document (Appendix 2)."
16.2.1.3 (Add)	Casing fabrication welds shall be subject to surface and sub-surface inspection. Forged components shall be subject to ultrasonic testing and testing for surface cracks. The SUPPLIER shall indicate the extent and method of examination offered in the proposal.
16.2.2.1.1 (Add)	The extent of non-destructive testing (NDT) for each component type shall satisfy the minimum examination requirements as specified in Table 7.
16.2.2.2 (Modify)	Replace this clause with….."Radiography shall be carried out in accordance with Section 8.7.1 of this document (Appendix 2). Where material sections cannot be radiographed and/or for wall thicknesses above 50 mm (2 in), ultrasonic examination shall be performed. The Vendor shall submit, for the COMPANY

API Clause No.	Description of Change
	approval, details of the critical sections proposed to receive radiographic / ultrasonic examination."
16.2.2.3 (Modify)	Replace this clause with….."Ultrasonic Examination shall be carried out in accordance with Section 8.7.2 of this document (Appendix 2).
16.2.2.4 (Modify)	Replace this clause with….."Magnetic Particle Examination shall be carried out in accordance with Section 8.7.3 of this document (Appendix 2).
16.2.2.5 (Modify)	Replace this clause with….." Liquid Penetrant Examination shall be carried out in accordance with Section 8.7.4 of this document (Appendix 2).
16.2.2.6 (Modify)	Replace this clause with….."Ultrasonic Examination shall be carried out in accordance with Section 8.7.2 of this document (Appendix 2).
16.2.2.10 (New)	1. PT of all blades shall be performed before installation on the rotor. 2. PT or MT of shrouds and closing pins shall be performed after installation.
16.2.2.11 (New)	1. MANUFACTURER shall perform a 100% visual inspection of blades and shrouds to ensure no tool marks are present prior to fitting and assembly of blades and shrouds to the rotor. 2. The inspection records shall be submitted to the Principal for review and approval.
16.2.2.12 (New)	1. For tenons 15 mm and larger, UT and MT shall be performed after peening.
16.2.2.13 (New)	1. UT of welds shall be performed for weld thickness over 30 mm. 2. Butt-welds shall be examined by RT. 3. Through-wall casting repairs shall be examined by UT.
16.2.2.14 (New)	1. Visual inspection (VI) shall be performed in accordance with ASME SEC V, Article 9. 2. All surfaces shall be inspected. 3. Acceptance criteria for pressure-containing steel castings shall be in accordance with ASTM A802. 4. Acceptance criteria for other parts shall be in accordance with the material specification and the MANUFACTURER's documented procedures.
16.2.3.3 (Add)	The following will be inspected for cleanliness:- a. All equipment and all piping and appurtenances furnished by or through Vendor, prior to installation of nozzle blocks and steam chest covers. b. The closure of openings in vessels and exchangers. c. Assembly of piping.
16.2.3.4 (Modify)	Replace this clause with…. 1. If the datasheets require hardness testing of materials during fabrication, a representative 10% of the production welds and associated heat affected zones shall be hardness tested.

API Clause No.	Description of Change
	2. The MANUFACTURERs hardness testing procedures shall be subject to Company review.
16.2.4 (New)	The MANUFACTURER, SUPPLIER and/or SUB-SUPPLIER shall furnish material certificates in accordance with BS EN ISO 10204 and ISO 10474, of the type indicated for each component as listed in Table 7 of this document (Appendix 2).
16.2.5 (New)	1. All pressure casings shall be marked for identification. 2. Parts with a wall thickness in excess of 5 mm (0.2 in), except those items manufactured from austenitic stainless steel or from nickel alloys, may be marked by hard-die stamping. 3. Only low-stress stamps (dot-type or round-nosed with a minimum radius of 0.25 mm (0.01 in)) shall be used for hard-die stamping. Alternative processes are subject to approval by COMPANY. 4. For items manufactured from austenitic stainless steel or nickel alloys, and for items with a wall thickness of 5 mm (0.2 in) or less, the marking may be applied by stencil.
16.3.2.2.1 (Add)	1. For temperatures above 315 °C (600 °F), the hydrostatic test pressure shall be temperature corrected as per the requirements of ASME VIII, paragraph UG-99. 2. Auxiliary piping shall be hydrostatically tested to the same test pressure as the portion of the casing to which it is attached.
16.3.3.1 (Add)	Add to end of first sentence…. “In multi-casing turbine trains, all contract power transmission components (couplings, gears, etc.) and all turbine casings shall be tested in the same configuration during the mechanical test run as that intended for field installation.” Add to sub-clause (h)…. “Instrumentation shall be provided by the MANUFACTURER to display and record real time frequency spectra for each bearing in both planes and in the axial direction for each shaft. The recording shall be continued during the optional part load running test.”
16.3.3.2 (Modify) **[PSR]**	Add to sub-clause (b)… “The mechanical integrity of the turbine rotor(s) SHALL be tested at 105 % of the design trip speed for 3 min after operating for 15 min at trip speed. After the over speed test, the spare rotor shall be magnetic particle examined. The acceptance criterion being zero linear indications. Any shroud lifting or indications shall require the main rotor to be also inspected following testing. If the main rotor vibration signature changed after the trip speed test, the rotor shall be examined by MT. Add to sub clause c)… 1. During the mechanical test, the SUPPLIER **SHALL [PSR]** measure and confirm that the over speed trip system response time meets the design requirements calculated in (12.3.1.1, Item 2.a) and does not exceed 1 second.

API Clause No.	Description of Change
	2. The mechanical integrity of the turbine rotor(s) **SHALL [PSR]** be tested at 105 % of the design trip speed for 3 minutes after operating for 15 minutes at trip speed. Add new sub-clause (g)…"During the 4-h test, the lubricating oil viscosity shall be maintained within the range used during the rotor dynamics analysis. Add new sub-clause (h)…. "Oil leaks from bearing housings or job coupling guards on mechanical run tests are unacceptable and cause of rejection of the turbine."
16.3.3.3 (Add)	Add to sub-clause (b)… "Vibration readings and bearing temperatures at the end of the four-hour run shall be essentially the same as those recorded at the beginning of the four-hour test." Replace sub clause (e) with…. "Recordings shall be made of all real time vibration data for later retrieval and analysis and submitted to COMPANY as part of the Test Report."
16.3.3.4 (Add)	Add to sub-clause (b)…. "Internal rubs causing clearance changes that exceed new component tolerances shall be a cause for retest."
16.3.3.5 (New)	For all rotors, both stiff shaft and flexible shaft, the SUPPLIER shall identify all critical speeds up to the maximum test speed.
16.3.4.3 (Add)	Replace this ISO/API clause with…. "Refer to Section 11.7 of this document (Appendix 2) for details of complete unit test."
16.3.4.4 (Add)	Auxiliary equipment tests shall be performed in accordance with Section 11.9 of this document (Appendix 2). Refer to "Lubrication System Design Requirements' (Appendix 7) for lubrication system configurations.
16.3.4.5 (Modify)	Replace this clause with… "A post-test internal inspection shall be conducted only in the event of an unsatisfactory mechanical running test due to internal causes. If this inspection is conducted, all O-rings, gaskets and sealants shall be replaced."
16.3.4.10 (Add)	A trip valve test shall be performed.
16.3.4.12 (Modify)	Replace this ISO/API clause with…. "A noise test shall be carried out in accordance with Section 11.8 of this document (Appendix 2). The noise test at SUPPLIER's works is considered to be indicative only. Actual sound pressure levels will be verified during the site acceptance test (SAT)."
16.3.4.13 (New)	Each rotor shall be subjected to an over speed test of at least 115% of maximum continuous speed for a minimum duration of 3 minutes. After the over speed test, the rotor shall be dimensionally checked and examined for cracks and defects by magnetic particle inspection and shall then be rebalanced. Magnetic Particle Inspection (MPI) may be substituted by Dye Penetrant Inspection (LPI) if necessary, for areas of complex geometry.

API Clause No.	Description of Change
16.4 (Modify)	Replace this ISO/API clause with…. “For details of ‘Preparation for Shipment’ requirements, refer to Appendix 1 – General Technical and Contractual Requirements for Rotating Equipment.

INFORMATION REQUIREMENTS FOR GENERAL & SPECIAL PURPOSE STEAM TURBINES (API 611 and 612) SPECIFICATION Appendix 3 - AGES-SP-05-004

THE CONTENTS OF THIS DOCUMENT ARE PROPRIETARY.

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شركة بترول أبوظبي الوطنية
Abu Dhabi National Oil Company

	Information Requirements for **General & Special Purpose Steam Turbines**	Insert Project Logo Here

CLIENT : Insert Client_name

PROJECT TITLE : Insert Project Title

PROJECT LOCATION : Insert Project_location

JOB/PROJECT NUMBER : Insert Job/Project number here

TAG No. : Insert Tag_No

SERVICE : Insert Service Description

DOCUMENT NUMBER : Insert Project Document Number

REVISION : Insert Project Document Revision

Issue	Date	Issue Description	By	Checked	Approved	

ADNOC Document No. xxxxxxx Version 1.0 Sheet 1 of 1

Information requirements for
General & Special Purpose Steam Turbines
Manufacturer's Record Book (MRB) SUBMITTAL REQUIREMENTS

1 GENERAL

1.1 DELIVERABLES

The SUPPLIER document requirements are defined within the DELIVERABLES section of this APPENDIX. The listed documentation shall be considered to be the minimum required. Additional requirements shall be discussed and agreed where specifically required by individual projects. All drawings and documents shall be written in the ENGLISH Language.

1.2 MANUFACTURING RECORD BOOK

The Manufacturing Record Book (MRB) for each equipment item shall be compiled in accordance with the following requirements and the applicable codes:-
a) Documents shall be written in English.
b) Documents shall be in a legible, reproducible form.
c) The number of MRB's to be supplied shall be specified in the request for quotation (RFQ) and the Purchase Order (PO) documents.
d) Drawings and other data shall be based on the A4 series sizes, and all drawings larger than A4 size shall be folded to A4 size so that title box and status decal are visible from the front and inserted into pre-punched plastic sleeves.
e) The contents of the MRB shall be collated into a logical sequence in accordance with the Purchase Order/Contract requirements and in accordance with DGS 0000 003 "Minimum Shop Inspection and Certification Requirements". Tabbed dividers shall be provided to separate the sections of data.
f) MANUFACTURER/SUPPLIER shall submit a detailed MRB index/contents list for CONTRACTOR approval within 8 weeks of order placement unless stated otherwise in the Purchase Order.
g) The reports shall be provided in loose leaf form with numbered pages in 2.5 inch hard cover A4 size binders (MANUFACTURER / SUPPLIER can use narrower binders if appropriate subject to COMPANY/ CONTRACTOR approval). Binder mechanism shall be four pillar interlock type. The color and finish of the binder will be advised by CONTRACTOR / COMPANY during a pre-production meeting.
h) Multiple binders must be clearly referenced i.e. "1 of xx", and each contains an index detailing how many volumes and the contents of each volume.

2 DOCUMENTS

2.1 SUPPLIER'S RESPONSIBILITIES

As manufacturing of the equipment progresses, the MANUFACTURER / SUPPLIER shall compile the MRB with all the design, manufacturing, inspection, tests, and certification information on a per tag item number basis. Documents that are common to more than one item shall be duplicated in each report.

2.1 SUPPLIER'S RESPONSIBILITIES (Continued)

The MANUFACTURER / SUPPLIER shall present MRB's to the nominated inspector at each inspection visit. It is also their responsibility to ensure that Inspection & Test Plans are signed and dated by the nominated inspector on the day of any Inspection / Test. The spine and cover of each binder shall indicate the following as a minimum:-

a) Manufacturing Data Report
b) Project Name
c) MANUFACTURER / SUPPLIER Name
d) Purchase Order No.
e) Equipment No.
f) Equipment Description
g) MANUFACTURER / SUPPLIER Order Ref. No.
h) MANUFACTURER / SUPPLIER Doc. No.
i) Date of Issue and Revision

j) Alterations, deletions, or additions to certification are not normally permitted, and a new document must be prepared. However where this is not possible the alteration must be approved, signed and dated. Additions and revisions shall be added to the documentation, not as a replacement but as an addition to the existing records

k) The Manufacturing Data Report shall, after being accepted by clear endorsement of each page by stamp, date and signature of the nominated inspector, be submitted to the CONTRACTOR.

l) MDR documents that are already approved by CONTRACTOR with a signed and dated endorsement do not require additional endorsement by the nominated inspector at the MANUFACTURER / Supplier works. The nominated inspector shall endorse the index as correct with reference to documents embodied within the MRB. For multi-page documents the first page (used for approval) shall clearly state the document total number of pages and each page shall be numbered. CONTRACTOR can use dated stamps, subject to COMPANY approval (without requirement for signature endorsement) providing stamp is uniquely identifiable to individual inspectors.

m) The original and the required number of copies shall be forwarded promptly after the completion of the equipment in accordance with the terms and conditions of the purchase order. If the order is subject to inspection by COMPANY / CONTRACTOR, the release note for the acceptance of the equipment shall only be issued when the manufacturing report, including the required number of copies, is presented.

n) The use of colored markers to highlight certificates shall not be permitted.

o) The use of correction fluids is not permitted.

p) When test / material certification is called for, these certificates are to be countersigned by COMPANY / CONTRACTOR.

3 MANUFACTURER/ SUPPLIER QC DOCUMENTATION AND CERTIFICATION

Supplier document and deliverables shall be as per the attached schedule of DELIVERABLES, which shall be updated with the required document submission times according to project schedule requirements.

Information Requirements for General & Special Purpose Steam Turbines

شركة بترول أبوظبي الوطنية
Abu Dhabi National Oil Company

Deliverables

Column	Heading - Details and requirements
A	**Code** - a unique identifier for the Information Deliverable, referencing the Parent Standard, IOGP Supplement or Industry Standard where the Information is requested. e.g. API610#01.
B	**Requirement** - a short description of the Information Deliverable that would typically provide the Information required, based on the description in the Parent Standard, IOGP Supplement or an Industry Standard Title.
C	**Condition Invoking Requirement** - describes special condition(s) under which the Information Deliverable is required; e.g.. service offshore and weight greater than 1 tonne means information is required. NB: if blank, always required
D	**Typical Deliverable** - Purchaser to confirm or add a short description of the Information Deliverable that would typically include this Information Requirement
E	**Submit With Proposal** - Yes or No, where 'Yes' means the Information Deliverable is required to be submitted with Suppliers Proposal or 'No' is not required
F, G & H	**First Issue Post Purchase Order** - deliverable shall be issued 'For Information' or 'For Acceptance' at the agreed time defined as weeks after order placement (WAO), Weeks prior to delivery (WPTD), Weeks prior to test (WPTT) or weeks after test (WAT).
I	**Required As Built** - Yes or No, where 'Yes' means the Information Deliverable is required to be 'As Built' on completion or delivery of equipment or 'No' is not required 'As Built'
J	**Fulfilled by Information Deliverable Number(s)** – identifies which deliverable(s) to be provided by the Supplier include the Purchaser's information requirements described within the Definitions tab. NB; it should be noted that one single Deliverable may include more than one defined information line item.
K	**Manufacturer's Record Book** - Yes or Yes ®, where 'Yes' means that the Supplier shall provide details within the Manufacturer's Record Book and 'Yes ®' means that the MRB shall be reviewed by the inspector during inspection. This requirement does not preclude formal / duplicate submission of doucments for project purposes
L	**Installation, Operating and Maintenance Manual** - ✓, where ✓ means that the Supplier shall provide details within the Installation, Operating and Maintenance Manual(s)
M	**Translation Required** -Yes or No, where 'Yes' means the Deliverable should be translated into one or more other languages (where specified in the purchase order) other than English and 'No' means to be provided in English
N	**Remarks** - may include additional requirements, conditions & decisions as may be appropriate to the content of the deliverable.

Col A	Col B	Col C	Col D	Col E	Col F	Col G	Col H	Col I	Col J	Col K	Col L	Col M	Col N
Code	Requirement	Condition Invoking Requirement	Typical Deliverable	Submit At Proposal	First Issue Post Purchase Order			Required As Built	Fulfilled by Document Number(s)	MRB	IOM Manual	Translation Required	Remarks
				(Yes/No)	Purpose	(Weeks)	(Period)	(Yes/No)		(Yes / Yes ®)	(✓)	(Yes/No)	
Contract Management Information Deliverables													
MD#01	Supplier Master Information Schedule		Information Deliverables List	No	For Acceptance	2	WAO	Yes		Yes	✓		List of Supplier's Documents and Drawings
MD#02	Delivery Schedule		Delivery/Production Schedule	Yes	For Information		WAO	No					
MD#03	Progress Report		Progress Report	No	For Information		WAO (Monthly)	No					API 611, 9.3.3: API 612, 17.3.3. Bi-weekly progress email reports are required indicating lookahead and manufacturing status.
MD#04	Quality Plan	Required for CAS I & II	Quality Plan	No	For Acceptance		WAT	No		Yes			
MD#05	Design and Development Plan		Design and Development Plan	No	For Acceptance		WAO	No					
MD#06	List of Sub-Suppliers		List of Sub-Suppliers	Yes	For Acceptance		WAO	No			✓		To be updated monthly to show Sub-Supplier details, including component description, sub-order number, order placement and delivery dates
MD#07	Inspection and Test Plan (ITP)		Inspection and Test Plan (ITP)	Yes	For Acceptance		WAO	No		Yes ®			Prior to the start of manufacture, an ITP shall be submitted for approval by SUPPLIER for review at the Pre-inspection meeting.
MD#08	Packing, Shipping, Storage and Preservation Procedure		Handling, shipping and storage procedure	No	For Acceptance		WPTD	No			✓		Preparation of equipment for transportation shall conform to the packing, marking, and shipping instructions or other documents identified in the Purchase Order. In Addition SUPPLIER shall comply with the Handling - Package - Preservation and Storage requirements given in "Common Requirements" Appendix of this Specification.
MD#09	Non-Conformance Records		Nonconformance History	No	For Acceptance		WAO	Yes		Yes ®			
MD#10	Concession Requests		Concession request	Yes	For Acceptance		WAO	Yes		Yes			
MD#11	Preservation and Maintenance Instructions for Insurance/Capital Spares		Preservation and Maintenance Instructions for Insurance/Capital Spares	No	For Acceptance		WPTD	No			✓		This shall be submitted prior to the packing, shipping storage and preservation procedure, MD#08
Technical Information Deliverables													
API 611/2#01	General Arrangement Drawing		General Arrangement Drawing	Yes	For Acceptance	4	WAO	Yes			✓		Dimensional drawing, showing size, type, rating and location of suction and discharge nozzles, auxiliary piping interfaces , electrical motor terminal box locations and full details of baseplate foundation loads
API 611/2#02	Steam Turbine Performance Curves		Steam Turbine Performance Curves	Yes	For Information		WAO	Yes			✓		
API 611/2#03	Steam Turbine Data Sheets		Steam Turbine Data Sheets	Yes	For Acceptance		WAO	Yes			✓		
API 611/2#04	Noise Data Sheets		Noise Data Sheets	Yes	For Acceptance		WAO	Yes			✓		
API 611/2#05	Utility Requirements Schedule		Tabulation of Utility Requirements (Process and Electrical)	Yes	For Acceptance		WAO	Yes			✓		
API 611/2#06	Cross Sectional Drawings and Bill of Materials	Required for CAS I & II	Cross Sectional Drawings and Bill of Materials	Yes	For Information		WAO(Monthly)	No			✓		Steam Turbine
API 611/2#07	P&I Diagram of Steam Turbine		P&I Diagram of Steam Turbine	Yes	For Acceptance		WAO	Yes			✓		

Col A	Col B	Col C	Col D	Col E	Col F	Col G	Col H	Col I	Col J	Col K	Col L	Col M	Col N
Code	Requirement	Condition Invoking Requirement	Typical Deliverable	Submit At Proposal	First Issue Post Purchase Order			Required As Built	Fulfilled by Document Number(s)	MRB	IOM Manual	Translation Required	Remarks
				(Yes/No)	Purpose	(Weeks)	(Period)	(Yes/No)		(Yes / Yes ®)	(✓)	(Yes/No)	
API 611/2#08	P&I Diagram of Lube Oil System		P&I Diagram of Lube Oil System	Yes	For Acceptance		WAO	Yes			✓		
API 611/2#09	P&I Diagram of Shaft Sealing System		P&I Diagram of Shaft Sealing System	Yes	For Acceptance		WAO	Yes			✓		
API 611/2#10	P&I Diagram for Condition Monitoring Instruments		P&I Diagram for Condition Monitoring Instruments	Yes	For Acceptance		WAO	Yes			✓		
API 611/2#11	Shaft Seal Detail Drawings		Shaft Seal Detail Drawings	Yes	For Acceptance		WAO	Yes			✓		
API 611/2#12	Recommended Spare Parts		List of recommended spare parts for complete package including commissioning spares, two year spares and insurance spares.	Yes	For Information		WPTD	Yes			✓		
API 611/2#13	Life Cycle Cost Analysis		Life Cycle Cost Analysis	Yes	For Acceptance		WAO	No			✓		
API 611/2#14	Reliability & Availability Study		Reliability & Availability Study	Yes	For Acceptance		WAO	No			✓		
API 611/2#15	Site Acceptance Test Procedure (SAT)		Site Acceptance Test Procedures	Yes	For Acceptance		WAO	No			✓		Preliminary version to be submitted with proposal. FINAL version to be developed and submitted after purchase order award.
API 611/2#16	Detailed Drawings	Only for bespoke components. 'Required for CAS I & II	Detailed Drawings	No	For Information		WAO	Yes			✓		Steam Turbine
API 611/2#17	Stair, Ladders and Platform Drawing		Stair, Ladders and Platform Drawing	No	For Acceptance		WAO	Yes			✓		
API 611/2#18	Nameplate Drawing		Nameplate Drawing	No	For Information		WAO	Yes			✓		
API 611/2#19	Rotor Assembly Drawing		Rotor Assembly Drawing	No	For Acceptance		WAO	Yes			✓		
API 611/2#20	Drive Coupling Assembly Drawing		Drive Coupling Assembly Drawing	No	For Information		WAO	Yes			✓		complete with Bill of Materials
API 611/2#21	Electrical and Instrument Interconnecting Cable Block diagram or interface wiring schematic		Electrical and Instrument Interconnecting Cable Block diagram or interface wiring schematic	No	For Acceptance		WAO	No			✓		
API 611/2#22	Electrical and Instrument Connection & Wiring Diagrams with Bill of Material and termination details		Electrical and Instrument Connection & Wiring Diagrams with Bill of Material and termination details	No	For Acceptance		WAO	Yes			✓		
API 611/2#23	Foundation Loading Diagram		Foundation Loading Diagram	No	For Acceptance		WAO	Yes			✓		
API 611/2#24	Process Control Description		Process Control Description	No	For Acceptance		WAO(Monthly)	Yes					
API 611/2#25	Cause & Effect Chart		Cause & Effect chart	No	For Acceptance		WAO	Yes			✓		
API 611/2#26	Coupling Data Sheets		Coupling Data Sheets	No	For Acceptance		WAO	Yes			✓		
API 611/2#27	Electric Motor Data Sheets		Electric Motor Data Sheets	No	For Acceptance		WAO	Yes			✓		Separate data sheet required for each size/type of electric motor supplied for auxiliary equipment drives.
API 611/2#28	ISA Data Sheets for Instruments	Only for bespoke components. 'Required for CAS I & II	ISA Data Sheets for Instruments	No	For Acceptance		WAO	Yes			✓		
API 611/2#29	Material Safety Data Sheets		Material Safety Data Sheets	No	For Acceptance		WAO	Yes			✓		
API 611/2#30	Surface Preparation and Coating Procedure Specification		Painting Specification	No	For Acceptance		WAO	No			✓		
API 611/2#31	Insulation Specification		Insulation Specification	No	For Acceptance		WAO	No			✓		
API 611/2#32	Weight Data Sheet		Weight Data Sheet	No	For Acceptance		WAO	Yes			✓		
API 611/2#33	Vibration Data Sheet		Vibration Data Sheet	No	For Acceptance		WAO	Yes			✓		
API 611/2#34	Single Line Diagram	Only for bespoke components. 'Required for CAS I & II		No	For Information		WAO	No			✓		
API 611/2#35	Lubrication Schedule		Lubrication Schedule	No	For Information		WAO	No			✓		
API 611/2#36	Relief Valve Sizing Calculation	Required for CAS I & II	Relief Valve Sizing Calculation	No	For Information		WAO	Yes			✓		
API 611/2#37	Structural Calculations		Structural Calculations	No	For Information		WAO	Yes			✓		
API 611/2#38	CFD and FEM Calculation Notes		CFD and FEM Calculation notes	No	For Acceptance		WAO	Yes			✓		
API 611/2#39	Lube Oil System Data Sheets	'Required for CAS I & II	Lube Oil System Data Sheets	No	For Acceptance		WAO	Yes			✓		
API 611/2#40	Gearbox Data Sheets	'Required for CAS I & II	Gearbox Data Sheets	No	For Acceptance		WAO	Yes			✓		
API 611/2#41	Drawings of Auxiliaries and Itemized Equipment supplied loose	'Required for CAS I & II	Drawings of Auxiliaries and Itemized Equipment Supplied Loose	No	For Acceptance		WAO	Yes			✓		
API 611/2#42	Thermal Rating for Air Cooler / Heat Exchangers	'Required for CAS I & II	Thermal Rating for Air Cooler / Heat Exchangers	No	For Acceptance		WAO	Yes			✓		
API 611/2#43	Pressure Vessel / Cooler Fabrication Drawings	'Required for CAS I & II	Pressure Vessel / Cooler Fabrication Drawings	No	For Acceptance		WAO	Yes			✓		
API 611/2#44	Blades Campbell Diagrams		Blades Campbell Diagrams	No	For Acceptance		WAO	Yes			✓		
API 611/2#45	Electric Motor Performance & Data and Curves	Only for bespoke components. 'Required for CAS I & II	Electric Motor Performance & Data and Curves	No	For Information		WAO	Yes			✓		
API 611/2#46	Hydrostatic Test Procedure and Certificates	Required for CAS I & II	Hydrostatic Test Procedure and Certificates	No	For Information		WPTT	Yes		Yes ®			
API 611/2#47	Performance Test Procedure	Required for CAS I & II	Performance Test Procedure		For Acceptance		WPTT	No		Yes			
API 611/2#48	Auxiliary Equipment Test Procedure	Only for bespoke components. 'Required for CAS I			For Information		WPTT			Yes			
API 611/2#49	Complete Package Factory Acceptance Test Procedure		Complete Package Factory Acceptance Test Procedure	No	For Acceptance		WPTT	No		Yes			
API 611/2#50	Lateral Critical Speed Analysis		Lateral Critical Speed Analysis	No	For Acceptance		WAO	Yes			✓		
API 611/2#51	Material Certificates	Required for CAS I & II	Material Certificates	No	For Information		WAT	No		Yes ®			The document is not required to be submitted as a separate document part of project review cycle. It can be included part of the MDB.
API 611/2#52	Preservation, Packaging and Shipping Procedures	Required for CAS I & II	Preservation, Packaging and Shipping Procedures	No	For Acceptance		WPTD	Yes		Yes			
API 611/2#53	Torsional Critical Speed Analysis		Torsional Critical Speed Analysis	No	For Acceptance		WAO	Yes			✓		

Col A	Col B	Col C	Col D	Col E	Col F	Col G	Col H	Col I	Col J	Col K	Col L	Col M	Col N
Code	Requirement	Condition Invoking Requirement	Typical Deliverable	Submit At Proposal	First Issue Post Purchase Order			Required As Built	Fulfilled by Document Number(s)	MRB	IOM Manual	Translation Required	Remarks
				(Yes/No)	Purpose	(Weeks)	(Period)	(Yes/No)		(Yes / Yes ®)	(✓)	(Yes/No)	
API 611/2#54	Welding Procedure Specification, including Procedure Qualification Record / Certificates	Required for CAS I & II	Welding Procedure Specification, including Procedure Qualification Record	No	For Information		WPTF	No		Yes ®			
API 611/2#55	Welding Repair Procedure	Required for CAS I & II	Welding Repair Procedure	No	For Information		WPTF	No		Yes			
API 611/2#56	Complete Unit Test Report		Complete Unit Test Report	No	For Information		WAT	No		Yes			
API 611/2#57	Performance Test Procedure - Electric Motors	Required for CAS I	Perfomance Test Procedure - Electric Motors	No	For Information		WPTT	No			✓		Motor Routine Test to be performed on all auxiliary electic motors for CAS II, III & IV
API 611/2#58	Non-Destructive Examination (NDE) Report	Required for CAS I & II	Non-Destructive Examination (NDE) Report	No	For Information		WAT	No		Yes			
API 611/2#59	Instrument Calculation Sheets		Instrument Calculation Sheets	No	For Information		WPTD	No			✓		
API 611/2#60	Instrument Hook-Up Drawings		Instrument Hook-Up Drawings	No	For Information		WPTD	No			✓		
API 611/2#61	SIL / ATEX Certificates	Required for CAS I & II	SIL / atex Certificates	No	For Information		WAO	No		Yes ®	✓		
API 611/2#62	Instrument List/Index		Instrument List/Index	No	For Acceptance		WAO	No			✓		
API 611/2#63	Preliminary Packing List		Preliminary Packing List	No	For Information		WPTD	No			✓		
API 611/2#64	Installation, Operation and Maintenance Manual Index		Installation, Operation and Maintenance Manual Index	No	For Acceptance		WAO	No			✓		
API 611/2#65	Installation, Operation & Maintenance Manual		Installation, Operation & Maintenance Manual	No	For Acceptance		WPTD	No			✓		
API 611/2#66	List of Special Tools for Maintenance		List of Special Tools for Maintenance								✓		
API 611/2#67	Manufacturing Record Book Index		Manufacturer Record Book Index	No	For Acceptance		WAO	No		Yes			
API 611/2#68	Manufacturing Record Book		Manufacturer Record Book	No	For Acceptance		WPTD	Yes		Yes			
API 611/2#69	Non-Destructive Examination (NDE) Procedure	Required for CAS I & II	Non-Destructive Examination (NDE) Procedure	No	For Information		WPTF	No		Yes			
API 611/2#70	Declaration of Conformity	Required for CAS I, II	Declaration of Conformity	No	For Acceptance		WPTD	No		Yes ®			
API 611/2#71	Hazardous Area Certification	Required for CAS I & II	Hazardous Area Certification	No	For Information		WPTD	No		Yes ®	Yes		
API 611/2#72	Supplier's Piping Specification	For conformity to ASME B31.1 or B31.3 (as appropriate)	Written Specification	No	For Acceptance		WAO	No			✓		
API 611/2#73	List of Weld Repairs		List of Weld Repairs	No	For Information		WPTT	Yes		Yes ®			To include list of major and minor weld repairs

Information Requirements for General & Special Purpose Steam Turbines

شركة بترول أبوظبي الوطنية
Abu Dhabi National Oil Company

Definitions

Column	Heading - Details and requirements
A	**Code** - a unique identifier for the Information Deliverable, referencing the Parent Standard, IOGP Supplement or Industry Standard where the Information is requested. e.g. API610#01.
B	**Requirement -** a short description of the Information Deliverable that would typically provide the Information required, based on the description in the Parent Standard, IOGP Supplement or an Industry Standard Title.
C	**Description** - an excerpt from the Parent Standard, IOGP Supplement or Industry Standard.
D	**Reference** - reference to the Purchase Order, IOGP Supplement or Industry Standard that the Information is identified within.
E	**Format** - defines the required format of the relevant Deliverable to be submitted by the SUPPLIER to the Purchaser for information or for review and acceptance as shown in Table 9.1 of Instructions Tab.
F	**CFIHOS Discipline Document Type Code** - the CFIHOS discipline document type that could be used to classify the document containing this information.

Col A	Col B	Col C	Col D	Col E	Col F
Code	**Requirement**	**Description**	**Reference**	**Format**	**CFIHOS Discipline Document Type Code**
		Contract Management Information Deliverables			
MD#01	Supplier Master Information Schedule	Schedule of specific information deliverables developed by the [SUPPLIER] and accepted by the [COMPANY] to meet the information requirements defined in the agreed Information Requirements Specification (IRS). The schedule typically defines; a) information deliverable type, title/description b) unique identification (code/number) in the [supplier's] format unless agreed otherwise in the contract. c) planned submission arrangements including; purpose, formats, timing, frequency Arrangements for managing submissions, tracking progress and updating the schedule during the execution of the contract scope will be in accordance with contractual agreements.	Contract Requirement, API 611, 9.3 : API 612, 17.3	Native	
MD#02	Delivery Schedule	Schedule depicting, as applicable to the service or product scope, design, supply, manufacture, inspection, testing and delivery activities to be executed by [supplier/sub-suppliers] Schedule details typically** include;. a) Contractual milestones b) Activity early/late start/completion dates, durations, dependencies (Calendar Dates) c) Critical path and float d) Outsourced services and equipment (cross referenced to purchase order and supplier) e) Information deliverable submission dates identifying any execution activity dependencies Once agreed , changes to planned dates are subject to agreement by [customer]. Progress against planned dates is measured and the schedule updated and reported to the [customer] in accordance with contract reporting agreements. ** Schedule development tools, formats and submission protocols follow the [supplier's] standard practice unless otherwise agreed in the contract.	Contract Requirement, API 611, 9.3 : API 612, 17.3	PDF	
MD#03	Progress Report	Report detailing activities completed in the period, percent complete against planned, activities planned for the next period, risks/areas of concern, cause of any delays and proposed recovery plans, concessions, internal and outsourced inspection and audit activities.. Note: may also include actionable items such as Health, Safety, Security & Environment (HSSE) incidents & status if required under the Contract.	Contract Requirement, API 611, 9.3.3: API 612, 17.3.3	PDF	
MD#04	Quality Plan	Plan specifying the actions, responsibilities and associated resources to be applied by the [supplier], and when applicable [sub-suppliers] or [manufacturers], to deliver the services or procured item(s) in conformance with the agreed requirements. ISO9001 Clause 8.1 and ISO10005 may be used to inform the development of quality plans for specific applications, processes or products. [API Spec Q2 may be used to inform the development of Service Quality Plans]	Appendix 2- ADNOC Std	PDF	
MD#05	Design and Development Plan	Definition of the stages and controls for design and development; encompassing, design and development inputs, methods and associated controls (review, verification, validation), outputs and design change management. refer ISO9001, API Spec Q1 or equivalent requirements.		PDF	
MD#06	List of Sub-Suppliers	List to include component or material description, SUB-SUPPLIER name and contact details, sub-order reference number, manufacturing location, PO placement date (planned and actual) and contractual delivery dates for products or services that will be externally provided, including specifications and controls to be applied by the [supplier] to ensure conformance with agreed requirements. The schedule includes evidence of the basis of capability assessment , quality management system certification (or equivalent), process or product qualification for proposed suppliers of outsourced products and services when nominated in the Contract or Quality Requirements Specification (QRS) . Note: ISO9001, API Specs Q1/Q2 define requirements for assessing risks and establishing controls for outsourced products and services.		PDF	

Col A	Col B	Col C	Col D	Col E	Col F
Code	**Requirement**	**Description**	**Reference**	**Format**	**CFIHOS Discipline Document Type Code**
MD#07	Inspection and Test Plan	Tabular presentation of a quality plan typically used for process or product applications to define the specific sequence of inspection and testing activities, references to work instructions, acceptance criteria records and associated [Supplier], [purchaser] and independent conformity assessment activities. Inspection and test activities shall be listed in chronological sequence and shall include activities at sub-supplier(s) and shall identify them as such. The ITP shall include pre-determined intervention points advised by Contractor to Supplier in data sheets and/or within Appendix 2. ISO 9001, API Specification Q1 or equivalent quality management system standard (as agreed with purchaser) may be used to inform the development of inspection and test plans for specific processes and products. The ITP shall include inspection and testing activities to be performed for the complete package, including those at sub-suppliers' works and shall make reference to all testing procedures, control documents, and resulting records and reports. The acceptance criteria shall be clearly defined within the ITP as indicated within Appendix 2, 'QA Inspection and Testing Requirements' and referenced international codes and standards.		PDF	
MD#08	Packing, Handling, Shipping, Storage and Preservation Procedure	Definition of practices to be followed during the; storage, transport, lifting and preservation of the equipment and materials included in the scope of supply to maintain their functionality and guarantees. Procedures typically define: a) Packaging requirements; contents, identification, size, weight and number of packages/container (s), b) special packing/unpacking/handling requirements c)) storage location and requirements, d) preservation requirements detailing inspection periods and required maintenance, materials required etc., both prior to installation and post installation, but prior to commissioning.		PDF	
MD#09	Non-Conformance Records	Details of non-conformances raised by or to the [supplier/sub suppliers] against technical requirements prior to or during the delivery of the products or services. Non-conformance is managed by the [supplier] in accordance with ISO9001 Clause 8.7 and associated records typically include; description of non-conformance, analysis and disposition, correction implemented and details of any retesting or inspection taken to demonstrate subsequent conformance. Note: Instances where the proposed disposition is to accept a non-conforming condition are subject to agreement by the [Customer] in accordance with the concession management protocols defined in the Contract.	Contract Requirement	PDF	
MD#10	Concession Requests	Formal submission seeking [customer] agreement to accept deviations from the contracted scope or technical requirements. Requests may be raised as a result of, as examples, material or service availability, obsolescence, innovation, non-conformance. Requests are typically raised as required during execution with a summary report detailing concessions raised, [customer] directions, agreed action status provided with progress reports and at contract closeout	Contract Requirement	PDF	
MD#11	Preservation and Maintenance Instructions for Insurance/Capital Spares	Detailed instructions for preservation, storage and maintenance of insurance/capital spares (i.e. spare pump rotors, etc) which require specific controls to be applied. This shall be submitted prior to the packing, shipping storage and preservation procedure, MD#08.	Contract Requirement	PDF	
Technical Information Deliverables					
API 611/2 #01	General Arrangement Drawings	Dimensional outline drawings and list of connections, including the following: a. Size, type, rating, location, and identification of all purchaser connections b. The weight of the package and approximate overall erection and maintenance handling weights of equipment and subassemblies c. Principal dimensions including overall package, maintenance clearances, dismantling clearances, and those required for the piping design d. Shaft centerline height e. Direction of rotation for the bull-gear shaft & auxiliary drives f. Location of the center of gravity and lifting points g. Allowable piping loads h. Vendor recommendation for piping, including requirements for straight length of air inlet piping or for straightening vanes where applicable. i. Customer connection tie-in for electrical & control interface j. Lifting Arrangement	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #02	Steam Turbine Performance Curves	Performance curves shall be provided to include the following information as a minimum: a) steam mass flow, inlet and outlet pressure versus power for various settings of the hand valve or valves when the turbines are operating at normal speed; b) for multi-stage turbines, first-stage pressure versus steam mass flow when the turbines are operating at normal speed and steam conditions. c) throttling curve showing steam mass flow versus kW indicating the position of the governor valve openings.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #03	Steam Turbine Data Sheets	Supplier is also to complete in full a data sheet for all items of Equipment to be provided Supplier to include within the datasheet, the anticipated MAXIMUM steam flow at specified inlet pressure and temperature condition, considering the effects of steam turbine performance deterioration.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #04	Noise Data Sheets	The vendor is also to provide maximum expected overall sound pressure level @ 1.0 meter from the skid, and sound power level for the skid. Supplier is also to provide per octave band data for sound pressure level and sound power level for the equipment.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #05	Utility Requirements Schedule	Schedule to detail supply requirements for Plant Air, Instrument Air, Dry Air, Cooling Water, Cooling Medium, Heating Medium, Fuel Gas, Diesel Fuel, AC and DC Electrical Supplies incl maximum continuous and intermittent kW loads.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #06	Cross Sectional Drawings and Bill of Materials	Cross-sectional drawings and bill of materials, including a listing of all parts. To be submitted with Operation and Maintenance Manual	API 611, Annex C: API 612, Annex I	PDF	

Col A	Col B	Col C	Col D	Col E	Col F
Code	**Requirement**	**Description**	**Reference**	**Format**	**CFIHOS Discipline Document Type Code**
API 611/2 #07	P&I Diagram of Steam Turbine	Main process schematic including the following: a. Piping and valve sizes. b. Instrumentation, safety devices c. Purchaser's connections d. Minimum straght length at suction and discharge sides	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #08	P&I Diagram of Lube Oil System	Lube oil schematic including the following: a. Piping and valve sizes. b. Instrumentation, safety devices c. Purchaser's connections	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #09	P&I Diagram of Shaft Sealing System	Gland Sealing system Schematics , including the following: a. Seal system schematics showing necessary instrumentation and controls b. Pipe and valve sizes c.Instrumentation and safety devices d. purchaser connections (if any).	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #10	P&I Diagram for Condition Monitoring Instruments	Schematic showing number, arrangement, details of proximity probes, axial position probes, key-phasers, accelerometers, bearing temperature monitoring, winding temperature monitoring for compressor, gear and driver motor.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #11	Shaft Seal Detail Drawings	Shaft Seal cross-section / general arrangement c/w parts list to be submitted.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #12	Recommended spare parts	Spare parts list with stocking level recommendations in accordance with 9.3.4. The proposal is to include an itemized list of the recommended spares referenced to a typical cross-sectional drawing. Spares are to be individually identified and priced. As a minimum the following insurance spares are to be offered with the proposal: a. Complete spare rotor including buckets & diaphragms b. Complete set of Radial/Thrust bearings including RTDs c. Complete set of Labyrinths and packing d. Repair kits for Governor valve assembly, Trip and Throttle Valves, Over speed trip assembly e. Set of steam nozzles etc. according to turbine type f. Complete Starter (turning gear) assembly g. Complete set of inlet steam control valve, TTV trims h. Over speed trip mechanism Complete Assembly i. Load coupling j. Actuators for TTV and Steam control valve	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #13	Life Cycle Cost Analysis	A cost analysis to include operating costs, maintenance costs, repair and refurbishment costs for an equipment life of 30 years shall be performed. Parameters to be used for lifecycle costing such as utlity costs, escalation factors, discount factors, etc shall be agreed with COMPANY.		PDF	
API 611/2 #14	Reliability, Availability & Maintainability Study	Study to include details of equipment reliabilty, availability and maintainability based on mathematical modelling using typical equipment MTTF, MTTR and MTBF data supported by actual field reliabilty and maintenance data where available.		PDF	
API 611/2 #15	Site Acceptance Test Procedure	A preliminary version of the proposed SAT procedure shall be issued by the SUPPLIER with the Proposal. FINAL version to be developed and submitted after purchase order award. A fully detailed test procedure identifying the required site acceptance tests including test durations, test operating conditions, site utilities, test equipment and acceptable tolerances/limits. Refer to minimum test requirements detailed within Appendix 2 'QA Inspection and test Requirements'	Contract Requirement	PDF	
API 611/2 #16	Detailed Drawings	Dimensional drawings for all major auxiliary equipment or components or component (such as electric motor, lube oil reservoir, coolers) with bill of materials	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #17	Stair, Ladders and Platform Drawing	Dimensional drawings for all associated stairs, ladders and platforms to be supplied seprately from main equipment skid package.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #18	Nameplate Drawing	As a minimum, the following data is to be clearly stamped or engraved on the nameplate for compressor and auxiliary equipment: a. Suppliers name b. Serial number c. Size, model and type d. Rated capacity e. Rated discharge pressure f. purchaser's item number. Units is to be consistent with those used on the data sheets.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #19	Rotor Assembly Drawing	Detailed drawing of the complete turbine rotor assemby including relevant cross-sectional views and bill of materials. The shaft relative displacement (non-contacting) sensor area locations shall be clearly identified on the rotor assembly drawing.	API 611, Annex C: API 612, Annex I	PDF	

Col A	Col B	Col C	Col D	Col E	Col F
Code	**Requirement**	**Description**	**Reference**	**Format**	**CFIHOS Discipline Document Type Code**
API 611/2 #20	Drive Coupling Assembly Drawing	Shaft-coupling assembly drawings and bills of materials, including the following: a. The make, size, and type of the couplings b. Mounting procedure c. Shaft-end gap and tolerance d. Parallel & angular mis-alignment tolerance	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #21	Electrical and Instrument Interconnecting Cable Block diagram or interface wiring schematic	Electrical, instrumentation and control schematics	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #22	Electrical and Instrument Connection & Wiring Diagrams with Bill of Material and termination details	Diagrams are to display, in block form, the items of electrical and instrument equipment and all cables interconnecting them. They are to show each terminal block with the terminals numbered and the cores of the connecting cables identified and landed on terminal points. The core identifiers given are to be those ferruled onto the conductors and are required to follow the agreed numbering systems. Note: Reference on these diagrams is to be made to the internal wiring diagrams for each of the electrical and instrument equipment involved. In simple cases, the internal wiring for this equipment may be shown directly on the diagram for simplicity. Symbols are to be in accordance with IEC 60617 or BS EN 60617-12:1999.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #23	Foundation Loading Diagram	Foundation loading diagram including dimensions of baseplates complete with the following: a. Diameter, number, and locations of bolt holes; thickness of the metal through which the bolts must pass; and recommended clearance (for bolted down skid) b. Dimensions, number, material and location of deck plates including weld thickness (for skid welded to the deck e.g. for off-shore installation) c. Weights and centers of gravity for major components. d. Foundation loads at each support location for various load cases e.g. dead load, live load, dynamic load, seismic, wind, transportation load etc. This drawing can also be made part of the General Arrangement Drawing (2.1) e. for OFFSHORE application, shaft distortion calculation shall be submitted for review.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #24	Process Control Description		API 611, Annex C: API 612, Annex I		
API 611/2 #25	Cause & Effect chart	Cause & Effects (C&E's) are to include schedule of Control, Alarm, Trip and Start-Permissive Functions including recommended setpoints and associated actions and any narratives thereof. For offshore installations this ought to also take into consideration safety analysis checklist requirements for a compressor as defined in American Petroleum Institute (API) RP14C.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #26	Coupling Data Sheets	Supplier is also to complete in full a data sheet for all items of Equipment to be provided	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #27	Electric Motor Data Sheets	Supplier is also to complete in full a data sheet for electric motor (in sub-vendor data sheet format)	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #28	ISA Data Sheets for Instruments	ISA data sheets for all instruments.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #29	Material Safety Data Sheets	Material Safety data sheets	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #30	Surface Preparation and Coating Procedure Specification	The Supplier shall submit painting and protective coating specfication detailing painting and coating systems to be applied for all equipment and is to include as a minimum: surface cleaning and preparation, environmental controls for both shop and field painting, lining (where applicable) and repairs to damaged coatings. For review and approval.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #31	Insulation Specification	Supplier is also to provide insulation specfication to be reviewed and approved. (If aplicable)	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #32	Weight Data Sheet	Main and auxiliary equipment / parts weight are to be confimed with regard to total weight guranteed in proposal phase.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #33	Vibration Data Sheet	Vibarion level / range of frequencies transmitted to baseplate supports are to provided by Supplier.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #34	Single Line Diagram	Schematic diagram showing interconnection and distribution of electrical power supplies to package mounted auxiliary electrical equipment from electrical supply switchboard(s) where supplied with equipment package	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #35	Lubrication Schedule	Schedule to indicate type and grade of lubricants and other consumables required for all equipment supplied. For each schedule entry the following is also to be included as a minimum: Tag number, tag description / component (e.g. bearings, engine, gearbox, etc), lubricant manufacturer, lubricant type and grade (product code), first fill capacities, rate of consumption (litres / day) and frequency of change.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #36	Relief Valve Sizing Calculation	Sizing calculations for external relief valves	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #37	Structural Calculations	Structural Calculations for Baseplate and Lifting Beam taking into consideration various lifting configurations during lifting, transporatation and installation. Baseplate calculations are also to take into consideration dead and live load and also load arising from enviromental conditions such as wind, seismic etc.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #38	CFD and FEM Calculation notes	Computational Fluid Dynamic, Finite Element analysis, Skid Vibration calculation note, Skid strength & rigidity calculation note, 3D FEA)	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #39	Lube Oil System Data Sheets	Data Sheets for lube oil cooler, LO pumps and reservoir.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #40	Gearbox Data Sheets	Data sheets for gearbox (if applicable) shall be submitted according to the applicable international code (i.e. API 613, API 677, ISO, etc).	API 611, Annex C: API 612, Annex I	PDF	

Col A	Col B	Col C	Col D	Col E	Col F
Code	**Requirement**	**Description**	**Reference**	**Format**	**CFIHOS Discipline Document Type Code**
API 611/2 #41	Drawings of Auxiliaries and Itemized Equipment supplied loose	Coupling Drawing(s) & Bills of Materials; Cold and Hot alignment Data, 'Witches Hat' strainer and other Auxiliary Equipment Drawings & Bill of Materials	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #42	Thermal Rating for Air Cooler / Heat Exchangers	Heat transfer details calculation is to be submitted by Supplier	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #43	Pressure Vessel / Cooler Fabrication Drawings	All fabrication / shop drawing are to be submitted.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #44	Blades Campbell Diagrams				
API 611/2 #45	Electric Motor Performance Data and Curves	Curves for electric motor drives are to indicate torque and current against speed for 80% and 100% voltage conditions and at rated frequency, superimposed on driven equipment torque curve to confirm that there is adequate net torque for acceleration. The following performance curves are required for both 80% and 100% voltage: - motor speed 'v' torque - motor speed 'v' Power factor - motor speed 'v' current - driver equipment torque 'v' speed for all start up conditions	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #46	Hydrostatic Test Procedure and Certificates	Procedures for compliance with Purchaser specifications/ International Standards including duration of test, quality of test medium, confirmation of no leakage. Certificates of hydrostatic, leak and / or pneumatic tests carried out - Note! Specific Purchaser approval is required for all Pneumatic testing.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #47	Performance Test Procedure	Performance tests shall be conducted in accordance with ASME PTC 6.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #48	Auxiliary Equipment Test Procedure	Auxiliary equipment such as oil systems and control systems shall be tested in the supplier's shop. Details of the auxiliary-equipment tests shall be developed jointly by the purchaser and the supplier.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #49	Complete Package Factory Acceptance Test Procedure	Procedure to determine that equipment operates according to Purchaser requirements is to include- a. Performance test procedure as per ASME PTC 6, with test points, tolerances etc. b. Mechanical run test procedure c. Noise test procedure d. Control panel functional test procedure e. Lube oil flushing / cleanliness test procedure	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #50	Lateral Critical Speed Analysis	Lateral critical speed analysis report, including but not limited to the following: a. Complete description of the method used. b. Graphic display of critical speeds versus operating speed (speed vs phase & response amplitude showing Amplification Factor at x/y vibration probe location for each damped unbalance critical speed- Bode plot). c. Graphic display of bearing and support stiffness and its effect on critical speeds(Undamped critical speed-support stiffness map for bull gear rotor & both high speed pinion rotors). d. Graphic display of rotor response to unbalance (including damping) (deflected rotor shape showing the major-axis amplitude at key locations - radial bearing, shaft seal, oil seal to demonstrate amplitude well within diametral running clearance). e. Journal static loads. f. Stiffness and damping coefficients for min and max clearance (max and min pre-loads). g. Dimensional data/geometry and configuration of the bearing design in sufficient detail to enable calculations of stiffness and damping coefficients; h. Shaft geometry with sufficient detail to model the shaft including the location of bearing centerlines and mounted components; i. The weight, polar and transverse moments of inertia and center of gravity of the blade rows, balance piston, shaft end seals and coupling(s) with sufficient detail to conduct an independent analysis of the rotor; j. The input model used for the Manufacturer's analysis; k. The support stiffness used in the analysis and its basis; l. Dimensional data of the labyrinth seal design to enable calculation of labyrinth seal stiffness and damping coefficients, as well as leakage rates; m. Lube Oil properties such as viscosity; n. The support stiffness of the entire system used in the analysis and its basis, including the bearing, bearing housing, pedestal, base plate as a minimum."	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #51	Material Certificates	Type 3.1 and Type 2.2 material inspection certificates as per EN 10204 for various components for compressor and accessories.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #52	Preservation, Packaging and Shipping Procedures	Contains the following: - The instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the job site and before start-up, as described in API 686, Chapter 3. - Packaging procedure. - Shipping procedure.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #53	Torsional Critical Speed Analysis	Torsional critical speed analysis report, including but not limited to the following: a. Complete description of the method used. b. Graphic display of the mass elastic model. c. Tabulation identifying the mass moment and torsional stiffness of each component identified in the mass elastic system. d. Graphic display of exciting frequencies versus speed and natural torsional frequency (Campbell Diagram). e. Graphic display of torsional critical speeds and deflection angle for torsional vibration (mode-shape plot). f. Effects of alternative coupling on analysis.	API 611, Annex C: API 612, Annex I	PDF	

Col A	Col B	Col C	Col D	Col E	Col F
Code	**Requirement**	**Description**	**Reference**	**Format**	**CFIHOS Discipline Document Type Code**
API 611/2 #54	Welding Procedure Specification, including Procedure Qualification Record	Define all shop welding techniques and repair welding procedures in accordance with Code and Purchaser's requirements. WPQR – To define parameters, techniques and test results of all Sellers proposed welding procedures in compliance with Purchaser's requirements. WPS, PQR & NDE Procedures require Company approval.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #55	Welding Repair Procedure	When specified, documentation of major defects is to be submitted to the purchaser prior to any repairs being conducted at the manufacturer's shop and to include the following a. Extent of the repair b. Location c. Size d. Welding procedure specification e. Detailed photographs of the defect prior to any preparatory work and after preparation but prior to the actual repair. If the location of the defect cannot be clearly defined by photographic means, the location is to be indicated on a sketch or drawing of the affected component. f. Repair welding procedures in accordance with Code	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #56	Complete Unit Test Report	Test report from combined mechanical/ performance test of steam turbine package with tabulation of string test data. To also include noise test report, functional test report of local control panel, lube oil flushing test report & calibration certificates for test instruments/ apparatus. Report to include performance test results, Mechanical running test logs, including but not limited to the following: a. Oil pressures and temperatures. b. Vibration, including (where applicable) an x-y plot of amplitude versus revolutions per minute during start-up and coast-down. c. compressor performance data d. impeller over-speed test record alongwith the NDE record	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #57	Performance/Routine Test Procedure - Electric Motors	Performance Test Procedure for Medium Voltage Motor as per relevant standard *e.g. IEC 60034/ NEMA MG-1 etc. specifying the tests conducted, test method and acceptance criteria. A motor routine test to be performed on all LV auxiliary electic motors in accordance with IEC 60034-2 .	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #58	Non-Destructive Examination (NDE) Report	Complilation of all non-destructive test reports & logs such as radiography, magnetic particle, dye-penetrant, ultrasonic test and PMI. To be submitted part of the manufacturing data book.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #59	Instrument Calculation Sheets		API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #60	Instrument Hook-Up Drawings		API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #61	SIL / ATEX Certificates		API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #62	Instrument List / Index	Information to be provided as data entered within a Spreadsheet pro forma supplied and content defined by the Purchaser. Typical items for which information required are: Field instruments, Control instruments, Condition monitoring instruments, Panel mounted instruments, In-line instruments, Control valves, Actuated valves and Safety valves.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #63	Preliminary Packing List		API 611, Annex C: API 612, Annex I		
API 611/2 #64	Installation, Operation & Maintenance Manual Index	Installation, Operation and Maintenance Instructions Index is to be agreed prior to submission of the manual. Each manual and sub-Supplier manual is to include the below listed sections as a minimum. Index to also include full sub-indices details. Note that the Installation, Operation and Maintenance Manual is not to contain any SMIR documents that have been formally submitted to the Purchaser during the contract but listed and referenced. Section 1 - Installation Section 2 - Commissioning, start-up and operation procedures and acceptance criteria: i) lubrication recommendations; ii) pre-commissioning/pre-start-up checks and tests; iv) operation and shutdown procedures; iii) acceptance checks and tests. Section 3 - Disassembly and Reassembly Section 4 - Any start-up, shutdown or operating restrictions required to protect the integrity of the equipment Section 5 - Operating procedures for special tools, if any Section 6 - Shaft Sealing. Installation, Operation and Maintenance Manuals Section 7 - Detailed information covering the design & operation of the instrumentation & control system including but not limited to: - Wiring diagrams & logic diagrams - Self diagnostic capability of the controller - Design clearance tolerance sheets - Full balancing procedures for rotor assemblies Section 8 - All auxiliary equipment (add sections as appropriate), Installation, Operation and Maintenance Manuals Section 9 - Troubleshooting	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #65	Installation, Operation & Maintenance Manual	Provides sufficient information to install, operate and maintain the equipment, as well as sufficient information for troubleshooting. Description of methods of installing a piece of equipment. Installation refers to the mounting, setting, erection, etc. Description of methods of maintaining a specific piece of equipment. Typically originates from the equipment or package Supplier. 'Description of methods of operating a piece of equipment or process unit, including but not limited to instructions, procedures, drawings, tables, etc. for the operation -stop, start, and emergency shutdown. Including operational limits, function testing, possible interruptions, corrective actions, hazards and corrective measures to be taken. NOTE: Unless otherwise agreed, can be delivered in manufacturer's standard manual or as one or several documents clearly marked which part they cover (I, O, M)	API 611, Annex C: API 612, Annex I	PDF	

Col A	Col B	Col C	Col D	Col E	Col F
Code	**Requirement**	**Description**	**Reference**	**Format**	**CFIHOS Discipline Document Type Code**
API 611/2 #66	List of Special Tools for Maintenance	List of special tools and fixtures which are required to disassemble, assemble, or maintain the supplied equipment.		PDF	
API 611/2 #67	Manufacturing Record Book Index	To be submitted in accordance wioth COMPANY business unit standard index to be provided at time of order placement.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #68	Manufacturers Record Book	The Manufacturer's Record Book (MRB) is to contain all of the manufacturing and test records including certification referenced in the Purchaser approved Inspection & Test Plans (ITPs) and/or those required to demonstrate full compliance with the Purchase Order. This shall include but not be limited to material certificates, pressure test certificates, personnel qualifications/competence, inspection & test reports, NDT reports, calibration reports, balancing certificates, manufacturing, fabrication and test records, as built dimensions and clearances, declaration of conformity, etc. The MRB is to be compiled in strict accordance with the Purchaser's approved Index for Manufacturer's Record Book.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #69	Non-Destructive Examination (NDE) Procedure	Procedure describing how to perform non-destructive test (NDT) (i.e. Magnetic Particle Testing (MT), Liquid Penetrant Testing (PT), Radiographic Testing (RT), Ultrasonic Testing (UT) and Visual Testing (VT)) for a given object, including acceptance criteria and reporting. The procedure shall also include positive material identification (PMI) for corrosion resistant alloys, if applicable for any of the package component.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #70	Declaration of conformity	The manufacturers or other party's confirmation that the product is designed, manufactured and tested as specified. To be delivered according to applicable authorities requirements.	API 611, Annex C: API 612, Annex I	PDF	
API 611/2 #71	Hazardous Area Certification	Certification attesting to the suitability of mechanical and electrical equipment to operate within classifiied locations according to IEC 60079. Certificates shall be issued by a recognised independant certifcation body for each equipment type located in the specifed location.		PDF	
API 611/2 #72	Supplier's Piping Specification	Packaged equipment piping shall comply with either ASME B31.1 for Power Piping or ASME B31.3 for Process Piping. As part of Supplier's proposal, Supplier shall confirm compliance and provide a copy of their piping specification.	Contract Requirement	PDF	
API 611/2 #73	List of Weld Repairs	A complete list of major and minor weld repairs listing component location, weld procedure and NDT procedure used	Contract Requirement	PDF	

Information requirements for
General & Special Purpose Steam Turbines
Instructions & Guidance

This workbook contains a hidden sheet ('Pick Lists') which is used for drop down menu selection within the main part of this workbook.

1 Front & Preliminaries Tab

The 'Front & Preliminaries ' tab includes an IOGP Front sheet for the IRS followed by Acknowledgements, a Disclaimer, Copyright Notice, Foreword and Introduction.

2 IRS Cover Tab

The 'IRS Cover' tab has been included for COMPANY and/or CONTRACTOR to update and include as a Cover Sheet for the issue of the IRS to Suppliers, but Users may replace this sheet with an alternative User or Project format.

3 'Deliverables' Tab

The 'Deliverables' tab includes columns A to L, including Column A for the relevant requirement code and Column B for the requirement for the different Information Deliverables (Data, Documents and/or Models) to be provided by suppliers, based on the parent standard, IOGP Supplement or the specified parent industry Standard.
Condition Invoking Revoking Requirement Column C is included to allow any specific conditions to be identified that may require a additional deliverable(s).
Typical Deliverable Column D is provided for PURCHASER to identify the deliverable type that the information would typically appear within; this also allows the PURCHASERS's Requisitioning Engineers to group the various Information Requirements by the Deliverable Type.
Column E includes Submission Requirements (Yes or No) at Proposal, while columns F, G & H identify Issue Purpose (For Information or For Acceptance) and Durations (Period or Weeks/Months) for First Issue of the particular deliverable Post Purchase Order.

[***Note for PURCHASER*** *- default values in the downloadable IRS are set to the equivalent of CAS level D, as defined in the QRS. Buyer is to adjust the values in these columns to match the actual CAS level for the specific application].*
Required As Built, Fulfilled by Document Number(s), Translation Required and Remarks columns I, J, K & L are also included.
Definitions for each column are contained in the rows above the columns:
Abbreviations used for various submission requirements in Column H are shown in table 3.1 below:

Abbreviation	Description
WAD	Weeks After Delivery
WAI	Weeks After Inspection
WAO	Weeks After Order
WAO(Monthly)	Weeks After Order Monthly
WAT	Weeks After Test
WPTD	Weeks Prior To Delivery
WPTF	Weeks Prior to Fabrication
WPTT	Weeks Prior To Test

Table 3.1 - Information Submission Abbreviations

4 'Definitions' Tab

The 'Definitions' tab includes several columns A to F, including Column A for the relevant Code & Column B for the Requirement for the different Information (Data, Documents and/or Models) Deliverables to be provided by SUPPLIERS, all copied from the 'Deliverables' tab.
Column C includes a full description of the Information Deliverable based on the Parent Standard or relevant Industry Standard.
Column D gives a reference to the Purchase Order or Industry Standard that the Information is identified within.
Column E identifies the Deliverable format as listed in Table 9.1 below.
Column F relates the CFIHOS discipline document type that could be used to classify the document having this IRS content.
Definitions for each column are contained in the rows above the columns.

5 'Instructions' Tab

This 'Instructions' tab is provided to instruction & guidance to COMPANY, CONTRACTOR, PURCHASER and/or SUPPLIERS in the use of this IRS.

6 Abbreviations and Definitions

The following abbreviations, terms and definitions have been used in the various tabs of this workbook:

PURCHASER: Organisation placing a Contract or Purchase Order with Supplier for equipment or services on project; may be alternatively referred to as 'User' or 'Purchaser'
CFIHOS: Capital Facilities Information Hand Over Specification
COMPANY: Project Owner and/or Operator or other body acting on their behalf
CONTRACTOR: Nominated Contractor responsible for engineering, procurement of materials, building/installation and commissioning of the plant.
Information: Data Sheets, Documents, Drawings and/or PDMS Models
IRS: Information Requirements Specification
PO: Purchase Order
QRS: Quality Requirements Specification (QA Inspection and Testing Requirements - Appendix 2)
SMIS: Supplier Master Information Schedule
SUPPLIER: Organisation supplying equipment or services to Company and/or Contractor on project; may alternatively be referred to as "Supplier", "Seller" or “Manufacturer”.

7 CFIHOS

The Information Requirements and Deliverables described in this IRS are based on the CFIHOS (Capital Facilities Information Hand Over Specification) Industry Standard. The objective of CFIHOS is to create a common information standard across the Oil and Gas industry to facilitate efficient information exchange on projects. Further information on CFIHOS can be found at *http://uspi-global.org/index.php/projects/frameworks-methodologies/136-cfihos*

8 Document Metadata

Typical Metadata for Information Deliverables to be provided by Suppliers is shown in Table 8.1 below

Property_Name	Definition
document number	The unique identifier for the Document according to the Owner/Operator Document numbering scheme.
revision code	A code used to identify the content of a document at a certain point in time according to the Owner/Operator Document Revision Coding scheme. It is used to track the evolution of a document during its lifecycle and is applied at time of release from Originator to reflect the document is frozen.
document title	Describes in a short and concise manner the content of the document. Remark: The title of the document usually appears on the front page of the document or in title block.
revision date	The date of the document revision.
originator company	Identifies the name of the Company who has generated the Document.
author	Author(s) of the current revision of the document. This should be an individual name, not a role, i.e. Initials and last name, not just initials
accepted by	Name or UserID of the person who has accepted the current revision of the document as per the document management acceptance workflow. This should be an individual name, not a role, i.e. Initials and last name, not just initials.
file name	The unique name of the electronic file (including the file extension).
originator document number	The unique identifier for the Document according to originator which doesn't necessarily conform to the Owner/Operator's document numbering scheme. Remark: One potential use is to allow Owner/Operator to identify duplicate documents provided by multiple subcontractors but from the same OEM.
originator document revision code	A code used to identify the content of a document at a certain point in time according to the originator which doesn't necessarily conform to the Owner/Operator's document revision coding scheme. Remark: One potential use is to allow Owner/Operator to identify duplicate documents provided by multiple subcontractors but from the same OEM.
document status code	A code used to indicate the life cycle status of the document. A code which identifies the state of the document within the publication lifecycle process. A document is classified by a single state, which changes as the document advances through this lifecycle.
language	Indicates the language that the document is written in.
discipline document type short code	Classifies the Document with a Discipline_Document_Type.
project code	A unique code used to identify the Project.
document comment	Indicates any additional Comment / Explanation for a Document Revision.
plant code	Identifies the Plant that the document is related to. This is a smaller subdivision than 'Site' but larger than 'Unit' or 'Area.'
export control classification	Indicate the Export Control Rule applicable for the Document (e.g., ECCN, EAR).
transmittal number	A unique transmittal identifier generated by the document control system of the company sending the transmittal.
security classification	Indicates internal Owner-Operator access restriction applicable for the Document.

Table 8.1 - Supplier Deliverable Metadata

9 Deliverable Formats

The format of the relevant Information Deliverable to be submitted by SUPPLIER for PURCHASER/CONTRACTOR is to be as described in table 9.1 below. Where required to be 'As Built' deliverables are be updated and handed over in the native format.

1. All engineering documents shall be electronically transmitted in a searchable ADOBE pdf format, with text documents being supplied in A4 size, portrait orientation, and engineering drawings being supplied in A3 size, landscape format.
2. Engineering drawings shall be supplied in both the native CAD format and pdf copies
3. All text shall be typed and in Arial font size 10 as a minimum.

Format	Description
Hard Copy	Should be be electronically developed, but in particular and exceptional circumstances, say for legal reasons, may need to be handed over in printed paper format
Native	To be electronically developed and must be retained in the original application software format, with no embedded or linked files.
Portable Document Format (PDF)	To be electronically developed and must be in Optical Character Recognition (OCR) format which is text searchable & indexed. Embedded graphics in Joint Photographic Experts Groups(JPEG), Graphics Interchange Format (GIF) (suitably compressed) or Tagged Image File Format (TIFF) formats may be allowed but by exception only and with Purchaser's written approval.
Intelligent Vector (CAD)	Intelligent vector drawing Like CAD
Multi media (Film)	Multi media Like Film, Micro fiche, Video, Sound
Raster Image (Bitmap)	Raster Image like a bitmap
Structured Data (MS Apps)	Structured Data Like CSV file, MS-access, MS-Excel, Application Database
Technical Publication (Text)	Technical publication or Text

Table 9.1 – Deliverable Formats

		Information Requirements for General & Special Purpose Steam Turbines — شركة بترول أبوظبي الوطنية Abu Dhabi National Oil Company	Issue
2		Insert Tag_No	
3	Service :	Insert Service Description	
4		**USER SUPPLEMENTARY REQUIREMENTS**	
5	**API Clause Ref. API 611**	**Description of Amendment**	
6	**API 611, 6.9.2**	**Lateral Analysis**	
7	6.9.2.1 (Add)	Add to B.1.3 of Appendix B ....."If required, an undamped rotor response critical speed map shall be furnished that includes support stiffness curves superimposed on the plot for both minimum and maximum bearing clearances."	
8	**API 611, 9.2**	**Proposals**	
9	9.2.3 (Add)	Add the following sentence to sub-clause a) ..."API Standard 677 or API Standard 613 data sheets shall be used for the gear." Add the following new sub-clauses..... o) For each individual nozzle connection, allowable forces and moments. p) For lube oil system and other auxiliary systems, preliminary bill of materials, identifying all components by make, type, and materials. q) Retention time of lube oil reservoirs."	
10	9.2.4 (Add)	Add the following new sub-clause c) ..."SUPPLIER shall provide a throttling curve showing steam flow versus kW indicating the position of the governor valve openings."	
11	**API 611, 9.3**	**Contract Data**	
12	9.3.2.1 (Add)	Add the following new sub-clauses..... a. Rating and conditions of service shall be given for applicable components, such as pumps, drivers, heat exchangers, and heaters. b. Dial range for pressure and temperature indicator transmitters shall be given. c. Certified outline drawings shall be supplied for main components of auxiliary systems, such as pumps, drivers, filters, heat exchangers, and heaters. d. Drawings for heat exchangers shall include dimensions of shell, tube sheets, and tubes, as applicable.	
13	9.3.2.2 (Add)	In addition to the information described in Appendix C of API 611, the SUPPLIER shall include the Schematics shall also show:- - Temperatures - Relief valve settings - Control valve CVs - Equipment relative elevations	
14	9.3.2.3 (New)	In addition to the information described in Appendix C of API 611, the SUPPLIER shall provide the following details:- (i) Foundation loading notes for empty, operating, test loading condition for all applicable primary loads including wind, seismic, dynamic, thermal loads, etc. Loads shall be provided at all support locations with point of application (lever arm) of loads. ii) Indicate center of gravity (x, y, y) of the assembly at empty, operating & test condition on foundation loading drawing. iii) Holding down / anchor bolts details with locations, schematic diagram of base frame etc. required for foundation design. iv) Anchor bolt design and specifications to comply with the COMPANY Standard drawings STD-1781-002-001 and STD-1781-002-003. v) Anchor bolt design calculation shall be provided for COMPANY review and approval.	
15	9.3.4.1 (Add)	SUPPLIER shall submit his recommendation for spare parts using form contained in DGS for Spare Parts, DGS-MU-003 or other applicable business unit specification.	
16	9.3.4.3 (New)	Throughout the service life specified in API 611, Clause 6.1.1, spare parts for all components of the unit shall be available for purchase and all manufacturing drawings shall be retained.	

		Information Requirements for General & Special Purpose Steam Turbines شركة بترول أبوظبي الوطنية Abu Dhabi National Oil Company	Issue
2		Insert Tag_No	
3	Service :	Insert Service Description	
4		**USER SUPPLEMENTARY REQUIREMENTS**	
5	**API Clause Ref. API 611**	**Description of Amendment**	
17	9.3.5.1 (Add)	Add the following new sub-clauses..... a. Separate instruction manuals shall be provided for each turbine purchased. b. An electronic copy of manuals shall be provided. Capital spares requirements are defined within AGS-SP-019, General & Special Purpose Steam Turbines (API 611 and 612) Specidication.	
18	9.3.5.3 (Add)	SUPPLIER shall provide following additional details as part of the Installation, Operating and Maintenance manual (IOM). (a) All fits and tolerances shall be individually described, Interference fit removal / installation special tools to be listed with procedures. (b) Time based maintenance and condition based maintenance programme to be specified. (c) Flexible coupling assembly / disassembly procedure to be provided. (d) Steam trap orientation and maintenance procedure to be provided. (e) Alignment (reverse dial / laser) method and pre- misalignment (hot alignment) protocol to be documented in manual. (f) Warm up, pipe creep, stress releasing program to be established as per turbine orientation. (g) Normal / ESD shutdown / cooling hours and warm up / startup procedures to be documented in manual. (h) Bend shaft, bowing and short term / long term preservation procedures to be provided.	
19	9.3.5.4 (Modify)	Delete the words "If specified" at the start of the first sentence. Add the following at the end of the second sentence.... "This manual shall contain the following information in addition to the data required by API 611 Appendix C:- - Vibration plots for each probe during test run; - As-built bearing and labyrinth clearances and rotor end float; - Steam schematics.	

	Information Requirements for General & Special Purpose Steam Turbines شركة بترول أبوظبي الوطنية Abu Dhabi National Oil Company		Issue
2	Tag No. :	Insert Tag_No	
3	Service :	Insert Service Description	
4	**USER SUPPLEMENTARY REQUIREMENTS**		
5	**API Clause Ref.**	**Description of Amendment**	
6	**API 612, 6.1**	**General**	
7	6.1.8 (Modify)	Replace sub-clause (g) with..... "Range of steam condition is defined in the datasheets and/or in the requisition. The variation pattern is described in NEMA SM 24. Turbine and its auxiliaries shall be designed and constructed for safe operation with these conditions. The possibility of the presence of wet chlorides in the transition region makes it essential that all stages which may fall in this region are designed to be safe in a wet chloride atmosphere. Blading that could be in the transition zone between the dry and wet regions under any operating conditions shall be conservatively designed with low working stresses and to ensure adequate fatigue strength of blading materials. The MANUFACTURER shall present NEMA swing certification for the turbine pressure retaining components. If the turbine is capable of operating levels greater than the NEMA swings, the MANUFACTURER shall specify those limits for which the turbine can accept."	
8	6.1.8 (Add)	Add to sub-clause (h).... "SUPPLIER to include anticipated MAXIMUM steam flow at specified inlet pressure and temperature condition, considering the effects of steam turbine performance deterioration."	
9	6.1.22 (New)	The MANUFACTURER shall state in the proposal that the offered design details and materials have been used on new turbines for a minimum of three (3) years or have acquired at least 25,000 hours of successful operation. a. If the above criteria are not met, the COMPANY shall perform a novelty assessment. b. The MANUFACTURER shall confirm that at least three units of similar rating and mechanical design have been produced at the MANUFACTURER's proposed manufacturing plant.	
10	**API 612, 8.1**	**General**	
11	8.1.6 (New)	Before the rotor is machined it shall be subjected to a heat stability test at a temperature of at least 50°C above the maximum steam temperature. The heat stability test shall be in accordance with ASTM A 472, except that circumferential measurements shall be taken at eight positions (A, B, C, D, E, F, G and H) rather than at four positions. The turbine MANUFACTURER shall include in his proposal the detailed procedures for this test.	
12	**API 612, 8.2**	**Shafts**	
13	8.2.2 (Add)	The shaft relative displacement (non-contacting) sensor sensing area locations to be clearly identified by the SUPPLIER on the rotor assembly drawing.	
14	**API 612, 9.2**	**Lateral Analysis**	
15	9.2.7 (Modify)	Replace this clause with…. "A train lateral analysis shall be performed for all the machinery trains with coupling spacers greater than 1 meter, and/or rigid couplings."	
16	**API 612, 12.3**	**Turbine Shutdown System**	
17	12.3.4.8 (New)	The Temperature Throttle valave (TTV) shall be high integrity and of proven reliable design. The TTV design requirements shall be subject to approval by COMPANY.	
18	**API 612, 17.2**	**Proposals**	
19	17.2.3 (Modify)	[Replace] d) [with]: A list of spare parts for commissioning, normal maintenance (including a major overhaul), and the main insurance spares (e.g., rotor, guide blade carriers). [Add] q) API datasheets shall be used for all equipment. r) Blading limitations, approximate lateral critical speeds, and a description of the Vendor quality system.	
20	17.2.4 (Add)	[Add] VENDOR shall provide a throttling curve showing steam flow versus kW indicating the position of the governor valve openings.	
21	17.2.5 (New)	a. For each individual connection, allowable forces and moments on nozzles shall be stated in the proposal and confirmed after the order. b. For the lube oil system and other auxiliary systems, a preliminary bill of materials identifying components by make, type, and materials shall be submitted. c. Retention time of the lube oil reservoirs shall be provided.	
22	**API 612, 17.3**	**Contract Data**	
23	17.3.3 (Add)	The SUPPLIER shall submit recommended spare parts list in accordance with the Specification DGS-MU-003 or other applicable business unit specification.	

BUSINESS UNIT SPECIFIC REQUIREMENTS

FOR GENERAL & SPECIAL PURPOSE STEAM TURBINES (API 611 & API 612) SPECIFICATION

Appendix 4 – AGES-SP-05-004

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1. SCOPE

The following sections specify additional requirements which relate ONLY to ADNOC Business Unit specific requirements for the supply of General Purpose and Special Purpose Steam Turbines.

The requirements of Sections 2, 3 and 4 contained herein shall apply individually for each specified business unit in addition to the requirements specified within API Standard 611 5th Edition, General Purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services; API 612 7th Edition, Petroleum, Petrochemical, and Natural Gas Industries – Steam Turbines – Special-purpose Applications ; AGES-SP-05-004, General & Special Purpose Steam Turbines (API 611 & API 612) Specification; Appendix 1, 'General Technical and Contractual Requirements for Rotating Equipment'; Appendix 2, 'QA Inspection and Testing Requirements;' Appendix 3, 'Information Requirements'; Appendix 5, Instrumentation and Condition Monitoring Requirements and Appendix 6, Lubrication System Design Requirements.

2. NORMATIVE REFERENCES

References used throughout this appendix are listed within AGES-SP-05-004, General Purpose and Special Purpose Steam Turbines (API 611 and 612) Specification and Appendix 1, 'General Technical and Contractual Requirements for Rotating Equipment'.

In addition the referenced documents below relate to equipment supplied to specific ADNOC Business Units as listed.

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Table 1 – Normative References specific to COMPANY Business Units

ADNOC Refining	
Reference Document Number	**Reference Document Name**
IEC 60045-1	Steam Turbines – Part 1: Specifications
IEC 60953-1	Rules for steam turbine thermal acceptance tests Part 1 : Method A - High accuracy for large condensing steam turbines
IEC 60953-2	Rules for steam turbine thermal acceptance Tests - Part 2: Method B -Wide range of accuracy for various types and sizes of turbines
IEC 61064	Acceptance Tests for Steam Turbine Speed Control Systems

3. ONSHORE APPLICATIONS

The requirements listed in Table 2 relate **ONLY** to Steam Turbines used in onshore installations and shall apply in addition to the requirements specified within API Standard 611 5th Edition, General Purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services; API 612 7th Edition, Petroleum, Petrochemical, and Natural Gas Industries – Steam Turbines – Special-purpose Applications and AGES-SP-05-004, General & Special Purpose Steam Turbines (API 611 and 612) Specification.

Table 2 – Onshore Specific Requirements – API 612

API 612 Clause No.	Description of Change
15.4.2 (Add)	Add new sub-clause (e) …. "The Lube Oil system shall incorporate a shaft driven main lube oil pump and motor driven auxiliary lube oil pump".

4. REFINERY APPLICATIONS

The requirements listed in Table 3 contains the minimum technical requirements for **Hot Gas Expanders** for refinery applications, based on API 612 7th Edition. .

Table 3 – Refinery Specific Requirements – API 612

API 612 Clause No.	Description of Change
6.3 (New)	The SUPPLIER shall be responsible for the design and engineering, the total mechanical/aero-dynamic performance, and the guarantee of the entire expander train and auxiliary system supplied with the train (e.g. lube oil system). The extent of the train and auxiliary equipment will be indicated on the expander data sheet, but may include the expander, main air blower, steam turbine, gearbox and motor/generator. This responsibility shall include determining critical speeds and providing the lateral rotor dynamic analysis for each major component of the unit and the torsional analysis for the entire unit, as well as any other analysis specified in the data/requisition sheets.
6.7 (New)	The expander shall be of axial flow type with an overhung disc and single stage of blading. The inlet connection shall be axial and the discharge vertically upwards.
6.8 (New)	The expander shall be capable of delivering the stated power at the rated speed when operating at the normal conditions stated on the data sheets. The delivered power shall be guaranteed without negative tolerance. The power, efficiency and exhaust temperature shall be quoted on a flange to flange performance basis and include all inlet and exhaust casing losses as well as bearing and seal losses. The power quoted shall be available at the shaft end. Efficiency and high power output shall not be offered at the expense of blade life. Gas velocities within the expander shall be restricted to conservative values to ensure long blade life.
6.9 (New)	The SUPPLIER shall guarantee that with flue gas catalyst loading and concentrations specified in the data sheets, the expander rotor blades or stator vanes shall not require replacement due to the effects of erosion in less than four years operation and that power degradation shall not exceed 5%.
6.10 (New)	For expander trains which include the main air blower, the SUPPLIER shall provide a power balance summary showing the power developed or absorbed by all train components during start up and during normal operation and the maximum capacity available from the main air blower without the expander operating.
6.11 (New)	The SUPPLIER shall supply layout drawings showing the arrangement of the entire train and including details of the space required to permit removal of the expander rotor. A description of how the expander is dismantled to remove the rotor shall also be provided.
6.13 (New)	The expander may be exposed to increased inlet temperature excursions due to after burns. The CONTRACTOR shall indicate expected frequency, duration and maximum inlet temperature during after burns on the expander data sheet. The expander shall be capable of continuous operation during these periods. SUPPLIER shall advise any systems offered to mitigate the effects of after burn and any long-term effects on the life of the main components.
6.14 (New)	The SUPPLIER shall provide references for a minimum of two expanders in service on different Sites and similar to those proposed that have operated satisfactorily for more than two years. The references shall include the operating parameters, years in service, the name of a contact with an email address and telephone number.

API 612 Clause No.	Description of Change
6.15 (New)	Details of the cooling water available and other utilities are provided on the datasheets.
7.1.1 (Add)	The SUPPLIER shall provide references for a minimum of two expanders in service on different sites and similar to those proposed that have operated satisfactorily for more than two years. The references shall include the operating parameters, years in service, the name of a contact with an email address and telephone number.
7.4.4 (New)	The expander casing shall have centerline support and be designed to minimize stresses due to thermal expansion and cater for the rapid temperature changes and temperature gradients inherent in the duty. The SUPPLIER shall describe the features of the design which achieve this.
7.6 (New)	The design shall facilitate maintenance of the flow path components. The stator vanes and all rotating parts shall be replaceable on Site.
7.7 (New)	The SUPPLIER shall supply mating flanges for the main process connections of the expander.
7.9 (New)	The design of the casing shall be such that the hoop-stress levels of the material will not exceed the maximum allowable stress values specified in ASME VIII Division 1 for the metal operating temperature.
7.10 (New)	The construction rating for the casing shall be adequate for the specified condition, at the mechanical design temperature specified on the expander data sheet.
7.11 (New)	Drains shall be provided at the low points of the casing and shall be at least 2 inches Class 300.
7.12 (New)	Borescope and strobe light openings shall be provided to allow for inspection of stator vanes and of rotor blades during operation. The SUPPLIER shall provide platforms if necessary to access the view ports.
7.13 (New)	The SUPPLIER shall identify where gaskets are used to seal potential leakage paths through joints in the casing. The type of gasket and material used shall be indicated.
7.14 (New)	Any internal insulation required by the SUPPLIER's design shall be protected from windage and erosion by stainless steel shielding. The SUPPLIER shall indicate the thickness of the shielding. Internal insulation shall be permanently anchored.
7.15 (New)	If the nose cone projects beyond the expander inlet casing inlet flange, the SUPPLIER shall supply two piping spools with sufficient combined length to permit removal of the inlet case. The supply shall include all associated gaskets and bolting.
7.16 (New)	Details of any surface coating or partial surface coating offered to increase the life of the stator blading shall be provided.
8.5 (New)	The shaft end of the expander shall preferably be flanged.
8.6 (New)	The design of the disc to shaft junction shall maintain concentricity of the disc and shaft under all operating conditions including lack or loss of sealing gas flow to the exhaust casing shaft seal.
8.7 (New)	The disc and rotating blades shall be of forged material suitable for the temperature and service. The disc shall be capable of 100,000 hours service, without any cooling, at the normal (guarantee) point but including temperature excursions as specified. Supplier shall provide curves for the blades and disc showing percentage life consumed per unit time versus expander inlet temperature.

API 612 Clause No.	Description of Change
8.8 (New)	The SUPPLIER's proposal shall indicate the torque transmission limit of the disc to shaft interface at the normal speed.
8.10 (New)	The rotor assembly shall not require heat cycling or operation to seat interfaces before achieving successful operation.
8.11 (New)	The SUPPLIER's proposal shall provide the following rotor data: - rotor weight - bearing load and orientation at disc end - bearing load and orientation at coupling end - bearing span
8.12 (New)	The rotor construction and the maximum blade tip velocities shall be described in the SUPPLIER's proposal

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CONDITION MONITORING & MACHINE PROTECTION SYSTEM REQUIREMENTS FOR GENERAL AND SPECIAL PURPOSE STEAM TURBINES (API 611 & API 612) SPECIFICATION

Appendix 5 – AGES-SP-05-004

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Appendix 5

Condition Monitoring System Requirements to API 611 and API 612

This appendix contains minimum design requirements which should be taken in to account regarding Machine Monitoring System (MMS). These requirements are applicable in conjunction with the requirements which have been specified in COMPANY Business Unit Standards for Machine Monitoring Systems, as listed in Appendix-1.

All rotating equipment designed according to COMPANY Specifications SHALL [PSR] be supplied with safeguarding SHUTDOWN functions to preclude serious failures resulting in potential hazards to personnel or the environment.

Table1 – ALARM / SHUTDOWN Requirements for Steam Turbine					
Machine Parameter	**Condition Monitoring Sys. (See Table 2)**	**Instrument Type**	**Signal set point**	**Process Safety Req. [PSR]**	**Protection System Output (See Table 2)**
Axial Displacement *(Note 23, 28)*	✓	Vibration prob	High High	✓	Trip
Radial Bearing Vibration	✓	Vibration prob	High High	✓	Trip
Radial Shaft Vibration	✓	Vibration prob	High High	✓	Trip
Bearing Temperature	✓	RTD	High High	✓	Trip
Speed - Failure Of Governor Speed Prob (*Note19,22)*	✓	Tachometer		✓	Trip
Speed - Overspeed (*Note11)*	✓	Tachometer	High High	✓	Trip
Surface Condenser, Condensate Level	–	Level Transmitter	High High	✓	Trip
Lube Oil Header Pressure (*Note12)*	–	Pressure Transmitter	Low Low	–	Trip
Lube Oil Supply Temperature	–	Temperature Transmitter	High	–	Alarm or Trip

Table1 – ALARM / SHUTDOWN Requirements for Steam Turbine					
Machine Parameter	**Condition Monitoring Sys. (See Table 2)**	**Instrument Type**	**Signal set point**	**Process Safety Req.**	**Machine Parameter**
Lube Oil Run-Down Tank Level (*Note13)*	–	Level Transmitter	Low	–	Alarm, Permissive start
Governor Oil Pressure	–	Pressure Transmitter	Low	–	Alarm
Exhaust Hood Temperature (Condensing Turbine)	–	Temperature Transmitter	High	–	Alarm / Trip*(Note14)
Surface Condenser Vacuum (Note15)	–	Pressure Transmitter	High / Low	–	Alarm
Extraction Pressure (Note16)	–	Pressure Transmitter	Low Low	–	Trip
Speed - Low Speed	✓	Tachometer	Low	–	Alarm
Speed - Slow Roll Speed (With Turning Gear) (Note 20)	–	Tachometer	Low	–	Alarm
Bearing housings Purging rate (Note24)	✓	Flowmeter	High	–	Alarm

Table 2 -Machine Monitoring Philosophy and Protection System Description

Machine Monitoring System			Machine Protection	
Radial Vibration	**Axial Displacement**	**Bearing Temperature**	**Over speed Protection**	**TRIP SYSTEM**
Radial / Thrust Bearing Provide two X, Y arrangement, 90 degrees apart, proximity probes for each radial bearing. All four probes voting is 2oo4 comprising of all four probes (DE and NDE side). Apart from 2oo4, probe not OK shall be considered as vote to trip when probe is not functional. Logic shall include any one of four probes reading HH limit and other probes reaching H limit. **Radial Shaft Displacement** As the default, radial vibration shutdowns should be voted in a 1oo2 or 2oo4. 2oo4 configuration is generally preferred.	**Thrust Bearing** Three (or two) Axial position transducers shall be provided at each thrust bearing. When 3 probes are fitted, trip shall be based on 2oo3. Where 2 probes are fitted, HH trip shall be based on 2oo2. Logic shall consider probe Not OK as a vote to trip.	**Radial Bearing** 2 Duplex RTDs to be fitted per bearing within the expected load zone. For “load between pads” bearings the leading and trailing pads shall be fitted with RTDs. RTD's shall be installed and wired to Junction box mounted at skid edge in accordance with API 670 and DGS-MG-001, 6.4.2.3 (Note 7). HH trip shall be based on 2oo2 voting logic when two probes are fitted, or 2oo4 when four probes are fitted and where trips are configured within the MMS (Note 2, 27). **Thrust Bearing** b.Thrust bearings shall have four duplex RTD’s on each side (active & non-active side). Minimum 3 on each side shall be provided when 4 RTDs cannot be fitted due to space limitations. Bearing metal temperature sensors shall not be in adjacent pads for both active and inactive sides. They shall be located in highest load part of each pad. RTD's installed and wired to Junction box mounted at skid edge in accordance with API 670 and DGS-MG-001, 6.4.2.3 (Note 7, 27). HH trip shall be based on 2oo2 voting logic when two probes are fitted, or 2oo4 when four probes are fitted and where trips are configured within the MMS (Note 2).	Over-speed trip system (electronic) based on 2oo3 voting logic shall be furnished.(Note 11, 26) A key phasor, if gearbox transmission is used, key phasors for both high and low speed shafts shall be installed.	Trip system is to dump governor oil pressure from both the trip and throttle valve (TTV) and the governor speed control valve, forcing them closed. (Note.17,18,19, 26, 29) Two solenoid valves (open when deenergized to shutdown) in parallel, having 1oo2 voting system, to assure increased steam turbine reliability at trip are to be furnished (Note 22) .

Notes:

1. All machine trips shall be provided with a pre-alarm prior to a shutdown to allow Operations sufficient time (which to be finalized by COMPANY / SUPPLIER) to take action to prevent a trip.
2. Shutdown function design shall be based on an SIL Assessment.
3. Shutdown function design shall incorporate the recommendations of the original equipment Manufacturer (OEM).
4. NOT OK shall trigger a high priority operation Alarm and should be considered as vote to trip when probe is not functional.
5. For offshore applications, where space and weight are a concern, monitoring systems may be utilized with adjusted rack mounted, subject to approval by COMPANY.
6. MMS Design requirements for train driver such as Gas Turbine, HV Electrical Motors have been addressed in the respective ADNOC Standard.
7. Platinum (100 Ohm, three-wire) duplex RTD's (socket type) shall be used for bearing metal temperature detection arranged as follows. Transmitters are required for all the RTDs for further connections to the machine monitoring system.
8. Casing vibration instruments (probes) shall be supplied by SUPPLIER when requested. Monitors shall be part of VMS system and shall be supplied by COMPANY.
9. SUPPLIER to advise if permanent strain gauge OR torque meters for measurement and continuous monitoring of torsional deflections / shaft twist in coupling is required.
10. For instrumentation requirements refer to COMPANY I&C standard that defines the Machine Monitoring System (MMS) requirements. The MMS will form a part of the Process Control System (MMS) and Instrumentation Controls Package in accordance with COMPANY I&C standard. BN3500 System 1 will be provided as MMS.

11. Steam turbine drivers shall be equipped with an overspeed protection system that meets all of the following:
    a. is independent of other control systems;
    b. complies with the turbine OEM overspeed design criteria and protection philosophy (including test facilities up to the main steam trip valve);
    c. shall be electronic and redundant, allowing testing and maintenance without interruption of the turbine operation.
    d. responds within the speed of response limits determined to prevent damage to the equipment rotor and potential loss of containment;
    e. Include a two out of three (2oo3) voting logic on electronic overspeed detection systems,
    f. not use of time delays.

12. For turbines with turning gear, the turning gear operation shall be tripped on low lube oil header pressure.
13. There should be a permissive to start the turbine on sufficiently high level to assure there is adequate oil in the event of an emergency trip.
14. Trip should be considered if the maximum allowable working temperature can be exceeded for extended periods during start-up.
15. Low vacuum may need if the vacuum can go lower than the turbine's design capabilities for instance in extremely cold cooling water.
16. If design of machine forces to prevent the turbine blading, low extraction is needed.

17. To help ensure the TTV is able to function if required, a partial stroke test should be periodically performed.
18. The turbine trip system shall meet the required SIL of the IPF with the highest SIL requirement.
19. If specified in datasheet, two separate independent trip valve(s) or combined trip and throttle valve(s) SHALL be provided. In this case, they can either be installed in series with each other and voted 1oo2 to trip, or installed in parallel with each other with increased frequency of testing. The trip valve not in service can be fully stroke tested off line without interfering with the operation of the process.
20. Motorized turning gear is required for capacity exceeding 3 MW.
21. Shaft eccentricity probes are to be installed to avoid startup sag of rotor and to be included within startup logic.
22. The turbine SHALL [PSR] be provided with a minimum of two independent electrohydraulic solenoid-operated valves located in the shutdown system. Further, Trip solenoid valves SHALL [PSR] be de-energized to shut down. They also shall be low powered valves and shall be explosion proof.
23. For API 611 Steam Turbine, Unless the number/location of vibration transducers are given in the data sheet, Turbines with rating above 132 kW shall be fitted with a casing vibration transducer. Turbines with ratings above 750 kW shall be fitted with shaft displacement vibration transducers. Units smaller than 132 kW shall be provided with flats to facilitate hand held vibration monitoring.
24. For API 611 Steam Turbine, bearing housings shall contain suitable connections for Nitrogen purge seal gas supply. The nitrogen seal gas system shall be monitored.
25. Transmitters for alarm and trip shall be separated.
26. For API 611 Steam Turbine, a total of four (4) speed pickups shall be used: two(2) dedicated for over speed and two(2) dedicated for the electronic governor. The loss of one of the two over speed pickups output signals shall trip the turbine.
27. Journal bearings shall be tilting pad type. Each radial bearing shall have two pads each fitted with two single RTDs. Bearing metal temperatures shall not exceed 95 °C under any load conditions and at the maximum specified ambient or cooling water temperature.
28. Shaft relative displacement sensors shall be mounted sufficiently axially distant from the bearing journal in order that chrome plating of the bearing journal will not interfere with proper vibration measurement.
29. The turbine trip system shall be designed to detect when the trip valve or trip and throttle valve has been manually tripped locally and shall activate the DCS / ICSS shutdown system.
30. Steam Turbines control system shall have a counter with required software, connected with the DCS to count the Equivalent Operating Hours (EOH) automatically.

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LUBRICATION SYSTEM DESIGN REQUIREMENTS

FOR GENERAL AND SPECIAL PURPOSE STEAM TURBINES

(API 611 & API 612) SPECIFICATION

Appendix 6 - AGES-SP-05-004

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1. SCOPE

This Appendix contains lubrication system design requirements which shall be taken into account for steam turbines designed according to API 611 and API 612 in conjunction with relevant COMPANY Business Unit Standards.

The requirements stated within Section 3 and Section 4 as noted below shall take precedence over API Standard 611 5th Edition, General-purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Services; API 612 7th Edition, Petroleum, Petrochemical, and Natural Gas Industries – Steam Turbines – Special-Purpose Applications; AGES-SP-019 General & Special Purpose Steam Turbines (API 611 and 612) Specification and Appendix 1, 'General Technical and Contractual Requirements for Rotating Equipment'.

2. NORMATIVE REFERENCES

References used throughout this Appendix are listed within AGES-SP-05-004, General & Special Purpose Steam Turbines (API 611 and 612) Specification, Appendix 1, 'General Technical and Contractual Requirements for Rotating Equipment' and Appendix 4, 'Cross References'. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

3. LUBRICATION SYSTEM DESIGN REQUIREMENTS – API 611 & 612

Unless otherwise specified in the Purchase Order, the following requirements shall be applied for the design of the Lube Oil systems for General and Special Purpose Steam Turbines designed to either API 611 or API 612:-

1. Oil pumps shall be of positive displacement type “triple screw” or “gear type” according to API 676 with separate PSV (not integral with the pump). Horizontal lube oil pumps shall be installed on LO skid, although vertical pumps may be installed where space constraints exist.

2. For sizing of air coolers, use a design ambient temperature of 54°C for onshore and island applications and 48°C for offshore applications; based on single fan operation and peak ambient temperature of 58°C (with no design margin). At peak ambient temperature of 58°C, both fans shall operate to meet the cooling duty requirements.

3. Lube Oil coolers shall preferably be “air cooled” type and include two (2) x 100% cooling fans, induced draft type. Forced draft fans may be used ONLY if the fan diameter is less than 750mm. Use of OEM standard cooler instead of API 661 coolers for lube oil coolers is acceptable subject to COMPANY approval.

4. Lube Oil Coolers may be supplied with removable turbulators in stainless steel 316L. Marine grade aluminium extruded fins (394 fins/m) shall be provided on coolers. The complete lube oil cooler shall be constructed in Stainless Steel 316L (including tubes, headers, plugs etc.).

5. Water-cooled exchangers are acceptable if cooling water is available from site utility supply network. For water cooled systems, 2 x 100% shell and tube lube oil cooler/exchangers shall be used designed according to TEMA C. A removable-bundle design is required for shell-and tube coolers with more than 0.46 m^2 of tube surface area.

6. Each oil cooler shall maintain the lube oil supply temperature at or below 48 ºC for water cooled systems and 68 ºC for air cooled systems.

7. ASME U stamp or PED certified equipment is required for all heat exchangers (Lube Oil Coolers).

8. The following design margins shall be applied: The cooler shall be designed to accommodate 110% of the maximum required oil flow defined as per API 614, cl 4.4.11b. In addition, the cooler shall be sized for the following design cases:-

    a. 110% of the required heat transfer load and
    b. 110% of the calculated heat exchange surface area

9. Oil filters shall have a continuous flow switch-over valve including a pressure equalization line. Duplex filters shall be provided with suitable range differential pressure gauges

10. All vent lines shall be equipped with an isolation valve.

11. The lube oil tank shall be sized for a minimum of 5 minutes circulation volume at the lube oil pump duty flowrate. If required, a rundown tank shall be provided and is preferred instead of a DC emergency pump. A startup interlock shall be provided to ensure minimum required lube oil temperature prior to start-up. Two (2 x 100%) duty/standby motor driven horizontal lube oil pumps shall be provided and an accumulator shall also be provided to ensure smooth pump changeover. For onshore applications only, a shaft driven main lube oil pump and motor driven auxiliary lube oil pump may be provided, subject to COMPANY approval and valid references being provided.

    The complete lubricating oil system including, lube oil reservoir, oil coolers, filters and piping (except for lube oil pump) shall be supplied in Stainless Steel 316/316L construction as a minimum. Lube oil pump

shall have CS casing with SS rotor. However, when using seawater as the cooling medium, oil coolers shall be constructed from Titanium or other suitable material to mitigate corrosive attack by seawater.

12. Sight glass flow indicator shall be provided for each oil return line as specified in API 611 clause number 7.4.4.10.1.

4. PORTABLE LUBE OIL FLUSHING SKID (API 611 & 612 STEAM TURBINES)

The SUPPLIER shall provide a suitably designed portable lube purifier skid (with minimum 1000 Litre capacity lube oil tank) having electrostatic oil conditioning equipment that removes varnish from hydraulic and oil lubricating applications and circulates the fluids at a low velocity, removing submicron particles.

The skid shall comprise lube oil tank, heater(s), pumps, filters, centrifuge, piping supports, all required field instrumentation, local panel, flexible connecting hoses, etc. Skid shall be mounted on trolley with wheels of adequate capacity for movement within plant. Necessary electrical connectors shall be provided on skid.

The EPC CONTRACTOR shall provide the necessary power supply connection near to turbine for connecting required power at a single point. Similarly, connections to OWS system shall be available local to the turbines to collect drains / impurities from the lube oil cleaning skid. The requirement for suitability of use in hazardous area (online cleaning) or non-hazardous area (offline cleaning when area is safe) will be defined within the equipment data sheets.

The flushing skid shall be common for multiple packages and supplied on the basis of one skid per site/ project.

Appropriate separate connections will be required to allow for connection to the main equipment. Complete system shall be in SS316L (except pumps where CS casing with SS rotors can be used).

Vacuum dehydrators Oil Filtration Systems and Varnish Removal Systems shall be provided to remove varnish, lacquer, sludge, or tar including particulate and moisture contamination commonly found in s lubrication and hydraulic systems for steam turbines.