

Type of document	Procurement specifications
IDM Number	ITER_D_65PTXB
INDUS Number	II-3MAT7PA
References	
Current Document phase	Approved
Current Document Version	7.0
Version date	24-04-2024
Access Control	Restricted

Title	Technical Specification for Supply of Safety Important Pneumatic Butterfly Valves
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Distribution list	Pre-qualified bidders
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Definitions and Acronyms

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BHN	Brinell Hardness Number
BPVC	Boiler and Pressure Vessel Code
BW	Butt Weld
CCWS	Component Cooling Water System
CHWS	Chilled Water System
DPT	Dye Penetrant Test
EDH	Electrical Design Handbook
EMC	Electromagnetic compatibility
EPDM	Ethylene Propylene Diene Monomer
HCC	Hard Core Component
HP	Hold Point
IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronics Engineers
INB	Installation Nucléaire de Base (Basic Nuclear Installation)
ISO	International Organization for Standardization
ISPM	International Standards for Phytosanitary Measures
MIP	Manufacturing and Inspection Plan
MOC	Material of Construction
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
NB	Notified Body
NDE	Non-Destructive Examination
NP	Notification Point
NPT	National Pipe Thread
OBE	Operating Basis Earthquake
PCDH	Plant Control Design Handbook
PED	Pressure Equipment Directive
PIA	Protection Important Activity
PIC	Protection Important Component
PTFE	Polytetrafluoroethylene
QA	Quality Assurance
QC	Quality Control
QP	Quality Plan
RMS	Root Mean Square
RT	Radiographic Testing
SEP	Sound Engineering Practice
SIC	Safety Important Component
SSE	Safe Shutdown Earthquake



Tender Notice No.: I-I/ET-TPT/24003/24-25 dated 10.05.2024 for Supply
of Safety Important Pneumatic Butterfly Valves

II-3MAT7PA

UT	Ultrasonic Testing
VT	Visual testing

1 Preamble

The objective of ITER is to demonstrate the scientific and technological feasibility of fusion energy for peaceful purposes. ITER is being constructed at St. Paul lez Durance, Cadarache, France. The seven ITER partners (referred as the Domestic Agencies) are China, European Union (host country), India, Japan, South Korea, Russia and United States of America.

It is intended to procure the air-operated valves of ITER Component Cooling Water System (CCWS) and Chilled Water System (CHWS) and these valves will be installed in dedicated valve room (Level-3) of the Tritium building (B-14) and other rooms of Tokamak complex.

The valves are either 'ON-OFF type used for positive flow isolation' or 'modulating type used for process flow control'. All of these valves have confinement function too and therefore these valves should remain intact to keep their safety functions before and after accidental events.

The interfaces of these valves shall be the valve ends where the valve's pressure boundary connects to the adjoining piping.

2 Scope

This procurement specification covers design, seismic analysis, material, construction/manufacturing, inspection, testing, various qualifications, performance guarantee, packing and forwarding, supply and delivery requirements of butterfly valves, operated by pneumatic actuators of fail to close, 'Scotch and Yoke type'.

It is not the intent to completely specify all details of the design and construction of valves; nevertheless, the valves shall conform to high standards of engineering, design, and workmanship.

The mere compliance with this specification shall not relieve the contractor of his responsibility of supplying the valves of proper design, construction, testing and workmanship meeting the safe and efficient operating requirements. In case any accessories, commissioning spares/ tools that are necessary to operate but not specifically identified in this specification shall also be in Contractor's scope of supply.

3 Definitions

The definitions/ interpretations of specific technical terms are given under.

- Safety class SIC-1: The Structures, Systems and Components which are required to bring to and to maintain ITER in a safe state;
- Safety class SIC-2: The Structures, Systems and Components which are used to prevent, detect or mitigate incidents or accidents, but not required for ITER machine to reach a safe state;
- Hard Core Component (HCC): Safety important Component (SIC) which provides means to restore last nuclear confinement barrier (confine activated corrosion products and tritium);
- Safe Shutdown Earthquake (SSE), also termed as SL-2: According to International Atomic Energy Agency (IAEA) safety guide, it is an extremely unlikely event and corresponds to the seismic level required by French nuclear practice. It shall be demonstrated that all safety functions

are maintained during and after the event. For ITER site, the design earthquake is the SSE which is defined by enveloping of Séisme Majoré De Sûreté (SMS) and PALEO spectra;

- Operating Basis Earthquake (OBE), also termed as SL-1: According to IAEA safety guide, it is a likely event and corresponds to an event with a probability in the order of 10^{-2} per year and represents an investment protection earthquake level (following the Nuclear Pressure Equipment regulation, it corresponds to a foreseeable event). The equipment and all components which belong to SIC (Safety Important Class) shall be designed to restart and operate after an SL-1 event without special maintenance or test. Unless a specific SL-1 analysis is performed, seismic response to an SL-1 event may be obtained by dividing the results from SL-2 by a factor 3;
- SL-3: Beyond design (extreme) earthquake;
- Seismic Class SC1 (SF): Structural stability and required functional seismic safety performance maintained in the event of an earthquake, the respect of this level of requirement guarantees the level of safety as throughout the normal operation of the equipment. Nevertheless, taking into account seismic load characteristics, fatigue is not taken into account;
- Pressure Equipment Directive (PED) (2014/68/EU) applies to the design, manufacture and conformity assessment of stationary pressure equipment with a maximum allowable pressure greater than 0.5 bar. The directive entered into force on 20 July 2016. It sets out regulations for the pressure equipment, also sets the administrative procedures and requirements for the "conformity assessment" of pressure equipment, for the free placing on the European market without local legislative barriers. As per the design parameters, the contractor has to categorize the risk as Sound Engineering Practice (SEP), Category-1, Category-2, etc;
- Electromagnetic compatibility (EMC) Directive 2014/30/EU: Compliance with EMC Directive is mandatory for nearly all electrical and electronic equipment imported into the European Union (EU). The EMC Directive requires that all products shall comply with the basic protection requirement. It has a level of immunity to the electromagnetic disturbance to be expected in its intended use, which allows it to operate without unacceptable degradation of its specified performance;
- CE (Conformité Européene): CE marking signifies that the equipment complies with the appropriate European directive/s;
- Notified Body (NB): It is a company that has been nominated by a member state of European Union and notified to the European Commission for conformity assessment of equipment against various directives as applicable in European Union. The Notified Bodies include Lloyd's Register, Bureau Veritas, TUV India, TUV Sud, TUV Rheinland, DNV, etc;
- A Notification Point (NP) is a milestone where the Contractor is required to notify the Purchaser, that he has completed a specific task or a specific deliverable and is proceeding to the next task or to the next action on the specific deliverable. A NP is meant to enable Purchaser and ITER IO to follow the progress of the Contract and possibly to witness a critical manufacturing step at the manufacturer's premises. A NP shall not affect the production flow of the Contractor/Manufacturer that shall continue the work even without a reply from Purchaser;
- A Witness Point (WP) is a critical step in design and engineering, manufacture, procurement, testing, etc. where the Contractor is obliged to notify in sufficient advance of the start of activity/inspection/test so that it may be witnessed by Purchaser/Purchaser's representative;

- A Hold Point (HP) is a milestone where the manufacturer is required to notify Purchaser, that it has completed a specific task or a specific deliverable and must stop the associated processes until a HP Clearance is issued. The HP Clearance shall be issued on the basis of clearly identified Quality Control and data and acceptance test results to be provided to Purchaser. In case of clearance, the Contractor/Manufacturer shall resume his activity. In case of rejection, the Contractor/Manufacturer shall develop a recovery plan and shall submit to Purchaser for review.

4 Applicable Codes, Standards, Directives and compliances

The design, material, manufacture, inspection, testing and performance of the valves shall comply with all latest (as on the date of contract award) statutes, regulations and safety codes that are applicable in the locality (France) where the valves will be installed and operated.

The valves need to be qualified as per PED/ESP and other directives and legislations, as applicable in France. If the contractor is unaware of the regulations/legislations/directives being practiced in the locality (France) where the valves will be installed and operated, the contractor is encouraged to seek the expertise of external consultants. Moreover, if the regulations/legislations/directives require a Notified Body (NB) to qualify the valves, the contractor is required to hire appropriate Notified Body, apart from fulfilling the requirements of 'CE marking', as applicable.

The valves shall comply with the latest codes, standards and directives mentioned below and those mentioned in specification sheets. Any conflict between requirements shall be brought to the attention of ITER-India for resolution. The following codes/ standards/orders shall be followed in the design, selection, manufacturing, qualification and testing of the valves and actuators.

- [1] ANSI/MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges, and Unions
- [2] ANSI/MSS SP-55 - Quality standard for steel castings for valves, flanges and fittings and other piping components
- [3] ANSI/FCI 70-2 – Control Valve Seat Leakage
- [4] ANSI/IEC 60529-04 - Degrees of Protection Provided by Enclosures (IP Code)
- [5] API 598 - Valve Inspection and Testing
- [6] ASME B1.1 - Unified Screw Threads
- [7] ASME B16.20 - Metallic Gaskets for Pipe Flanges
- [8] ASME B16.25 - Buttwelding Ends
- [9] ASME B16.34 - Valves – Flanged, Threaded, and Welding End
- [10] ASME B16.5 - Pipe Flanges and Flanged Fittings
- [11] ASME B31.3 - Process Piping
- [12] ASME-QME-1 - Qualification of Active Mechanical Equipment Used in Nuclear Power Plants
- [13] BS EN 12570: Industrial Valves - Method for Sizing the Operating Element
- [14] EN 15714 - Valve actuator family of standards
- [15] EN 12266-1:2012, European Standard Industrial valves – Testing of valves Part 1: Pressure tests
- [16] EN 13555-2021 Flanges and their joints — Gasket parameters and test procedures relevant to the design rules for gasketed circular flange connections
- [17] IEEE-323 – Standard for Qualification of Equipment for Nuclear Power Generating Stations

- [18] IEEE-344-2013 – IEEE Standard for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations
- [19] IEEE-382 – IEEE Standard for Qualification of Safety-Related Actuators for Nuclear Power Generating Stations
- [20] IEEE-383 – IEEE Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations.
- [21] ISO 5752: Metal valves for use in flanged pipe systems – Face-to-face and centre-to-face dimensions
- [22] ISO 15848-1: Industrial Valves – Measurement, Test and Qualification Procedures for Fugitive Emissions – Part 1: Classification Systems and Qualification Procedures for Type Testing of Valves
- [23] Pressure Equipment Directive (2014/68/EU)
- [24] EMC Directive (2014/30/EU)
- [25] Machinery Directive (2006/42/EC)
- [26] French Decree 2015-799 and Article R557 of the French Environmental Code
- [27] IEC 60695-11-10 - Fire hazard testing – Part 11-2: test flames – 1 kW nominal premixed flame – Apparatus, confirmatory test arrangement and guidance
- [28] ISO-10497:2010 - Testing of valves — Fire type-testing requirements
- [29] INB (Installation Nucléaire de Base”) order
- [30] ISO 5211:2017 Industrial valves — Part-turn actuator attachments
- [31] ISA75.23, Control Valve Cavitation
- [32] ASME B16.10 – Face-to-Face and End-to-End Dimensions of Valves
- [33] ASME Boiler and Pressure Vessel Code, Section III Division 1, Subsection NC, 2015 edition
- [34] ISO-148-1:2016 Metallic Materials Charpy Pendulum Impact Test
- [35] RCC-M, Section VI, Probationary Phase Rule RPP-4 qualification of active mechanical equipment (pumps and valves) requiring qualification to accident conditions Volume-Q
- [36] RCC-E: 2019 – Design and Construction Rules for Electrical and I&C System and Equipment

Apart from the above, the contractor is required to comply the following ITER applicable documents, procedures and guidelines

- [37] Load Specification for Cooling Water System located in B11, B13, B14, B15 and annex, B21, B23, B24, B37 and annex, B74 (XLTXGR v1.2)
- [38] EDH Part 4: Electromagnetic Compatibility (EMC) (4B523E v3.0)
- [39] Plant Control Design Handbook (27LH2V v7.1)
- [40] Order dated 7 February 2012 relating to the general technical regulations applicable to INB – EN (7M2YKF v1.7)
- [41] ITER Procurement Quality Requirements (22MFG4 v5.1)
- [42] Quality Classification Determination (24VQES v5.2)
- [43] Procurement Requirements for Producing a Quality Plan (22MFMW v4.0)
- [44] Requirements for Producing an Inspection Plan (22MDZD v3.7)
- [45] Provisions for implementation of the generic safety requirements by the external interveners (SBSTBM v2.2)
- [46] Quality Assurance for ITER Safety Codes Procedures (258LKL v3.1)

- [47] Propagation of the Defined Requirements for Protection Important Components Through the Chain of External Interveners (BG2GYB v3.3)
- [48] Procedure for management of Nonconformities (22F53X v9.1)
- [49] Procedure for the management of Deviation Requests (2LZJHB v8.1)
- [50] Chemical composition and impurity requirements for materials (REYV5V v2.3)
- [51] Guideline – Framework instruction for safety demonstration Art 3.8 INB Order (PQT8AC v1.2) Overall Surveillance Plan of External Interveners Chain for Protection Important Components, Structures and Systems and Protection Important Activities (4EUQFL v7.4)
- [52] ITER Policy on Safety, Security and Environment Protection Management (43UJN7 v3.1)
- [53] Organization of nuclear safety inspections in ITER Organization and its supplier chain (CW8EL3 v4.0)
- [54] Accreditation of nuclear safety inspectors (DBFV2L v1.8)
- [55] Compliance ASME B16.34 and ESP/ESPN (33YHTZ v1.1)
- [56] ITER Numbering System for Components and Parts (28QDBS v5.0)
- [57] Working Instruction for Manufacturing Readiness Review (44SZYP v5.0)
- [58] Procedure for Transportation of Components to ITER Site (RY5C6Q v3.1)
- [59] Working Instruction for the Delivery Readiness Review (DRR) (X3NEGB v2.0)
- [60] Risk and Opportunity Management Procedure (22F4LE)
- [61] Procedure for Identification and Controls of Items (U344WG v2.2)
- [62] Technical specification for coating and tagging (S9YVVG v1.0)
- [63] Radiation environment for equipment during operations (3FM52L v1.1)
- [64] 85HR3P v4 - Magnetic Field Maps Database Query Tool
- [65] Safety requirement Roombook (KF63PB v2.11)
- [66] CCWS-1 Design Conditions Calculation (5JYBAW v2.0)
- [67] CCWS-1 thermal-hydraulic analysis report (8A7KY8 v2.0)
- [68] Procedure for Analyses and Calculations (22MAL7 v6.6)
- [69] Instructions for Structural Analyses (35BVV3 v4.0)
- [70] Codes and Standards for ITER Mechanical Components (25EW4K v4.0)
- [71] Guidelines for Qualification by Analysis (9C242A v2.0)
- [72] Deviation request for estimating radiation dose rate on CWS Valves using not yet baselined RAD MAPS 2020 (93GNUT v1.1)
- [73] Deviation request for estimating magnetic field modulus on CWS Valves using not yet baselined Magnetic Field Map 2019 (96C9YP v1.1)

The applicable documents will be shared with the contractor, after award of the contract. However, the key requirements are covered in this procurement specifications.

5 General requirements

5.1 Ambient design conditions

The valves shall be designed, considering the following ambient conditions.

- Minimum ambient temperature: 5 °C
- Maximum ambient temperature for nuclear operation: 35 °C for 14 years
- Maximum ambient temperature for non-nuclear operation: 40 °C for 10 years
- Loss of HVAC Ambient Temperature: 80 °C with 50 occurrences 1 hour each
- Fire Minimum Temperature: $T_{\text{design}} + 140$ °C

Note: Thermal cycle will affect the fatigue life of the valves hence fatigue calculation shall be presented for verification.

5.2 Design conditions

The design temperature, design pressure, flow and pressure classes of all the valves are as specified in Annexure-1

Some of the valves termed as Hard Core Component (HCC) are meant for the safety of the plant (e.g. Protection Important Components) which are needed in extreme scenarios to prevent cliff-edge effects and shall be qualified accordingly.

5.3 Material Requirement

In general, all the valves shall be of ASTM A351 Gr CF8M construction.

The key limiting requirement of Cobalt (Co) $\leq 0.2\%$, Niobium (Nb) $\leq 0.1\%$ and Tantalum (Ta) $\leq 0.05\%$ shall be considered while selecting material of construction of the components [50].

All material shall conform to the Essential Safety Requirements of the PED/ESP.

The Contractor shall provide material Inspection certificates type 3.2 according to EN-10204.

5.4 Service applications

The service condition of the valves is Demineralized water.

5.5 Radiation

Maximum radiation dose at End of Life is 10 Gy, Neutron flux is $100 \text{ n.cm}^{-2}.\text{s}^{-1}$ and 1 MeV equivalent neutron fluence is 10^8 n.cm^{-2} . The dose value has been derived from [63] [72] in rooms B11-L3-02W, B14-L2-TG2, B14-L3-23, and B14-L4-22.

5.6 Electro Magnetic Compatibility

Magnetic Field Modulus at valve location is 15 mT and it is derived from [64] [73] in rooms B11-L3-02W, B14-L2-TG2, B14-L3-23, and B14-L4-22. However safety factor of 1.4 shall be used for qualification purpose.

5.7 Seismic Requirement

All valves and actuators shall be seismically designed and qualified to operate during combinations of loads, normal and accidental environmental conditions. Structural stability and functionality are to be maintained in the event of an earthquake; Seismic qualification using shake table is required. Reference acceleration is 4g.

The valves shall be suitable for installation with shaft either in horizontal, vertical and any position in between as indicated in Annexure-1.

5.8 Cycling

Valve are subjected to number of mechanical, thermal and loss of HVAC cycles as given below,

1. Mechanical Cycle (full open/close): 1000 on/off valves and 10000 modulating valves;
2. Thermal Cycle: 30000 temperature increase from 31°C to 80 °C with rate of 0.3 °C /sec;
3. Loss of HVAC: 50.

5.9 Available air pressure

The supply air pressure of 0.7 MPa-g shall be available for the valves actuation and accordingly, the actuators need to be designed. The maximum and minimum supply pressure of air shall be 1.1 MPa-g and 0.6 MPa-g respectively. Actuator torque calculation shall be done on the minimum supply pressure. The valves and actuators must retain full functionalities for all conditions and within a pressure range which goes from 1.1 MPa-g and 0.6 MPa-g.

5.10 Constraints & limits

The end-to-end dimensions & weights: As per the limitations indicated in Annexure-1.

The required full open CV of the valves are listed in Annexure-1.

5.11 Quality, safety and seismic Classifications

- Quality class: QC-1
- Seismic class: SC-1 (SF)
- Safety class: SIC-2

5.12 Compliance to EU Directives

All the aspects like design, manufacturing, qualification, logistics, etc. need to comply applicable European Directives [23][24][25].

6 Technical requirements of butterfly valves

The air-operated cast stainless steel Butterfly valves shall be of full-bore, triple offset design, metal-seated, preferred directional sealing (reverse sealing for supply line valves and forward sealing for return line valves as indicated in Annexure-1) with over travel limit stoppers.

The end-to-end dimensions shall be in accordance with ASME B16.10 [32], with the constraints as specified in Annexure-1.

The valves shall be designed to ASME B16.34 and to the additional requirements specified in this specification.

The valves and actuators shall have a design life of 24 years at the specified conditions, excluding items such as gaskets, packing, elastomer parts, lubrication materials and other consumables. The consumables shall have a design life of at least 5 years. The components and spare parts of valves and actuators shall be mutually interchangeable among the valves of one type or size and to maximum practical extent elsewhere.

Heavy components of valves shall be provided with a method of handling, such as lugs or eyebolts.

The valve tag numbers of the valves are listed in Annexure-1.

The materials of various components have to be selected in such a way to meet the requirements and the approval of ITER-India is mandatory.

6.1 Body

The valves shall be of ASTM A351 Gr CF8M construction.

The internals of valve body shall be designed for streamlined flow and low pressure drop.

The minimum wall thickness of valve body shall be governed by the design standard ASME B16.34.

The valve body end connections shall be of Lug type with through body holes with studs and nuts and shall be supplied with weld neck companion flanges along with all necessary fasteners.

The design of valve trim shall provide maximum protection against the effects of corrosion, erosion, galling and leakage; hence the design and the selection of the material need to be done accordingly.

The internals of the valve body shall be designed [9] to limit the deposition of possible corrosion product and other erogenous materials inside the valve body. This may be achieved in the design of the internals eliminating sharp angles, strong reductions and spaces likely to trap the deposits of products of corrosion, zones of retention, socket welds and materials which do not have an optimum surface quality. The body free of pockets or stress concentration points.

The finish on all un-machined internal and external surfaces shall be 10 microns RMS or better.

For valves that require a certain installation orientation, an arrow shall be provided on the external surface of the valve body depicting the required flow direction through the valve.

The valves shall be suitable for installation with shaft either in horizontal, vertical and any position in between as indicated in Annexure-1.

6.2 Valve Seat

The valve seat leakage rate shall conform to the requirements listed in the Annexure-1 and shall be accordance with EN 12266-1 [15]. Hard faced valve seats shall be free of Cobalt.

6.3 Valve Stem

Valve shall be specially designed to prevent stem leakage to the environment. Valves shall be designed so that the stem seal retaining fasteners (e.g., packing, gland fasteners) alone do not retain the stem. Specifically, the design shall be such that the stem shall not be capable of removal from the valve, while the valve is under pressure, by the removal of the stem seal retainer (e.g. gland) alone. Actuator mounting flange and stem connection shall be designed to ISO 5211 [30] for direct mounting to actuators. The valve Stem leakage rate to environment and the leak tightness of the stem seal shall conform to the requirements of given Class as listed in Annexure-1 and shall be accordance with ISO 15848-1 [22]. Stem mechanical integrity shall be demonstrated for the highest supply pressure. The valve stem shall have blow-out proof design.

6.4 Trim

The stem shall be of Non-Rising type made of ASTM A 564 Gr. 630 H1075 (17-4 PH) and the disc shall be of single cast piece made of ASTM A351 CF8M.

The valves shall be metal-seated with hard facing. The material used for hard facing shall be Cobalt-free, Nickel based alloy. There shall be hardness difference of minimum 50 BHN between seat and disc seal. The valves shall have preferred directional sealing.

6.5 Packing

The packing material shall be suitable for the fluid handled and the design shall allow easy replacement of packing. The packing material shall be halogen free. The parts subjected to wear, corrosion or other deterioration requiring adjustment, inspection or repair shall be easily accessible and shall be capable of easy removal for repair/replacement and the means of adjustment shall be provided for wearable parts where applicable. The internal hardware like pins/ nuts/ screws shall be made of SS 316.

6.6 Position Indication

The position indication of the valve shall be designed such that components of the indicating means cannot be assembled to falsely indicate the valve open or closed position. Valves of the quarter-turn shall have a means to indicate the disc position.

6.7 Valve Coefficient (Cv) and Cavitation assessment

The valve size and characteristics shall be selected such that the required Cv is no greater than approximately 80% of the valve's rated (100% open) Cv for the operating conditions listed in the Annexure-1. At the minimum flow conditions, valve position shall be a minimum of 20% open, so that the valve seat and plug shall not be susceptible to damage. The Contractor shall submit a sizing calculation note to show the flow coefficient of fluids through control valves. The minimum required CV valves are listed in Annexure-1.

Cavitation characteristics and assessment shall also be submitted with the calculation according to [31] for ITER-India review.

6.8 Mechanical Stops

Adjustable mechanical stops shall be provided to prevent over travel in open and closed positions. The stops shall be designed to absorb full operator torque.

6.9 Hand wheel

The valves shall be provided with manual override to open or close the valve in the event of loss of actuator power. For safety reasons, it is required that a manual declutch mechanism needs to be included. Engaging the declutch mechanism changes the operation from powered to manual (hand-wheel) operation. The declutch mechanism needs to be provided with a locking device to prevent unauthorized manual operation. In most applications, the hand-wheel should not turn while in powered operation as a safety precaution.

The hand-wheel drive must be mechanically independent of the pneumatic drive and it shall permit valve operation in a reasonable time. The manual force required to operate the valve shall meet the requirements standard BS EN 12570. The orientation of the manual operators with respect to the direction of flow through the valves or accessibility for manual operation shall be subject to the IO's approval. The clockwise operation of the hand-wheel shall give closing movement of the valve.

The hand-wheels shall be of carbon steel construction with necessary painted/coated, spoke design preferably with not more than six spokes. Webbed or disc hand-wheels shall not be used.

Valves of sizes DN400 and above shall be provided with gear operation.

Chain wheel with sprocket rim and chain guides on both sides of the wheel shall be provided to facilitate operation of valves located above ground level. The chain shall be of adequate length so as to operate from the floor.

6.10 Fasteners

Threaded fasteners used shall have unified screw threads and shall conform to ASME B1.1. All threaded pressure retaining fasteners shall be provided with corrosion resistant positive locking devices. Frictional locking devices are not acceptable. All nuts and bolts shall have hexagonal heads unless otherwise specified. The materials of construction of bolts and nuts conform to SA 193 Gr. B8 and SA 194 Gr. 8 respectively.

6.11 Companion flange

Weld neck companion flanges shall be supplied with valves along with all fasteners. Since these valves are at the last pressure boundary, special attention shall be required while selecting the weld neck thickness as per Annexure-1. Companion flange connection shall be calculated according to EN 1591-1 with max available piping loads provided by ITER-India and selected gasket shall meet the leakage requirement from EN 13555 as per Annexure-1.

6.12 Miscellaneous items

The accessories include, but not limited to chain wheel, supporting brackets, lifting lugs, valve position indicator, I/P converter, Integral position indicator on the stem and top mounting flanges for disc position identification, etc.

7 Technical requirements of Pneumatic actuators

The following general requirements shall be considered while selecting/ designing the pneumatic actuators.

The actuator design shall be 'Fail to close', 'Scotch and Yoke type' type and the type of actuator shall be either 'ON-OFF' or 'Modulating type control valve', as specified in Annexure-1. The material shall be aluminum or austenitic stainless steel, however to reduce the overall assembly weight aluminum shall be preferred.

The actuators shall be sized to open or close the valve with a differential pressure equal to design pressure mentioned in the Annexure-1 during their entire stroke (i.e. from open to close position).

The torque shall be minimum 1.25 times that of 'the maximum required torque'. The supply air pressure of 0.7 MPa-g shall be available for the valves actuation. The maximum and minimum supply pressure of air shall be 1.1 MPa-g and 0.6 MPa-g respectively. The valves and actuators must retain full functionalities for all conditions and within a pressure range which goes from 1.1 MPa-g and 0.6 MPa-g. The Contractor shall perform the sizing calculation for the actuator based upon the sum of the maximum shut-off pressure and resulting torque requirements, and shall be based on the minimum air supply pressure. Air consumption characteristics shall be submitted with each valve.

Each valve actuator shall have ample power capacity for accurately seating, unseating, and positioning the valve when subjected to the most severe operating condition, including any mechanical friction and/or other restrictive conditions that are inherent in the valve assembly.

The valve actuator design shall be such that it will allow in-situ installation of required accessories such as the air set, limit switches, positioners, solenoid valves, air pressure regulator, and position indicator/feedback etc. The modulating valves shall be provided with Pneumatic Positioner. The actuators shall have a visible indication of the valve position, to facilitate operator's assessment of valve position.

The actuators shall be as small and compact as possible so that when connected with the valves, the valve cum actuator assembly would be accommodated within the dimensional, volumetric and weight limits as specified in Annexure-1.

The materials of various components have to be selected in such a way to meet the requirements and the approval of ITER-India is mandatory. The pneumatic actuator shall be stiff enough to maintain the valve stem position when the unbalanced forces on the plug changes suddenly. The force necessary to compress the actuator spring a distance equal to 100% of the valve stroke, under bench conditions, shall be large relative to the unbalanced force on the stem when the plug is subjected to the maximum differential pressure. The Contractor shall submit required calculation for the same.

The cylinders shall be capable of utilizing the instrument air supplied to give full travel of the air piston from fully close to fully open. The design of the piston operator linkage shall utilize the optimum mechanical advantage to ensure positive positioning of the valve from open to the closed position. The piston cylinder shall be sealed against leakage when the piston is in any position. Actuators shall be provided with self-lubricated piston rings and stem seals. The piston shall be

adequately supported to provide direct linear-motion. Orientation of the piston operators with respect to flow direction through the valve or to adjacent space limitations shall be subject to IO's approval. The actuators shall have a visible indication of the valve position, to facilitate operator's assessment of valve position.

The maximum opening and closure times of valves shall be 30 - 40 seconds and Contractor shall provide Cv curve for each valve.

The actuators shall be designed per guidance from EDH Part 4: EMC to minimize the induction effects within the various components of the actuators.

Whenever the possibility of aerodynamic noise in a control valve exists under any operating condition, the contractor shall select a special equipment for that application to limit the noise less than 85dB.

7.1 Actuator Gearing

The actuator gearing shall be totally enclosed within the oil-filled gear case suitable for operation at any angle. Grease lubrication is not permissible. All gearing must be of metallic construction, preferably made of die cast aluminum alloy. The design shall be such as to permit the gear case to be opened for inspection or disassembled without releasing the stem thrust or taking the valve out of service.

7.2 Actuator Housing

A means for safely hoisting the actuator, either separately or assembled to the valve, shall be provided. Lifting lugs or areas where straps may be secured without damaging any of the components on the actuator housing or valve will be considered acceptable.

7.3 Actuator Shaft and Bearings

The actuator shaft shall be of a noncorrosive material, preferably alloy steel and shall be securely fastened to the valve shaft in a manner such that there is no possibility of play, misalignment, or other undesirable characteristics occurring between the actuator and valve shaft and disc assembly. An external replaceable shear key shall be provided.

The shaft bearing shall be lifetime self-lubricating bearings of the sleeve type.

7.4 Actuator Yoke Design

The valve actuator yoke design shall be such that it will accept installation of required accessories such as the air set, limit switches and position indicator. The yoke material shall be austenitic stainless steel.

7.5 Junction Box

Junction box shall be mounted on actuator with all electrical connections from Smart Positioner as well Limit switches. Junction box shall be interface point between the supplier and client for electrical

connections. Junction Box shall be IP67 as per IEC-60529. Gasket material shall be EPDM/PEEK, Teflon is not acceptable. Junction box should consist of following parts but not limited to Terminal block which comprises terminal strips for cable connections, breather/drain plug, cable entry with cable glands, PE conductor termination, mounting rail complete with end bracket etc. Junction box shall be qualified for Electromagnetic compatibility (EMC) Directive 2014/30/EU.

7.6 Limit Switches

The limit switches shall be electrically compatible with the IO control power parameters provided in the Plant Control Design Handbook section 4.5.5 [39]

Limit switches shall be mechanical type instead of microswitch so that their operation is not affected by magnetic field. The switches shall be enclosed in weather proof enclosures conforming to IP-65 requirements as per ANSI/IEC-60529. Limit Switches shall be qualified for Electromagnetic compatibility (EMC) Directive 2014/30/EU. The limit switches shall, as a minimum, meet the qualification standards of IEEE-323 [17], IEEE-344[18] and IEEE-383[20]. Qualification of limit switches shall encompass the environmental parameters and operating requirements specified in the valve specification sheets.

The mounting of the limit switches or limit switch actuating mechanism shall be such as to permit smooth, continuous adjustment and exact fixing of the switch actuating point. The design of the actuating mechanism shall permit the adjustment of switch over travel without disturbing the valve. The limit switch should be rigidly mounted on the valve such that it does not get disturbed by pipe line vibrations. Control input for limit switches shall be 24 V DC.

Contact wiring details shall be shown in the manufacturer's drawings in the form of detailed wiring diagram.

7.7 Pneumatic Positioner

Digital (smart type) pneumatic positioners (with 4-20mA analog feedback signal) with diagnostic capability and HART compatibility shall be supplied with modulating type of valve for positioning the disc of valve to control the flow. The environmental protection for the pneumatic positioner shall be IP65 as per ANSI/IEC-60529. Position Transmitter and I/P converter shall be inbuilt in pneumatic positioner.. All positioners shall have metallic casing and cover either of stainless steel or of anodized aluminium. The Contractor shall demonstrate that the selected positioner's function is unaffected by the magnetic and radiation field, otherwise the Contractors shall provide solution with alternative approach.

7.8 Solenoids valves/ Piezo valves

The solenoids / piezo shall be electrically compatible with ITER power supply parameters as specified in the specifications. The solenoids / piezo shall be enclosed in weather proof enclosures conforming to IP-65 requirements as per ANSI/IEC-60529. The solenoids shall, as a minimum, meet the qualification standards of IEEE-323 [17], IEEE-344[18] and IEEE-383[20]. Qualification of solenoids shall encompass the environmental parameters and operating requirements specified in the

specifications. This valve should allow the override control by safety system to close Process valve in event of safety risk. Pneumatic schematic shall be designed for this operation. The Contractor shall demonstrate that the selected solenoid/piezo valve's function is unaffected by the magnetic and radiation field, otherwise the Contractors shall provide solution with alternative approach.

7.9 Position Indication

The position indication of the valve shall be designed such that components of the indicating means cannot be assembled to falsely indicate the valve open or closed position.

7.10 Compliance to EU Directives

All the electrical / electronic components shall be qualified for Electromagnetic compatibility (EMC) Directive 2014/30/EU as well as any other applicable directives from section 4.

7.11 Miscellaneous items

The accessories include, but not limited to limit switches, air-lock relay, pneumatic positioners, lifting lugs, required air tubing & fittings, etc.

8 Load specifications

The Various symbols and the characteristic loads as shown in Table 1

Symbol	Load case	Characteristic loads
P	Pressure Load	Refer Annexure-1
Dw	Dead Weight	Gravitational acceleration: $g = 9.81 \text{ m/s}^2$
T	Temperature Load	Refer Annexure-1
T_{env}	Environment Temperature Load	$5 \leq T \leq 40^\circ \text{C}$
FIRE	Fire - Minimum Environment Temperature [°C]	$T_{\text{fire}} = T_{\text{design}} + 140^\circ \text{C}$
PL	Piping loads	Shall be provided
P_{test}	Test Pressure	As per requirement and applicable code
D_{test}	Test dead weight	Fluid density = 1000 kg/m^3 and Gravitational acceleration: $g = 9.81 \text{ m/s}^2$

Table 1: Symbols & characteristic loads

The load combination for valves is as given in Table 2. SL-1, SMHV, SL-2 and SL-3 can be replaced with uniform simultaneous 4g static loading in all three direction in a conservative way.

Service Level	Event Category	Load Combinations	Number of Cycle
As per Table 3	I	P + Dw + T + PL	30000
	II	P + Dw + T + SL-1+ PL	50
As per Table 3	III	P + Dw + T + SMHV + PL	10
As per Table 3	IV	P + Dw + T + SL-2+ PL	10
		P + Dw + T + SMHV + FIRE + PL	1
As per Table 3	V	P + Dw + T + SL-3 + PL	1
		P + Dw + T + SL-2 + FIRE+ PL	
Hydrostatic Test		P _{test} + D _{test}	10

Table 2: Load specifications for valves

ITER loading conditions are categorized into four classes based on the expectation of occurrence as below:

- Category I: Operational / Loading Conditions
- Category II: Likely Loading Conditions
- Category III: Unlikely Loading Conditions
- Category IV: Extremely Unlikely Loading Conditions

Other events or events combinations that are beyond design basis may be classified in an additional category (category V).

Table 3 indicates the relationship between Load Combination Category (loads and likelihood categories) and acceptable damage limit as a function of the component safety class (SIC and HCC) and these applicable damage limits need to be considered while carrying out the analysis.

Loading Category		Category I: Operational / Design Loading	Category II: Likely Loading	Category III: Unlikely Loading	Category IV: Extremely Unlikely Loading	Category V: for HCC BDBA	Test Loading
Valves Function: Integrity + Operability + Seat Tightness	SIC-2 and HCC	Normal	Normal	Normal	Normal	Normal	Normal / Test
Valves Function: Integrity + Operability	SIC-2	Normal	Normal	Upset	Upset	N/A	Normal / Test

Where:

- Normal is equal to Service Level A
- Upset is equal to Service Level B
- Emergency is equal to Service Level C
- Faulted is equal to Service Level D

Table 3: Damage limits for loading categories

9 Qualification requirements

The contractor shall prepare a qualification program showing details of how the valves will be demonstrated to be able to perform their functions in accordance with qualification requirements. Based on their industrial experiences, also made in other nuclear projects, the contractor can propose a plan to reduce the repetition of the effort based on similarities of the valves dimensions/assemblies. Qualification Program shall be available for review and acceptance by the ITER-India as it represents a Hold Point (HP). In order to complete qualification program, the Contractor may involve third party expertise, testing facilities and/or qualified laboratories which shall be reviewed and accepted by ITER-India.

This Qualification program shall at least include the following items:

- The list of analyses and, the list of tests;
- The list of software and methods used for the analyses, the applied codes or standards for the analyses and, test;
- The Acceptance Criteria.

The primary objective of qualification is to demonstrate with reasonable assurance that the valve bodies and valve actuators for which a qualified life or condition has been established can perform their function without experiencing failures before, during, and after applicable events. Valves and actuators, with their interfaces, must meet or exceed the requirements of this specification. The specific service conditions and qualification requirements are included Annexure-1 of this Specification.

Valves and actuators shall be qualified considering specific requirements with regards to:

1. Radiation aging, End of Life Radiation Dose at valve location;
2. Magnetic field - Electro Magnetic Compatibility (EMC), Magnetic Field Modulus at valve location;
3. Seismic loads. Valves shall be qualified to be maintain its integrity, seat tightness and failure mode during and after the event;
4. Cycling. Total number of cycles to age the valve;
5. Fire: High temperature event to demonstrate its functionality;

This qualification program shall address all load conditions as listed in table-2, as applicable for analysis.

The qualification by analysis alone cannot be used to demonstrate the intended performance and functionality, so required testing also needs to be conducted to qualify.

The Contractor should also provide the recommendation related to the maintenance and future surveillance plan for the qualified items.

The manufacturing & test procedures shall also include the NDT control procedures, approved by qualified personnel as per ASNT NDT Level-III/ISO 9712:2012 Level-III, the NDE performing personnel shall be qualified as per ASNT Level-II/ISO 9712:2012 Level-II, the material certificates, the calibration certificate of the measurement equipment and the valid software licence.

The contractor shall define or confirm that the valve geometry/characteristics and the specific design solution adopted for the requested functions in normal operations (e.g. for isolation scope (on/off),

flow control (Cv characteristic), overpressure control and reverse flow control). In abnormal conditions, the contractor shall confirm these following functionalities for the valves:

- Valve Seat tightness: it is defined to ensure that, leakage rate through the valve seat during and after the accident.
- Valve Operability: it is defined to ensure that the valve is able to open or close during and after the accident.
- Valve Functional Capacity: it is defined to ensure that the valve is able to provide its functional capacity such as providing the relevant cooling flow rate during and after the accident.
- Valve Integrity: it is defined to ensure that the valve will not collapse and confinement/leak tightness with the pressure boundary (external confinement) is ensured during and after the accident. As minimum, the integrity of the valves shall be demonstrated

The complete qualification process along with the procedures (analysis & test) need to be submitted by the contractor for the approval of ITER-India.

9.1 Qualification by analysis

The object of these analyses is to demonstrate that the integrity and the mechanical/structural stability of the valves all-inclusive of the pressure retaining parts as well as of the actuators (manual wheels and pneumatic) and the accessories (limit switches, positioners/indicators, servo-valves etc.) in normal, failed/accidental conditions as per the load, combinations and conditions shown in the Table 2

The analyses shall be performed by proper FEM/FEA calculations according to the Load Specification and procedure established in [68] [69] [71]. In particular, the analyses shall demonstrate the margin of resistance to the allowable limit according to the applicable code for each load combination. Main codes and standards used for ITER mechanical components are defined in [70]. The allowable limits shall be used from ASME Section III Division 1, Subsection NC [33]. In particular, the analyses shall identify the stress/deformation/displacement of the full valve assembly as well as on the single valve components (e.g. valve body, bonnet, stem, seat, disc and the main parts of the actuators/accessories).

The analysis reports of the valves' Qualification shall indicate the FEM procedures/meshes and methods and the load combination adopted for the FEA analyses and the relevant results both in graphical and tabular forms.

The valve(s) shall be made to withstand an equivalent simultaneous seismic static loading, as described in the Load Specification. The load shall be applied at the center of gravity of each component or part. Appendages shall be considered as separate pieces of equipment, mounted in place, for analysis and design. The allowable working stress range of materials involved will not be increased for the required seismic loadings. The methodology for seismic qualification of valves can be obtained from ASME QME-1. The Contractor shall prepare and submit an analysis report in the template that would be provided by ITER-India. The Contractor shall be responsible for submitting analysis reports for per size per class.

9.2 Qualification by testing

In addition to the qualification by analysis, the Contractor is required to carry out experimental tests which are needed to complete the qualification of the valves. These tests shall be performed on proper test rig with the main aim to confirm and/or to validate the theoretical qualification by FEM/FEA and also to qualify to the environments and the accidental scenario, for which these valves are designed and qualified design life shall be demonstrated. The Contractor shall prepare Qualification Plans for each test to be performed to demonstrate the intended functions.

9.2.1 Environmental Qualification

The Contractors shall consider in the preparation of the qualification plan the aging effect due to environmental conditions, the possible cycling §5.8 or any other accidental conditions that could happen conservatively on the last day of ITER operation life when the PIC/SIC equipment is aged. In fact, the component degradation with time due to the exposure to environmental extremes conditions (e.g. temperature, pressure, humidity, radiation, vibration and, if applicable, magnetic field, low temperatures and submergence resulting from a design basis accident conditions) can generate a common-cause failures of the relevant PIC/SIC equipment.

An environmental qualification of the non-metallic components of valves shall be performed at the bounding environmental conditions, to evaluate the function of the valve component whose failure could prevent the valve from performing the intended function. The qualification shall meet the requirements of ASME QME-1. The material environment capabilities shall be identified, including references to the verification documentation. All the ageing tests shall be performed before the accidental tests (e.g. seismic, fire).

9.2.2 Seismic Qualification by testing

Load Specification for Cooling Water System located in B11, B13, B14, B15 and annex, B21, B23, B24, B37 and annex, B74 (ITER_D_XLTXGR)', 'Load Specification (LS) (ITER_D_222QGL)' and 'Technical Specification for the Experimental Seismic Qualification of Active Electrical and Mechanical Components (ITER_D_AGL2QP)' shall be the basis for seismic design of the valves.

Since the valves have to remain intact to keep their safety functions before and after seismic events, the valves have to be tested in a seismic experimental test rig (i.e. shaking table) by establishing the seismic conditions. The test shall be carried-out on the full valve assembly (valve body plus actuators and accessories as limit switches, positioners, servo-valves etc.) to assess the integrity, Operability, Seat Tightness and Functional Capacity after the seismic event. The aim of the test is to ensure, and to validate what has been assessed by the theoretical analysis, that the maximum bending on the stem, the maximum deformations on the disc and/or seat rings, are within the elastic limits to do not jeopardize the function of operability (on/off or the flow control) including the seat tightness. The reference acceleration for seismic qualification is 4g in simultaneously all three direction.

The Contractor shall propose the detailed experimental test and the valve arrangement on the test rig, the test procedures and the sequences for the objectives: Operability, Functional capacity, Structural

Integrity and Seat Tightness requirements shall be certified and compared before and after the test on shaking table up to 4 g and shall meet the acceptance limits defined in this specification.

9.2.3 Weak Link Analysis

A weak link analysis shall be performed on the valve and its various components to determine the maximum loads they can be subjected to. The analysis will review each component in the valve to determine the maximum load the weakest component can safely sustain. All weak link analyses shall use the same coefficient of friction (COF). Weak link evaluation shall distinguish between torque and thrust limitations.

9.2.4 Qualification under electromagnetic and radiation condition

Special consideration shall be given to the selection of components which age faster under radiation, like rubber parts & gaskets, and which has severe impact on functionality under radiation and/or magnetic field, like solenoid valves, relays, electronics etc.

The valve & components shall be subjected to the suitable qualification tests for Magnetic field and Radiation Conditions as given in Annexure-1.

9.2.5 Fire Qualification by testing

The fire experimental test rig shall follow the test arrangement mentioned in ISO 834, ISO 10497 and the temperature value indicated in the Table 1. The aim of the test is to check the Structural Integrity of the valve body, the Operability and the Seat Tightness. The Structural Integrity and the Operability shall be checked only on the valve body after this fire test in the nominal (open or closed) condition without the actuator. In particular, for the Operability, the valve shall be unseated from the closed position and moved to the fully open (or vice versa) positions recording any variation of the load and/or torque applied. The Seat Tightness shall be checked on both through-seat as well as for any external leakage during the burn and after the cool-down period. The maximum allowed leakage shall respect the limit reported in the Table 1 of ISO 10497. In particular, the valve body shall be able to keep its integrity during and after the postulated fire event which is defined as the ISO-834 standard fire curve applied for 2 hours time.

The valve body shall be able to maintain its integrity during and after being heating at 'Design temperature + 140° C', for 2 hours. An upper deviation of 10% is acceptable. Instead of exposing directly the valve body to the flames, it is possible to wrap the valve body with cloth made of fire insulation material and heat it up with a resistance wire. The burn period is set at 2 hours. According to ISO-10497:2010 clause 5.6.4, the test pressure is set at 75 % of the maximum allowable seat pressure at 20 °C (high pressure test). The tolerance on all test pressures is $\pm 10\%$. The test pressure is maintained during the burn and cool-down periods, momentary pressure losses of up to 50 % of the test pressure are permitted provided that the pressure recovers within 2 min and the cumulative duration is less than 2 min.

The leakage through seat and external leakages will be measured during burn and cool-down period. The maximum allowed leakage will be as per ISO-10497:2010. After the fire test, the valve shall be unseated from the closed position and moved to the fully open position. The failure of the valve to operate at manufacturer's published torque value means failure of the fire test.

The Contractor is required to prepare the detailed procedure for the approval of ITER-India for carrying out the test conforming to ISO-10497:2010 with some specific required adaptation so that all the valves sizes are covered according to similarity. The Contractor shall provide the design of passive fire protection of the valves as per inspectability and maintainability requirement.

9.2.6 Prototype/Reference Testing

The Contractor shall perform the prototype test/reference test for seismic, cycling, radiation, magnetic and environment qualification as per this specification on the selected size of the valves depending upon the similarity principle as defined in IEEE-344, IEEE-382 and ASME QME-1. A valve will be considered similar to another when they share similar:

- Technology (material, size, shape, actuation);
- Operational conditions (aging mechanism, loads);
- Potential risk and management of that risk (function, functionality, etc.).

According to RCC-M Section VI RPP-4 Volume-Q [35], suggested size for prototype testing is DN300 class 600 with scotch yoke actuator modulating type control valve. Suggested size and type for prototype test is for indicative purpose only, the Contractor can suggest alternative size and class with proper justification as per their experience and knowledge subjected to approval of ITER-India/ITER-IO. Selected valve/s for prototype test shall be additional one/s than required quantity as indicated in Annexure-1. The Contractor shall handover the tested prototype valves assemblies to ITER-India.

The steps in prototype testing shall be completed in a sequence that places the sample in the worst state of degradation that can occur in service during the qualified life as indicated in IEEE-323 [17] and IEEE-382 [19]. All steps in the sequence shall be performed on the same test sample. The test sample shall be representative of the same design, materials, and manufacturing process as the installed equipment.

During the prototype/reference test, to achieve the qualification, the record of modification brought to the valve, actuator, accessories etc. shall be maintained in the reference file. The reference file is made up of documents corresponding to the qualified state of the equipment in order to ensure the conformity of the standard equipment to the prototype/reference equipment. The Contractor shall be responsible for ensuring that any modifications made to the prototype/reference model (valve+ actuator along with accessories) to achieve the qualification are seamlessly integrated into all the valves listed in Annexure-1 and shall be from same manufacturer specially for actuator and its accessories.

The contractor shall also maintain a qualification preservation sheet to inform the operator, manufacturers and installer/fitters about all the instructions and recommendations resulting directly

from the qualification process so that qualifications granted for accident conditions are guaranteed in the long term during the installation, assembly and operation phases.

9.3 Qualification Plan

1. A qualification plan shall be submitted to the ITER-India, for review and acceptance, which provides the procedures, method of analysis, and test setup for all qualification testing.
2. The following elements shall be determined from the qualification plan:
 - a. What tests are to be performed on which equipment and for what purpose.
 - b. What analyses are to be conducted on which equipment and for what purpose.
 - c. The sequence in which the program is to be conducted.
 - d. The acceptance criteria to be employed.
3. The following major points must be addressed in the Qualification Plan:
 - a. Purpose
 - b. Scope
 - c. Test Lab facilities details
 - d. Equipment Description
 - e. Function
 - f. Qualified life objective or design life
 - g. References
 - h. Service Conditions
 - i. Aging technique with justification
 - j. Margins
 - k. Qualification Test Program
 - l. Acceptance Criteria
 - m. Quality Assurance
 - n. Qualification Test Report, and documentation to be maintained
4. The qualification plan must also include a technical justification for the adequacy of the test specimens selected to model the full range of equipment configurations to be qualified; this may be accomplished by a reference to a separate document.
5. The qualification plan shall include provisions for test inspections at pre-determined points of the test sequence.
6. The qualification plan shall be submitted to the ITER-India, for review and acceptance, before any qualification activities are undertaken.
7. Any of the qualification reports prepared as part of this program shall be available for review by the ITER-India and shall be included in the final report. The final report shall be prepared and submitted to the ITER-India for review and acceptance. It shall provide evidence of the qualification of the valve/actuator and shall cite any precautions, restrictions, proprietary data, or limitations which must be accounted for by the ITER-India in order to maintain the qualified status of the valve/actuator.

9.4 Qualification Procedures

These procedures, coupled with the qualification plan, shall form a complete picture of the program to be conducted and activities to be performed. The procedures shall be prepared by the Contractor, are an integral part of the overall program, and shall provide for the following:

1. Complete identification of all equipment to be qualified (tested and/or analysed), including type, make, model, model family, manufacturer, number of test specimens, etc.
2. Pre Test activities/inspection on equipment and specimen in order to check assembly condition, operability status, leak tightness, prior to starting the test.
3. Complete test setup requirements, including:
 - a. Mounting arrangements, including test specimen orientation
 - b. Interface simulation of the test items to the actual field installation
 - c. Connection requirements
 - d. Power applied to the test items
 - e. Monitoring and recording instrumentation
 - f. Required test specimen settings or adjustments
 - g. Acceptable ambient environmental parameters for the test
4. Identify the equipment parameters to be monitored and recorded, and the method of connecting the monitoring and recording equipment.
5. Identify the environmental parameters, including margin, to be monitored and recorded, and the methods to be employed.
6. Identify any assumptions used and provide suitable justification for their use.
7. Identify the parameters to be simulated during the test and identify the range, duration, etc., of the test parameters and the method of monitoring and recording.
8. Identify the requirements that the test or analysis is intended to verify.
9. Identify the acceptance criteria that will be utilized to evaluate the results.
10. Indicate the number and identification of test samples to be included in each test.
11. Provide test equipment performance requirements.
12. Identify the sequence in which the test is to be conducted.
13. Identify the method of processing and disposition of failures and anomalies that may occur during testing.
14. Provide step-by-step procedures for conducting the tests.

The qualification procedures shall be submitted to the ITER-India, for review and acceptance, before any qualification activities are undertaken.

9.5 Qualification Reports

Qualification reports shall be prepared by the Contractor. Qualification documentation shall be in accordance with Section 7.2 of IEEE 323 [17]. Each report shall provide the following:

1. Contain the related qualification plans and procedure(s) which serve as its basis.
2. Contain all data required by the qualification effort.
3. Identification of the safety-related functions(s).

4. Contain all analytical methods and models utilized for qualification service and environment.
5. Specify qualification service and environment.
6. Show classification table of components with/without age-related failure degradation mechanisms.
7. Contain justification of aging methods.
8. Contain the acceptance criteria and evidence that report applies to the items tested.
9. Demonstrate successful performance in terms of the acceptance criteria.
10. Report and analyse all anomalies that occurred to provide demonstrable proof that the anomaly does not invalidate the qualification results.
11. Provide historical data or other justification for replacement intervals.
12. Correlation of program information with instruction book/operations manual for maintenance, surveillance, replacement intervals, etc.
13. Contain appropriate Contractor signature(s) and date(s) indicating review and approval of the report, in accordance with approved/accepted QA program.

Any of the qualification reports prepared as part of this program shall be available for review by the ITER-India, and shall be included in the final test report. A final report shall be prepared and submitted to the ITER-India, for review and acceptance that provides evidence of the qualification of the subject equipment and shall cite any precautions, restrictions, or limitations which must be accounted for by the ITER-India in order to maintain the qualified status of the subject equipment.

10 Manufacturing Requirements

10.1 Manufacturing and Inspection Plan (MIP)

Prior to commencement of any manufacturing, a MIP shall be produced by the contractor and subcontractors and approved by the ITER-India and IO. MIPs shall be used to monitor Quality Control and acceptance tests during the execution of the Contract. It should be noted that interventions additional to those required in this Technical Specification may be included on the MIP by ITER-India/ IO.

Work plans and applicable procedures (e.g. material management, marking & traceability, visual & dimensional inspection, heat treatment, welding, hydro-test, performance test, functional test, NDT, cleaning-pickling& passivation, painting, packing & shipping, sub-contractor control etc.) shall be developed by the Contractor for each step of manufacture/operation and the same shall be submitted to ITER-India & IO for review and approval prior to any related work being executed. All testing operations shall be listed in the MIPs and interventions (e.g. HP, W, R, S1/S2) shall be marked by the parties (Manufacturer, ITER-India and IO). PIA shall be identified and marked in MIP.

Manufacturing activities shall be carried out in accordance with the approved MIP produced by the Contractor in accordance with format/template, to be provided to the Contractor. MIP template is enclosed as Annexure-3.

The MIP shall allow the identification of manufacturing operations and interventions by all the parties (e.g. manufacturer, the ITER-India, ITER-IO). Minimum expected key interventions by ITER-India & IO are as follows:

- Approval of design documents and drawings
- Approval of Quality documents (e.g. QP, MIPs, Procedures)
- Material procurement
- Subcomponent procurement
- Material Identification
- Material test certificates
- Welding procedure qualification
- Welder performance qualification
- NDE personnel and procedures qualification (e.g. RT, UT, DPT, VT)
- Qualification testing
- NDE Reports/Films review
- Hydrostatic testing
- Functional and Performance testing
- Visual and dimensional measurement
- Cleaning, painting, pickling & passivation
- Marking
- Non-conformance handling
- Marking and Packing
- End of manufacturing report
- CE marking and declaration of conformity
- Release Note

These control points shall be indicated and applied by ITER-India & ITER-IO in the MIP that will be mutually agreed and approved by ITER-India & ITER-IO. However, such inspection, examination and testing by ITER-India shall not release the contractor from his obligation under this Contract.

A Notification Point (NP) is a milestone where the Contractor is required to notify the ITER-India/IO, that it has completed a specific task or a specific deliverable and is proceeding to the next task or to the next action on the specific deliverable. A NP is meant to enable the ITER-India/IO personnel to follow the progress of the Contract and possibly to witness a critical manufacturing step at the Contractor's premises. The Notification shall be sent by the Contractor to the ITER-India/IO at least 10 working days prior to the scheduled manufacturing step. The ITER-India/IO shall decide whether or not they want to attend. A NP shall not affect the production flow of the Contractor that shall continue the work even without a reply from the ITER-India/IO.

A Hold Point (HP) is a milestone where the Contractor is required to notify the ITER-India/IO, that it has completed a specific task or a specific deliverable and must stop the associated processes until a HP Clearance is issued. The HP Clearance shall be issued on the basis of clearly identified Quality Control and data and Acceptance test results to be provided to the ITER-India/IO at the time of the request. The ITER-India/IO shall have a maximum of 5 working days to review the Contractors data and to notify the Contractor of its decision. In case of clearance the Contractor shall resume its activity. In case of rejection, the Contractor shall develop a recovery plan that shall be submitted and reviewed by the ITER-India/IO within 10 working days of submission.

A Witness Point (W) is a milestone which identifies an operation to be witnessed. Adequate notice shall be given to the ITER-India/IO, in order to allow the ITER-India/IO to participate to the operation.

Review point (R) identifies a document or report to be reviewed.

Manufacturing Readiness Review (MRR) shall be conducted as per the IO procedure “Working Instruction for Manufacturing Readiness Review (ITER_D_44SZYP).

The Contractor shall procure and ensure the quality of all materials and tooling required to manufacture the valves

10.2 Manufacturing Readiness Review (MRR)

The MRR, “Working Instruction for Manufacturing Readiness Review (ITER_D_44SZYP)” will be conducted and upon successful completion of the MRR, the manufacturing clearance will be granted to the contractor. The following are the pre-requisites to hold MRR.

- The engineering deliverables (Manufacturing Design and Analysis) like Manufacturing drawings (parts, subassemblies, general arrangement), Design analysis reports and calculations per the standard and Specifications for parts are approved
- The following are ensured
 - Manufacturing environmental conditions meet product technical requirements (e.g.temperature, humidity, cleanliness class, ventilation, segregation from other material, etc.).
 - Production materials used for the Contract are correctly procured, qualified, inspected and stored. Compliance with contractual requirement is confirmed and all material (raw, finish goods, nonconforming product, etc.) are well controlled in production line.
 - Appropriate procedure/system for assuring material identification and traceability.
 - All products designed for manufacturing shall be designated with type reference codes.
 - Personnel who work on delivery of the Contract have been trained and evidence that requirements, as imposed through the contract documents, are understood is available.
 - Personnel are qualified as may be applicable. In particular the qualified operators for special process (e.g. welding, heat treatment, NDE, surface treatment) are available and sufficient number of resource is allocated.
 - Machines, jigs, measuring and testing equipment used for the Contract are qualified and valid for usage, e.g. the equipment list is in place, the maintenance plan is established, the calibration is kept valid, etc.specific manufacturing processes (e.g. heat treatment, welding, coating, cleaning, bending, forming, etc.) have been qualified as may be applicable.
 - Check documents relevant to the Contract are approved or accepted by IO as may be applicable (e.g. Quality Plan, the MIPs, manufacturing procedures, the work instructions, manufacturing drawings, etc. including all changes affecting the component).
 - Check documents stating compliance of manufacturing processes, facilities and personnel (including applicable approval and qualifications) and whether manufacturer has capability to ensure quality of product within required schedule.

- Check documents describing packing, packaging, transportation, handling and protection
- Check relevant documents detailing installation and maintenance and particularly specific tooling and spares when needed.
- Check Planned Delivery List describing all items or groups of items to be delivered.

The following documents need to be submitted by the contractor before MRR,

- Engineering
 - Manufacturing drawings (2D) and models (3D) tagged/identified appropriately
 - Assembly drawings at the shop
 - Parts and Material list
- Manufacturing/ material management
 - Manufacturing and Inspection Plan
 - Material procurement technical specification and sub-orders (including e.g. consumables whereas applicable)
 - Identification and control of material
 - Material certificates
 - Material traceability procedure
 - Storage conditions
 - Handling procedures
 - Manufacturing procedures including special processes (e.g. machining, forming, wiring, brazing, soldering, welding, cleaning, heat treating, others and non-destructive examination, etc.).
- Test methods
 - Factory acceptance test program identifying all factory acceptance tests as defined at design stage and including details on extent of the tests, type, examinations and inspections of the Items (verification of requirements for acceptance stage)
- Quality Acceptance
 - Quality Plan
 - List of Suppliers/Subcontractors and their scope
 - Suppliers and Sub-contractors Quality Plans
- Tooling
 - List of machines, test equipment and tools including relevant calibration protocols: the calibration status and records of the machines and tools
 - Measuring and test equipment qualification and maintenance
 - Requirements regarding special tooling / spares and any special pieces of equipment or tools needed for packaging, handling, storage, transportation.
- Training and qualification
 - List of qualified welders, welding equipment operators and NDE personnel with supporting evidence
- Transportation and preservation
 - Packing and packaging description
 - Planned delivery list
- Installation and maintenance plans

10.3 Manufacturing Control

During the Manufacturing phase of the contract, the ITER-India & IO shall conduct oversight of the production of the Contractor (and Subcontractors) using quality surveillance as per approved MIP. This monitoring includes Control Points at critical steps in the contractor's plans. The control points shall be integrated into the agreed detailed Schedule for the contract.

The contractor shall complete the relevant entries in the MIP (e.g. test report numbers, dates, signatures, etc.) as the work progresses. Should there need to be a change to the Quality Plan or MIP during Manufacturing, the Contractor shall re-submit the plans for IO/ITER-India re-acceptance. The procedures like welding and weld repair procedures, heat treatment procedures, etc. need to be submitted for the approval of ITER-India.

10.4 Material Requirements

All materials shall conform to the requirements and specifications.

All material shall conform to the Essential Safety Requirements of the PED/ESP.

Mercury shall not be used in any manner, including construction of the valve, which can result in exposure of valve parts to the metal or its vapour. The use of lead or other low melting point metals in contact with the working fluid is prohibited. The use of nitrated surfaces exposed to the working fluid is prohibited. Care shall be taken to prevent contamination of valve material by red lead-graphite-mineral oil, molybdenum disulphide lubricants, halides, sulphur, copper, zinc and phosphorus. Teflon and similar elastomers may not be used. The use of Halogen products is prohibited. The use of materials containing asbestos or PCBs shall be prohibited.

10.5 Welding

The details for the welding end preparation for valves shall be in accordance with ASME B16.25 with the tolerances for the inside and outside diameter conforming to ASME B16.34 para. 6.2.1.

The welding and heat treatment of welds shall be performed in accordance with ASME B16.34 para 2.1.6(b).

Examination of castings which are repaired by welding shall be carried out as per provisions of ASME B16.34. Weld repairs of castings shall be carried out with prior approval of ITER-India.

10.6 Surface Preparation Requirements

The selection, qualification, and application of coating materials shall be in accordance with applicable sections of the Steel Structures Painting Council (SSPC) specifications. All coating systems must be applied in accordance with the supplier's recommendations. The blast-cleaned surfaces shall be coated with the base coat within four hours after blasting and before rusting occurs.

The contract shall comply the requirements of 'Technical specification for coating and tagging' [62].

All surface preparation and painting work (including colour) shall be subject to the approval of ITER-India.

11 Quality and Safety Requirements

Quality Requirements shall be in accordance with the “ITER Procurement Quality Requirements ITER_D_22MFG4 v 5.1”. The ITER Quality Assurance Program shall be applied to all the work under this contract, which is inclusive of and integrates the requirements of the INB Order dated 7th February 2012. The contractor and subcontractors carrying out works placed under this Contract shall be in compliance with the QA requirements under the relevant ITER QA classifications as per the requirements of Quality Classification Determination ITER_D_24VQES v 5.2.

The Contractor shall have quality system certified as per ISO 9001:2015 or through equivalent standard. The Quality Assurance System (QAS) of the contractor shall include procedures for control and acceptance of incoming materials. Review, verification and validation of design activities shall be part of the Contractor’s Quality Assurance System. The management of the schedule shall be implemented in the Quality Assurance System. Prior to commencement of work under this Specification, a “Quality Plan” must be submitted for the ITER-India and IO review and approval giving evidence of the above QAS and describing the organization for this work; the skill of workers involved; any anticipated sub-contractors; and giving details of who will be the independent checker of the activities. This Quality Plan shall be produced in line with 22MFMW v4.0 - Requirements for Producing a Quality Plan (ITER_D_22MFMW v4.0). Quality Plan format will be provided to the contractor after the award of contract.

Work shall not start until the Quality Plan is approved by ITER-India. A revised Quality Plan shall be subject to the same acceptance procedure as the original Quality Plan. Work should continue in accordance with the current approved Quality Plan until the revised Quality Plan is accepted.

The subcontractors not performing Critical Quality Activities (i.e. activities that if not performed correctly may affect safety, functionality or reliability) may be exempted from the requirement to supply Quality Plans and Manufacturing & Inspection Plans, subject to agreement by the ITER-India/IO.

The method of carrying out the QA program shall be indicated in the contractor’s quality plan.

The Contractor shall be responsible for and shall perform all inspections necessitated to establish and maintain the quality of workmanship in his works and that of his sub-contractors in order to ensure mechanical accuracy of components, compliance with drawings, identity and acceptability of all materials, parts and equipment.

The overseeing of the quality control operation by ITER-India shall not release the contractor from his responsibility in meeting any aspect of this Specification. The contractor shall be fully responsible for quality with respect to all services, materials, manufacturing, and testing, etc. They shall be

responsible for imposing all technical and quality requirements as applicable to all the fabricator's sub-contractors furnishing hardware or services in accordance with all applicable Specifications.

Contractor shall prepare Risk management plan and Project Risk and opportunity Register (PRR) to comply IO Risk and Opportunity Management Procedure (22F4LE)

Contractor shall provide access to ITER-India/ITER-IO for regular planned quality audits
Documentation developed as the result of this contract shall be retained by the contractor for a minimum of 10 years and then may be discarded at the direction of ITER-India.

11.1 Non-Conformance and Deviation Requests

Non-conformities shall follow the procedure detailed in the IO document: Procedure for management of Nonconformities (ITER_D_22F53X). Non-conforming conditions shall be promptly reported to ITER-India as per the requirements of the procedure, upon identification of the Non-conforming condition. No further work shall be performed until the approval of the proposed disposition of the non-conforming condition from ITER-India. The internal process for management of internal non-conformances shall be done as per the contractor's internal procedure.

All requirements of this Technical Specification and subsequent changes proposed by the Contractor during the course of execution of this Contract are subject to the Deviation Request process described. Deviation requests shall follow the procedure detailed in the IO document: Procedure for the management of Deviation Request (ITER_D_2LZJHB).

11.2 Conformity Assessment

The conformity assessment shall be carried out by implementing the procedures and demonstrating the requirements of Pressure Equipment Directive (2014/68/EU).

11.3 Safety Requirements

ITER is a Nuclear Facility identified in France by the number-INB-174 ("Installation Nucléaire de Base"). The Contractor must comply with the all requirements expressed in Reference [26] for each requirement, the external intervener must explain in its quality system the dispositions taken to implement the requirements stipulated.

These valves support the safety function of confinement of radioactive material, and are therefore classified as Protection Important Component (PIC). Any activity related to the design, manufacture, testing, cleaning, packaging and delivery that can affect the components is identified as a Protection Important Activity (PIA).

For PIC and in particular Safety Important Class components (SIC), the French Nuclear Regulation must be observed, in application of the Article 14 of the ITER Agreement.

Under the French Order of 7th February 2012 (the "INB Order") which establishes the general rules for licensed nuclear installations, Contractors and Sub-contractors must be informed that:

1. The INB Order applies to all protection important components and the protection important activities.
2. Compliance with the INB Order must be demonstrated in the chain of external Contractors.
3. In application of article II.2.5.4 of the INB Order, the Nuclear Operator (IO) shall undertake supervision of activities undertaken by external interveners (The Contractor and sub-contractors). Surveillance by the Operator (ITER-IO/ French regulator) shall be enabled through the provision of access to the Contractor's workshop and all necessary documentation.

The supplier/contractor must comply with all the requirements expressed in document 'Provisions for implementation of the generic safety requirements by the external interveners (SBSTBM).

12 Inspection and Testing

The contractor shall conduct all tests required to ensure that the material conforms to the requirements of applicable codes and this specification.

Inspection and Testing shall be carried out as per Manufacturing and Inspection Plan (MIP) duly approved by ITER-India. ITER-India and/or his authorized agencies shall have full access to Contractor's premises at all reasonable times to the extent necessary to assess the compliance with the provisions of this specification.

All the test procedures including NDE procedures, hydrostatic body and seat test procedures, air leak body and seat test procedures, leakage test of, static and dynamic performance test procedures for control valves need to be submitted to ITER-India for approval.

Instruments used for conducting tests shall be calibrated. Calibration certificates shall be furnished from a recognized institution. The calibration shall have been carried out not more than six months prior to the testing date.

In the event of failure of a valve or any part thereof to meet fully the examination or test requirements specified herein, the Contractor shall obtain permission from ITER-India before repair or subsequent use of such valve or part. If the repair including redesign are likely to affect the results of tests or work previously completed, appropriate re-examination and re-testing shall be conducted.

The Contractor shall notify well in advance the date by which the valves will be ready for final inspection. Shop examination and inspection by ITER-India shall not relieve the Contractor of his contractual responsibility of furnishing valves in compliance with this specification and meeting specified guarantees.

All tests shall be carried out by an ISO 17025 accredited laboratory.

The Inspection and testing shall comprise of but shall not be limited to those specified in this specification. Each valve, its components and auxiliaries must be subjected to all mandatory tests and checks called for in the respective codes.

12.1 Material tests

All materials designated in accordance with ASME/ASTM standards, shall be subject to mill tests for chemical and physical properties as required by such standards.

Certificates (test reports) showing that required tests have been carried out at the source should be submitted; and if such certificates are not available, the tests shall be performed by the Contractor at his own cost.

All components machined or fabricated from plate, sheet or stock shall meet the material requirements of ASTM or Material Specification approved by ITER-India.

Tensile testing will be undertaken at ambient temperature and at the relevant design temperature.

Certificates (test reports) showing that required tests have been carried out at the source should be submitted. Minimum of Type 3.2 certificate as per EN 10204 shall be provided for materials.

Material test reports for both heat and product shall be provided.

12.2 Impact and Tensile Testing

Mechanical properties shall be tested from test specimens that represent the final heat-treated condition of the material required by the material specification. Unless other values are required in accordance with other criteria that shall be considered, a material is considered as sufficiently ductile if, in a tensile test carried out by a standard procedure, its elongation after rupture is no less than 14 % and its bending rupture energy measured on an ISO V test-piece is no less than 27 J, at a temperature not greater than 5 °C.

ISO-148-1:2016 [34] for tensile and impacting testing shall be used.

12.3 Hardness Test

Shore hardness test of the rubber parts used in the valve, shall be carried out and certificate of compliance for the rubber components shall be submitted. Shore hardness value shall be Shore-“A” Hardness 70+/-5.

12.4 Shell leak Test

Shell leak test shall be conducted on each valve in accordance with the requirements of ASME B16.34 Section 7.1. Testing shall be performed prior to any painting or coating of the valves. Stem and Bonnet external leak tightness test requirements shall conform to the requirements of ISO 15848-1 for leak rate as per Annexure-1.

12.5 Valve Closure and Leak Tightness Test

Each valve shall be given a closure test & upstream-downstream seat leak tightness test in accordance with the requirements of ASME B16.34 Section 7.2 and shall conform to the requirement of EN 12266-1 for leak rate as per Annexure-1.

12.6 Disc Strength Test

As these valves are being used as confinement last barrier, hence as per PED requirement valves disc will be act as a pressure boundary. Disc strength test shall be performed to check the structural integrity of disc. Test pressure shall at least 1.5 times of rated pressure. Disc strength test shall be done as per EN 12266-2.

12.7 Testing of actuators

The type tests on actuators as per IEEE 382 shall be carried out as required.

Each actuator must be performance tested and individual test certificates shall be supplied. The test equipment shall simulate a typical valve load and the various parameters including actuator output speed, operating time etc. shall be recorded.

Torque test and actuator housing air leak test shall be carried out on all actuators. In addition, the test certificate shall record the details of specification such as gear ratios for both manual and automatic drive, closing direction, wiring diagram code number etc.

Functioning of limit switches, pneumatic positioners, solenoid valves, and position feedbacks shall be checked and necessary certifications shall also be provided as per applicable codes, standard and directives.

12.8 Hydrotest/Pneumatic test of actuator Cylinder

Actuator cylinder shall be hydro- tested at or pneumatically tested considering maximum supply air pressure mentioned in section 5.8 conforming PED requirements to ensure actuator integrity.

12.9 Combined (valve + actuator) Testing

Each valve shall be tested along with its actuator to check valve seat leakage, and proper functioning of the valve. Opening and closing times shall be recorded. Valve shall be opened against pressure and closed for minimum three times.

All valves shall be subjected to functional qualification test at the design service pressure. Before testing all valves shall be fully calibrated including setting of limit switches, mechanical stoppers, position indication etc. as applicable. During valve operation, the limit switch setting shall also be checked. Operating air supply shall be used with limits. The valves shall be operated with actuator with the help of motive power and performance to be checked.

12.10 Non-destructive Examination

Non-destructive examinations shall be performed on the cast, forged, rolled, wrought, or fabricated material after heat treatment required by the material specification either prior to or after the finish machining if it is indicated in materials procurement specifications. Surfaces shall be clean and free of surface conditions that may mask unacceptable indications. Radiography/Ultrasonic test examination shall be performed as per the clauses below.

12.10.1 Radiography Test (RT)

12.10.1.1 Castings

The radiographic procedures and acceptance standards to be used shall be in accordance with ASME B16.34 para. 8.3.1.1 and Mandatory Appendix I.

12.10.1.2 Forgings, Bars, Plates and Tubular Products

Forgings, bars, plates, and tubular products are radiographically examined in accordance with the procedure and standards in ASME B16.34 Mandatory Appendix I and para. 8.3.2.1.

12.10.1.3 Dye Penetrant Test (DPT)

All exterior and all accessible interior surfaces of bodies, bonnets, and covers shall be given a surface examination. For surface examination, DPT shall be used.

DPT shall be in accordance with the procedure and acceptance standards of ASME B16.34 Mandatory Appendix III,

Following components of a valve shall be subjected to DPT before assembly

- All external and accessible internal surfaces of the pressure bearing parts of the body and bonnet. Where these surfaces have previously been inspected by the manufacturer of castings or forgings, such inspections need not be repeated except in areas which have been subsequently machined
- The complete surface area of valve discs or gates including the facings
- Complete surface area of stem
- All pressure retaining studs, bolts and nuts (examination shall be performed after threading)
- Butt weld edge preparations
- All weld repairs

12.10.2 Ultrasonic Testing (UT)

12.10.2.1 Castings

For castings, ultrasonic examination is performed in accordance with ASME B16.34 Para 8.3.1.3.

12.10.2.2 Forgings, Bars, Plates and Tubular Products

For forgings, bars, plates, and tubular products, ultrasonic examination shall be performed in accordance with ASME B16.34 Mandatory Appendix IV and para. 8.3.2.1. If during the examination, ultrasonic indications are not interpretable due to, for example, grain size, the material shall be radiographed using the procedure requirements.

12.10.2.3 Weld Examination

All fabrication welds of bodies and bonnets consisting of an assembly of welded segments of castings, forgings, and bars, tubular products, or plates, or combinations thereof, shall receive non-destructive examination in accordance with the ASME B16.34 para. 2.1.6(c).

12.10.2.4 Visual Examination

The rubber parts used in the valve shall be visually inspected for any nicks, gouges, cuts, or any discontinuities that may compromise the physical integrity or function of the part. A complete visual inspection of the pressure boundary parts on all valves is required before final assembly and on accessible pressure boundary parts without disassembly after hydrostatic testing. The purpose of the visual inspection is to verify all surfaces are free of cracks, hot tears, arc strikes, prod marks and/or other detrimental discontinuities. All finished welds shall be subject to visual examination.

12.10.3 Wall Thickness Measurements

Wall thickness measurement requirements are supplementary to Code requirements. The Contractor shall submit its procedure and drawings for wall thickness measurements, with the critical dimensions to be measured specified, to ITER-India for approval. Wall thickness measurements shall be performed after machining operations have been completed. As a minimum, the wall thickness shall be measured at 4 points 90 degrees apart on body and on the neck of the valve. Flange thickness of the bonnet and the thickness of the nozzle flanges in the case of flanged-end valves shall be measured at 4 points 90 degrees apart. The Contractor shall take several measurements in a general area, giving special attention to suspect locations and shall record the location of the measurements on the drawing.

12.10.4 Dimensional Inspection

All valves and actuators shall be subjected to dimensional inspection.

13 Cleaning, Protection and Painting

All valves shall be free of mill scale. The inside surface of the valve shall be degreased and then flushed with clean filtered demineralised water. Pickling and passivation shall be done for the stainless steel surface as per applicable codes and standard. It shall be visibly clean, free of sand, dirt and any other foreign matter.

The ends should be properly cleaned and treated with a suitable rust preventive other than grease and then securely fitted with plastic or wooden caps.

The actuators and positioners shall be painted with a coat of paint to protect them against corrosion.

Stainless steel surfaces shall not be painted. All carbon steel exterior surfaces shall be thoroughly cleaned to remove mill scales, rust, grease etc. by wire brushing or sand blasting, and painted as needed.

Carbon steel part shall be painted with RAL-6018 and Actuators shall be with RAL-7032.

A sack containing silica gel desiccant shall be firmly attached to the inner surface on the cover of one end of each valve. The desiccant shall be non-corrosive and shall not liquefy under saturated conditions.

14 Packing, forwarding, delivery and acceptance

The contractor has to prepare the detailed procedures for identification & traceability, Cleaning, painting, paint testing, packing & shipping procedures, etc. and submit to ITER-India for approval. These procedures are to be prepared inline with the requirements given in this specification. The procedure for identification and traceability shall comply with [U344WG]

14.1 Labelling/ Marking

At least following data concerning the valve shall be shown on the valve or on the permanent stainless-steel name plate attached to the valve with stamped or chemical, mechanical, or electrical etched:

1. PO number
2. Valve tag number
3. Valve size
4. Body material
5. Type
6. Service for which the valve is used
7. Primary pressure and temperature ratings
8. Manufacturer's name and address
9. Manufacturer's Serial Number
10. Manufacturer's Model Identification
11. Year of Manufacture
12. Service Description
13. Valve type
14. Applicable data such as pressure, temperature, size, material, etc
15. PNI (part number of ITER to be provided by ITER-India/ITER-IO)
16. CE Marking, if required

At least following data concerning the actuator shall be shown. The actuator name plate may be combined with the valve name plate.

1. Tag number
2. Size
3. Type
4. Air supply pressure (maximum air pressure for operation) for pneumatic actuators
5. Maximum torque setting
6. Actuator type, wiring diagram number/catalogue number, etc.
7. Manufacturer's name, year of manufacture
8. Serial number

14.2 Packing

ITER-India requires the approval of the seaworthy packing procedures before the items are packed. The Contractor shall be entirely responsible for ensuring that the packing is suitable for the mode of

shipment and such inspection will not exonerate the Contractor from any loss or damage due to faulty packing.

All parts shall be properly packed, boxed, gated or otherwise protected for preventing any possible damage during transportation. Following general instructions shall be followed for packing.

- a. The interior of the valve shall be clean and dry.
- b. All exterior finished or machined carbon steel surfaces shall be protected against corrosion with a liberal coating of an approved and easily removable compound. All machined surfaces shall be protected against mechanical damage.
- c. All openings shall be adequately sealed.
- d. The construction and lining of the boxes shall provide protection for their contents. The packaging shall also include adequate cushioning, blocking, bracing, skidding, hoisting and the tie-down provisions. The packaging shall be subject to the approval of ITER-India.
- e. A sack containing silica gel desiccant shall be firmly attached to the inner surface on the cover of one end of each valve.
- f. Accelerometers shall be fitted to the packaging and shall be capable of recording the acceleration along three perpendicular directions up 6g. Contractor shall ensure that packing of the valves in a way that accelerometer reading shall not exceed 3g in all three directions and same will be inspected during site acceptance of valves at ITER site.
- g. All parts shall be properly packed, boxed, gated or otherwise protected for preventing any possible damage during transportation.
- h. The packaging shall also include adequate cushioning, blocking, bracing, skidding, hoisting and the tie-down provisions.
- i. Small openings such as coupling, threadolts, and nipples shall be sealed by use of small light corrosion resistant stainless steel or plastic inserts pressed in and retained with a seal of waterproof tape.

In general, the following guidelines shall be considered by the contractor while preparing the packaging procedure:

14.2.1 Base Pallet and Box:

Metal: M S Tubular Sections fabricated frame made of metal duly painted with one coat of primer and one coat of Enamel Paint for base pallet with sufficient load carrying capacity

Wood: The box shall be made using Pine wood and Plywood of suitable cross section / thickness depending on the goods weight and size. All wood and timber used for packaging is free of bark and visible signs of insect or fungal attack, these shall be complying with International Standards for

Phytosanitary Measures (ISPM) 15. Wood and timber shall be free of any toxic substances that may be harmful to the health of any person coming into contact with the packaging during handling and disposal. Wooden packing material marking with a legible and permanent mark in accordance with requirements of the international standards.

14.2.2 Internal packing

- VCI Bubble/PE Foam and Stretch film on protruding parts
- First Layer of VCI Poly + Aluminum Foil vacuumed
- Second layer of Stretch film wrapping.
- Providing 2"x2" wooden block and lashing belt with 6 mm PE foam to restrained the movement of valve and absorb the shock inside the package or box
- The surfaces are protected suitably using plastic caps with bubble film wrapping

14.2.3 External Packing:

- Third layer of wooden box
- Fourth layer of HDPE Bag on top.
- Fifth layer of Stretch wrapping.
- Polyester Lashing Belt
- Shipping & Handling Marks

Alternate suitable procedures can also be proposed by the contractor and the approval of the same would be at the discretion of ITER-India

14.3 Data/documents to be submitted before shipment

The Contractor shall be required to submit following documents/drawings before effecting the shipment in the form of history docket.

1. Purchase Order and Sub-Order copies
2. Approved as-built drawings
3. Valve characteristics
4. Approved MIPs
5. Approved Procedures
6. Material test certificates and reports
7. NDE reports
8. Radiography films
9. Stress relief Time-Temperature charts
10. Heat treatment charts and reports
11. Welding procedures and Welder's Qualification certificates/reports
12. Hydrostatic (body and seat) test reports
13. Air leak (body and seat) test reports
14. Qualification test reports
15. Performance test procedure and performance test reports with curves
16. Visual and Dimensional reports

17. Cleaning, pickling/passivation & painting reports
18. Spare list and its inspection reports
19. Packing inspection reports
20. Shipping release copies
21. All non-conformance reports and approved deviation requests, if any
22. Guarantee and compliance certificates
23. Installation, Operation and maintenance manuals
24. Preservation plans and procedure

The above documents need to be submitted in one hard copy and four soft copies in pen drives/ hard drives

14.4 Delivery

Delivery/shipping term for the prototype/reference test valves shall be Free Door Delivery to Purchaser's Site.

Delivery/shipping term for main BOQ valves shall be FCA Incoterms (Free Carrier). The Contractor is responsible for safe loading of the supplies on the vehicle of the transporter identified by the Purchaser. The Purchaser is responsible for transportation and ad-valorem insurance of the items upon safe loading on the truck of the transporter. Before the shipment, a Release Note shall be prepared in accordance with the "Contractor Release Note" and approved by the IO. As part of dispatch planning, the contractor has to submit packing list and proforma invoice at least 4 weeks prior to the planned date of dispatch. The contractor should have provision to retain the consignment for a period of 2 months after successful FAT, without any additional cost to the Purchaser, if the need of storage arises.

The following documents will be submitted to IO to logistics.data@iter.org at least 15 working days prior to the planned shipment date

1. Contractor Release Note
2. Packing List
3. Declaration of conformity
4. Equipment Storage & Preservation Requirements details

Formats for above documents shall be provided to the contractor upon award of contract.

Delivery Readiness Review (DRR) as per Working Instruction for the Delivery Readiness Review (DRR) (ITER_D_X3NEGB) will be conducted to validate that IO has the signed release note, Delivery Report, the native-file Packing List, the Storage & Preservation requirements, customs documents, and/or any other technical or logistical information that is needed so that the material can be adequately managed through transportation, reception, storage, and ultimately into ITER construction and assembly. This DRR is will be undertaken by IO prior to the transportation of valves from the manufacturing factory to the ITER Site.

14.5 Acceptance

The ownership of the items covered under the contract shall be transferred to the Purchaser upon safe loading on the transporter's vehicle (identified by the Purchaser) following successful acceptance test at the factory and issue of Purchaser's dispatch clearance. The transfer of ownership to the Purchaser shall not relieve the Contractor of its obligations under the Contract in case of non-conformities of the components for the duration of the warranty period.

The Contractor shall provide a standard commercial warranty covering repair or replacement up to 3 (three) years from the date of acceptance at The Contractor's factory after successful final acceptance test.

15 Performance Guarantee

The Contractor shall guarantee that all valves and any accessories furnished therewith are entirely suitable for the service conditions indicated in this specification and meet the performance requirement called for in this specification, and applicable regulations in the locality (France) where the valves will be installed and operated. All performance parameters shall be demonstrated during shop tests.

If performance test results deviate from the guaranteed values, the Contractor shall try to correct the deficiencies or replace the valve with the one that meets guaranteed values at no extra cost to ITER-India.

The guarantee Period shall be three years from the date of delivery at ITER site. If the subject valve or any part thereof is found defective during the stipulated guarantee period, the Contractor shall replace the same with new one at no extra cost to ITER-India.

The Contractor shall obtain similar guarantees from each of his sub-contractors. However, the overall responsibility shall lie with the Contractor.

16 Spare Parts and Maintenance Tools

The Contractor shall furnish a list and supply a set of recommended spare parts adequate for installation/start-up/commissioning of each valves. The Contractor shall also supply a set of essential spares for each valves. Essential spares are those spares which are considered necessary by the Purchaser for three (3) years of normal plant operation. The list of recommended spares is given below for each size and class. This list shall be considered as complete set for the supply.

1. Packing – 1 set
2. Gasket for disc – 1 no
3. Gasket for Bottom cover – 1 no
4. Laminar seal – 1 no
5. Fasteners – 1 set
6. Seal kit for actuator – 1 set
7. Limit Switch – 1 no
8. Air filter Regulator – 1 no
9. Solenoid/Piezo – 1 no

10. Positioner – 1 no (Applicable to modulating flow control valves only)

The Contractor shall also furnish a list and supply (free of cost) one set of special tools and tackles necessary for maintenance, handling, commissioning, and operation of individual valve. The Contractor shall indicate if the same tool can be used for a series of similar valves included in this specification.

17 List of Annexures

- i. Annexure-1: Design conditions of valves
- ii. Annexure-2: Technical details to be furnished by the contractor
- iii. Annexure-3: MIP template

Annexure-1



Annexure-1.pdf

Design conditions of valves

Spreadsheet of Annexure-1 is also attached in IDM.

[illegible]

*HCC-N) -The valve is installed on a HCC line but is not required to operate during or after a SL3 event

Annexure-2

Technical details to be furnished by the contractor

The technical details as asked in this annexure needs to be submitted by the bidder along with the technical bid.

The dimensional cross-section drawings of valves with part list and materials of construction, manufacturer's drawings, data sheets, actuator wiring diagrams, valve characteristic curves, sizing calculations/curves for actuator selection, shaft diameter selection, shaft to disc connection, pin sizing calculations etc. need to be submitted to ITER-India for approval.

Detailed activity schedule covering submission of drawings, analysis, procedures, MIP and quality plan approval, procurement of material and sub orders, manufacture, inspection, type tests, routine tests, performance test, submission of history docket including instruction manuals and test reports, packing, loading, transportation etc.

It is to be noted that the details need to be submitted in the format given below, separately for each type/ size of the valve. The Contractor can provide additional details, also.

Valve size: DN_____;Pressure class: #_____;Actuator type: ON-OFF/ Modulating

Sr. No.	Item	Technical Data
Details of valves		
A	General	
1	Valve Tag Number	
2	Manufacturer	
3	Model Number	
4	Low Cobalt%	
5	Type of the Valve	
6	Size of the Valve, DN	
7	Operation (Manual/Electric/Pneumatic)	
8	Numbers offered	
9	Seismic Class	
10	Safety Class	
11	Quality Class	
12	Valve Design Standard	
13	Design Pressure Class	
14	PED 2014/68/EU category	
B	Valve Performance	
1	Fluid	
2	Fluid Density at 15°C, kg/m ³	

3	Design Pressure, MPa	
4	Design Temperature, °C	
5	Design Flow Rate, kg/s	
6	Maximum allowable Flow Rate, kg/s	
7	Maximum allowable Fluid Velocity, m/s	
8	Maximum Disc Differential Pressure, MPa	
9	Maximum Differential Back Pressure allowable for operation, MPa	
10	Pressure Drop across the valve at design flow, MPa	
11	Maximum allowable Pressure Drop, MPa	
12	Coefficient of Velocity C_v	
C	Valve Design and Construction	
1	Construction Features	
2	Pressure Rating	
3	End Connections	
4	Valve Body	
5	Disc	
6	Body/Disc Seat	
7	Stem	
8	Packing	
9	Shaft seal	
10	Shaft Bearing	
11	Bolts	
12	Nuts	
13	Hand Wheel	
14	Wheel Nut	
D	Inspection and Testing	
1	Material Test	
2	Hydrostatic body test pressure (MPa-g) and duration (minutes)	
3	Hydrostatic Seat/Disc Test pressure (MPa-g) and duration (minutes)	
4	Air Leak Body Test pressure (MPa-g) and duration (minutes)	
5	Air Leak Seat Test pressure (MPa-g) and duration (minutes)	

6	Disc Strength Test pressure (MPa-g) and duration (minutes)	
E	Others	
1	Accessories	
2	Spares	
F	Probabilistic Analysis Input Data	
1	Mean Time Between Failures (MTBF)	
2	Test Frequency	
3	Impact of ageing on performance	
4	No. of cycles of operation in life time	
G	Physical Data	
1	Weight of the Valve, kg	
2	Weight of the largest piece, kg	
3	Dimensions	
4	Weight of the Counter Flanges	
Details of Actuator		
A	Pneumatic Actuator	
1	Make	
2	Model No.	
3	Type (Scotch Yoke)	
4	Actuator Action Type (Single/Double Acting)	
5	Fail Safe Position	
6	Actuator Orientation	
7	Effective Working Area, mm ²	
8	Maximum force available, N	
a	Valve Open	
b	Valve Close	
9	Maximum Working Pressure, MPa	
10	Instrument Air Supply Pressure, MPa (g)	
a	Minimum	
b	Maximum	
11	Close By (Air/Spring)	
12	Open By (Air/Spring)	
13	Closing Time, Sec	
14	Opening Time, Sec	

15	Positioner Input Signal	
16	Positioner Output Signal	
17	Volume Booster	
18	Length of Stroke, mm	
19	Stroke Volume, lit	
20	Air Consumption Per Stroke	
21	Spring force for closing/opening on air failure, N	
23	Control Power Supply	
24	Cable Entry	
25	Materials of Construction	
a	Body/Casing/Shell	
b	Dish End/End Cover	
c	Shaft	
d	Diaphragm	
e	Piston	
f	Piston Rod	
g	Piston Guide	
h	Rack	
i	Pinion	
j	Seal	
k	Nuts	
l	Bolts	
B	Positioner	
1	Manufacturer	
2	Model No.	
3	Type	
4	Air Signal Range	
5	Pilot Valve Capacity	
a.	Feed, Nm ³ /hr	
b.	Bleed, Nm ³ /hr	
6	Steady State Consumption, Nm ³ /hr	
7	Materials of Construction	
a.	Base Cover etc.	
b.	Relay Body	
c.	Relay Nozzle	

8	Pressure Gauge provided	
9	Cams as desired provided	
10	Tubing between positioner and actuator provided	
11	Zero and Span adjustment available	
C	Limit Switches	
1	Numbers provided	
2	Manufacturer	
3	Model No.	
4	Type	
5	Mounting Type	
6	Number of Contacts	
7	For Close	
8	For Open	
9	Enclosure	
10	Contact Rating	
11	Voltage	
12	Ampere	
13	Cable Entry Size	
14	Number of Cable Entries Available	
15	Blind Provided as Entry (Yes/No)	
16	Casing Material	
17	Casting IP Rating	
18	Contact Resistance	
19	Insulation Resistance	
20	No of Operations	
21	Gasket	
D	Snubber	
1	Manufacturer	
2	Model No.	
3	Type	
4	Damping Medium	
E	Handwheel	
1	Material	
2	Diameter, mm	
F	Physical data	
1	Weight, kg	
2	Dimensions	

Complete assembly (Valve + Actuator)

1	Weight, kg	
2	Dimensions	



ITER-India
(Institute For Plasma Research)

INDUS Ref.
II-3MAT7PA

Annexure-3

MIP template

MANUFACTURING AND INSPECTION PLAN					
Document Number:				Revision Number:	
ITER Procurement Arrangement Number:		ITER Contract Number:		Title of Item / Identification:	
Name of DA/Supplier:				Name of Supplier/Subcontractor:	
Prepared by (Name & signature)		Approved by DA (Name & signature)		ITER IO QA Acceptance (Name & Signature)	Code*
Position:		Position:		Position:	HP: Hold Point
Date:		Date:		Date:	NP: Notification Point
					W: Witness of Operation
					S1: 100% Inspection
					S2: Random Inspection
					R: Review Report

Operations	Expected		Inspection Body	Records	Observation(s)
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(Manufacture, Inspections & Tests, etc.)(2)		Date	Applicable procedures, drawings, instructions, etc	Supplier	DA	ITER IO	Others ⁽¹⁾	(report, non-conformance number, etc)	
				Name, Sign & Date	Name, Sign & Date	Name, Sign & Date	Name, Sign & Date		
1					*		*		
2									
3									
4									
...									

(1) Others: Third Party Inspection Organization (TPI) etc. shall be identified

(2) If the operation is a Protection Important Activity (PIA), this PIA shall be identified and a technical control shall be defined.

[Code]

- Hold Point (HP): Identifies an operation that must be signed off by an IO representative before work proceeds beyond this point.
- Authorization to Proceed Point (ATPP): Identifies an operation that must be signed off by a DA representative before work proceeds beyond this point.
- Notification Point (NP): Identifies an operation that must be notified to an IO/DA representative. This notification gives the IO/DA representative the opportunity to arrange an inspection visit if deemed necessary therefore adequate notice must be given to permit arrangements for this visit. In the absence of the appointed representative and with IO/DA documented agreement work can proceed.
- Witness (W): identifies an operation that must be witnessed.
- Surveillance (S1): identifies an operation that requires 100% inspection.
- Surveillance (S2): identifies an operation that requires random inspection or spot checks.
- Review (R): identifies a document or report that must be reviewed.
- Where R/W is used for Radiography, this means that actual radiographs must be checked as well as the reports

[How to fill out the form]

- Operations (Manufacture, Inspections & Tests, etc.): List of operations in sequence expected.
- Expected date: An approximation of the date when an operation is scheduled (estimated month).
- Applicable procedures, drawings, instructions etc: All documents giving reference requirements and acceptance criteria which will be used for the designated operation, such as Welding Procedure Specifications, Welding Plans, Welding Inspection Record Sheets, NDE Procedures, Pressure/Leak Test procedures, etc.
- Identify any other organization employed to perform inspection activities.
- Records (report, non-conform. Number, etc.): Documented products issued during the operation. It is also recommended to include identification number of documentation.
- Observation(s): Any special issues or clarifications raised during inspection for reference or information.