IDM UID
833S4E

VERSION CREATED ON / VERSION / STATUS
15 Dec 2023 / 1.3 / Approved

EXTERNAL REFERENCE / VERSION

Technical Specifications (In-Cash Procurement)

VVPSS valves - Technical Specification

This specification defines the technical requirements for the design, manufacturing, testing, equipment qualification and delivery of the full set of valves for the Vacuum Vessel Pressure Suppression System (VVPSS). The valve's datasheet is provided in ITER_D_7HPDZF.

CONTENTS

1 PREAMBLE

This Technical Specification is to be read in combination with the General Management Specification for Service and Supply (GM3S) – [AD- 59] that constitutes a full part of the technical requirements.

In case of conflict, the content of the Technical Specification supersedes the content of [AD- 59].

2 PURPOSE

The purpose of this document is to describe the technical requirements for the design, equipment qualification, manufacturing and delivery of the valves for the Vacuum Vessel Pressure Suppression System.

3 SCOPE OF THE WORK

This specification defines the material grades, fabrication, inspection, examination, testing, QA, qualification and other requirements for the different valves and actuators, procured for the ITER Vacuum Vessel Pressure Suppression System (VVPSS).

Above all other requirements of this technical specification, the Contractor shall be responsible for all necessary design development, qualification and manufacturing activities that ultimately enable the delivery of the VVPSS valves that have been demonstrated to fulfil all the applicable requirements.

Due to the large scope and the complex integration of the valves in the VVPSS, IO foresees a staged approach to execute this Contract. The Contractor shall present a proposal to meet the ultimate goal of this specification at the tender stage, which is the delivery to IO of qualified valves.

The following stages are foreseen:

- Task 1: Design and technical assessment phase – The first task is dedicated to the feasibility study based on the requirements defined in this technical specification and the valve's datasheet. The Contractor shall develop the preliminary design of the VVPSS valves to the level of detail required for manufacturing. The Contractor shall demonstrate compliance with all the requirements specified in this document.
- Task 2: Manufacturing – The Contractor shall manufacture the VVPSS valves in line with the approved valve's drawings, design codes and ESPN regulations.
- Task 3: Inspection, examination and factory acceptance tests – The Contractor shall perform all necessary inspections, examinations and testing required by the design code and this technical specification. When classified as PED and ESPN, the Contractor shall lead and enable the PED and ESPN conformity assessment required for certification of the VVPSS valves.
- Task 4: Delivery to IO site - The Contractor shall design, analyse and manufacture a suitable transport package. The Contractor shall prepare and hand over all documentation required by this technical specification and design codes to IO.

NOTE, Task 2 can only start after the approval of the internal ITER design gate.

4 ABBREVIATION

For a complete list of the ITER abbreviations, see ITER_D_2MU6W5. The abbreviations listed below shall have the following meanings where used:

ALARA – As Low As Reasonably Achievable
ANB – Agreed Notified Body
ANSI – American National Standards Institute
ASME – American Society of Mechanical Engineers
ASN – Autorite de Surete Nucleaire (French nuclear safety authority)
ASTM – American Society for Testing and Materials
DA – Domestic Agency
DN – Nominal Diameter
DOE – Department of Energy
DTR – Drain Tank Room
EN – European Standard
ESP – Equipements Sous Pression
ESPN – Equipements Sous Pression Nucléaires
I&C – Instrumentation and Controls
IAEA – International Atomic Energy Agency
ICE – Ingress of Coolant Event
INB – Installation nucléaire de base (Basic nuclear installation)
IO – ITER Organization
ISO – International Organization for Standardization
LOCA – Loss Of Cooling Accident
LOVA – Loss of Vacuum Accident
MIP – Manufacturing and Inspection Plan
MRR – Manufacturing Readiness Review
MQP – Manufacturing Quality Plan
MSS – Manufacturers Standardization Society
NDE – Non-destructive Examination
PBS – Plant Breakdown Structure
PED – Pressure Equipment Directive (equiv. ESP)
PIA – Protection Important Activity
PIC – Protection Important Component
PQR – Procedure Qualification Record
QA – Quality Assurance
QADP – Quality Assurance Data Package
QAP – Quality Assurance Program
QC – Quality control
QP – Quality Plan
SDR – Supplier Deviation Request
SIC – Safety Importance Class
SO – Supply Order
TCWS – Tokamak Cooling Water System
VVPSS – Vacuum Vessel Pressure Suppression System
WPAR – Welding Procedure Approval Record
WPQ – Welding Procedure Qualification
WPQR – Welding Procedure Qualification Record
WPS – Welding Procedure Specification

5 LIST OF APPLICABLE AND REFERENCE DOCUMENTS

The orders, directives, codes and standards that shall be used in this contract are listed in Table 1. Other standards may also be acceptable, subject to IO's approval. The Contractor shall demonstrate conformity with the orders, directives, codes and standards in their last version.
For items not covered by the prod codes and technical specifications, the Contractor shall justify the soundness of the design approach.
For the ITER Reference Documents, the last approved version applies. IO will notify the Contractor in case of updates of any of the documents listed in the table below.

Table 1, List of Applicable Codes and Standards

Codes and Standards		
[AD- 1]	EN 13480-1	Metallic industrial piping – Part 1: General
[AD- 2]	EN 13480-4	Metallic industrial piping - Part 4: Fabrication and installation
[AD- 3]	EN 13480-5	Metallic industrial piping – Part 5: Inspection and testing
[AD- 4]	EN 593/A1	Industrial valves – Metallic butterfly valves
[AD- 5]	EN 1983	Industrial valves – Steel ball valves
[AD- 6]	EN 1984	Industrial valves – Steel gate valves
[AD- 7]	EN 13709	Industrial valves – Steel globe, globe stop and check valves
[AD- 8]	EN 1092-1	Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories PN designated – Part 1: Steel flanges.
[AD- 9]	EN 12627	Industrial Valves – Butt welding ends for steel valves.
[AD- 10]	ASME QME-1	Qualification of active mechanical equipment used in nuclear facilities
[AD- 11]	RCC-M	RCC-M Section VI Design and Construction Rules for Mechanical Components of PWR Nuclear Islands, Volume "Q" Qualification of Active Mechanical Equipment (Pumps and Valves) Requirements Qualification to Accident Conditions
[AD- 12]	ASME NQA-1	Quality Assurance Requirements for Nuclear Facility Applications
[AD- 13]	ISO 724	ISO general-purpose metric screw threads – Basic dimensions
[AD- 14]	ASME B18.21.1	Heavy Helical Spring Lock Washers
[AD- 15]	EN 10204	Metallic products – Type of inspection documents
[AD- 16]	EN 1591	Flanges and their joints - Design rules for gasketed circular flange connections - Part 1: Calculation
[AD- 17]	ISO 17025	General requirements for the competence of testing and calibration laboratories
[AD- 18]	ISO 9001	Quality management systems - Requirements
[AD- 19]	ISO 9712	Non-destructive Testing - Qualification and Certification of NDT Personnel
[AD- 20]	SSPC-1	Solvent Cleaning
[AD- 21]	SSPC-2	Hand Tool Cleaning
[AD- 22]	SSPC-5	White Metal Blast Cleaning
[AD- 23]	SSPC-10	Near-White Metal Blast Cleaning
[AD- 24]	EN 60068-3-3	Seismic test methods for equipment
[AD- 25]	EN 12570	Industrial valves: Method for Sizing the Operating Element
[AD- 26]	EN 12266	Industrial valves – Testing of valves – pressure tests, test procedures and acceptance criteria
[AD- 27]	EN 1779 EN 1593	Non-destructive testing. Leak testing. Criteria for method and technique selection Non-destructive testing. Leak testing. Bubble emission techniques

	EN 13185	Non-destructive testing. Leak testing. Tracer gas method
[AD- 28]	EN 10269	Steels and nickel alloys for fasteners with specified elevated and/or low-temperature properties
[AD- 29]	EN 3834-2	Quality requirements for fusion welding of metallic materials - Part 2: Comprehensive quality requirements
[AD- 30]	EN 15614-1	Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys
[AD- 31]	ISO 9692	Welding and allied processes — Types of joint preparation — Part 1: Manual metal arc welding, gas-shielded metal arc welding, gas welding, TIG welding and beam welding of steels
[AD- 32]	EN 2516	Aerospace series - Passivation of corrosion-resisting steels and decontamination of nickel base alloys
[AD- 33]	EN 17637	Non-destructive testing of welds - Visual testing of fusion-welded joints
[AD- 34]	EN 17636	Non-destructive testing of welds - Radiographic testing - Part 1: X- and gamma-ray techniques with film
[AD- 35]	ISO 10675-1	Non-destructive testing of welds — Acceptance levels for radiographic testing — Part 1: Steel, nickel, titanium and their alloys
[AD- 36]	EN 11666	Non-destructive testing of welds - Ultrasonic testing - Acceptance levels
[AD- 37]	EN 17640	Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment
[AD- 38]	EN 9606-1	Qualification testing of welders – Fusion welding – Part 1: Steels
[AD- 39]	EN 4126-1	Safety devices for protection against excessive pressure - Part 1: Safety valves
[AD- 40]	IEC 60947-5-1	Low-voltage switchgear and control gear - part 5 control circuit devices and switching elements - section 1, electromechanical control circuit devices
[AD- 41]	EN 12982	End-to-end and centre-to-end dimensions for butt welding end valves
[AD- 42]	EN 1515-4	Flanges and their joints - Bolting - Part 4: Selection of bolting for equipment subject to the Pressure Equipment Directive 2014/68/EU

Table 2, List of ITER Applicable Documents

ITER Applicable Documents		
[AD- 43]	ITER_D_22MFMW	Procurement Requirements for Producing a Quality Plan
[AD- 44]	ITER_D_22MDZD	Requirements for Preparing and Implementing a Manufacturing and Inspection Plan
[AD- 45]	ITER_D_VT29D6	Instruction for Seismic Analysis
[AD- 46]	ITER_D_22F52F	Requirements for Producing a Contractors Release Note
[AD- 47]	ITER_D_35BVV3	Instructions for Structural Analyses
[AD- 48]	ITER_D_2LTQ96	Radioprotection guide for ESPN application
[AD- 49]	ITER_D_XB5ABP	Equipment Qualification Program
[AD- 50]	ITER_D_KTU8HH	Software qualification policy

[AD- 51]	ITER_D_28QDBS	ITER Numbering System for Components and Parts
[AD- 52]	ITER_D_X3NEGB	Working Instruction for the Delivery Readiness Review (DRR)
[AD- 53]	ITER_D_7HPDZF	Valve list for VVPSS system
[AD- 54]	ITER_D_44SZYP	Working Instruction for Manufacturing Readiness Review
[AD- 55]	ITER_D_22F53X	Requirements for DA / Supplier / Subcontractors Deviations & Nonconformities
[AD- 56]	ITER_D_258LKL	Quality Assurance for ITER Safety Codes Procedure
[AD- 57]	ITER_D_4EUQFL	Overall supervision plan of the chain of suppliers for Safety Important Components, Structures and Systems and Safety Related Activities
[AD- 58]	ITER_D_22MFG4	ITER Procurement Quality Requirements
[AD- 59]	ITER_D_82MXQK	General Management Specification for Service and Supply (GM3S)
[AD- 60]	ITER_D_74C73Q	Guideline for allowable loads for valves with flanged connection

Table 3, List of Applicable Orders and Directives

Applicable Regulatory Documents		
[ARD- 1]	PED/ESP	European Pressure Equipment Directive 2014/68/EU of 15th of May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment
[ARD- 2]	ESPN	Order dated 30th of December 2015 on nuclear pressure equipment. Consolidated version after the 1st of January 2019 shall be taken into account.
[ARD- 3]	INB Order	Order dated 7 February 2012 relating to the general technical regulations applicable to INB
[ARD- 4]	Machinery Directive	Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on Machinery, and Amending Directive 95/16/EC
[ARD- 5]	EMC Directive	Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the Approximation of the Laws of the Member States Relating to Electromagnetic Compatibility and Repealing Directive 89/336/EEC

Table 4, List of ITER Reference Documents

Reference Documents		
[RD- 1]	ITER_D_DU9A7L	ASN Guide #8 Conformity Assessment of Nuclear Pressure Equipment - Version of 2012-09-04 - EN
[RD- 2]	ITER_D_FXQ9NZ	ASN Guide #19 - Application of the French Order dated 12/12/2005 on Nuclear Pressure Equipment – Version of 21-02-2013 - EN
[RD- 3]	ITER_D_2LAJTW	Tritium Handbook
[RD- 4]	ITER_D_2EZ9UM	ITER Vacuum Handbook
[RD- 5]	ITER_D_SBSTBM	Provisions for implementation of generic safety requirements by the external interveners
[RD- 6]	ITER_D_BG2GYB	Propagation of the Defined Requirements for Protection Important Components Through the Chain of External Interveners
[RD- 7]	ITER_D_QVEKNQ	Release Note Template
[RD- 8]	ITER_D_TL25DK	Specification for Labelling of Equipment on ITER Project
[RD- 9]	ITER_D_WZPYVZ	Delivery Report Template

[RD- 10]	ITER_D_XBZLNG	Package & Packing List Template
[RD- 11]	ITER_D_WU9636	Template - Equipment Storage & Preservation Requirements Form
[RD- 12]	ITER_D_VUEEDB	Instructions for Computational Fluid Dynamics Analyses
[RD- 13]	ITER_D_27LH2V	Plant Control Design Handbook (PCDH)
[RD- 14]	ITER_D_2EB9VT	EDH Guide A: Electrical Installations for SSEN Client Systems
[RD- 15]	ITER_D_VQVTQW	Template for Structural Analysis Reports
[RD- 16]	ITER_D_PSTTZL	List of ITER–INB Protection Important Activities

6 GENERAL REQUIREMENTS APPLICABLE TO VALVES AND ACTUATORS

The below requirements apply to all the valves and actuators within this specification.

6.1 DECLARATION OF CONFORMITY TO PED – ESPN REGULATIONS

- According to the ESPN classification, see valve datasheet [AD- 53], the Contractor shall appoint an Agreed Notified Body (ANB) to perform the conformity assessment according to the module selected. A declaration of conformity shall be drawn up and signed certifying that the valves comply with the Essential Safety Requirements of the ESPN Order [ARD- 2].
- The Contractor shall declare the module selected for the ESPN conformity assessment during the procurement phase.
- When a valve has a PED class higher than “I”, see valve datasheet [AD- 53], the Contractor shall appoint a Notified Body (NB) to perform the conformity assessment and obtain the CE mark.

The procedure governing the conformity assessment of nuclear pressure equipment is determined by the Contractor based on its level, risk category and nature. Even though it is the Contractor’s responsibility to choose, IO recommends the selection of B+F or G modules for those Contractors with no experience in ESPN assessments and module H or H1 for those Contractors with proven experience in ESPN regulations.

As a general remark, for the ESPN conformity assessment, the sizing of critical pressure parts shall take into account the worst-case tolerance analysis. Moreover, particular attention should be paid to the list of documents to be generated by the Contractor, in agreement with [ARD- 1] and [ARD- 2], to properly assess the additional work required for the ESPN conformity assessment.

As QC-1 components, the critical quality activities must be approved by IO before being undertaken. Throughout the document, special processes are identified. These special processes will require their procedures to be submitted to IO and accepted prior to their undertaking and reports submitted in the manufacturing dossier.

6.2 DESIGN CODES

- Independently from the design code selected, the Contractor shall demonstrate the compatibility of the valve assembly with the stainless steel pipework, designed according to EN 13480 [AD- 1] standard.
- The final valves should be designed and manufactured by EN standards. In addition to EN standards, the Contractor may use another design code to meet the requirement. The choice of the code is at the discretion of the Contractor. The responsibility of the Contractor is the full respect of PED/ESPN and the coverage of any gap between the PED/ESPN and the selected code.
- The design features not specifically addressed in this specification, codes and standards specified herein shall be performed by good engineering practice.
- The Contractor may propose alternative design codes where it believes adequate justification may be made. The alternative codes shall be accepted by IO.

6.3 OPERATING CONDITIONS

- Operating and design conditions to be satisfied, for each valve application, are given on the valve datasheet [AD- 53] that will be included in the supply order. The design of each valve/actuator shall satisfy the requirements of this specification as a minimum. The Contractor is expected to supplement these with the Contractor's design and quality requirements.
- The valve/actuator assemblies shall be designed for safe, proper and continuous operation over the design life, at their design conditions as specified in this specification and the valve datasheet. They shall also be designed to minimize fatigue, thermal transient effects, corrosion, deterioration, vibration, and other operational problems.
- Valve/actuator assemblies shall be designed to permit satisfactory operation at the pressure conditions, accelerations, temperatures, flow rates, differential pressures, system fluid and imposed loads as specified in the body of this specification and the valve datasheet.
- All valves shall be designed such that they may be applied by any of the pressure and temperature combinations as defined by EN standards for the primary pressure rating of the valve.
- Valves/actuators and materials furnished by the Contractor shall be suitable for installation and service at the specified site conditions found in the valve datasheet.
- All valve actuators shall be sized to open and close against the maximum inlet pressure and the maximum differential pressure shown on the valve datasheet.

6.4 STRUCTURAL INTEGRITY ANALYSIS

Structural integrity analyses are considered "Special Processes".

- Final valve/actuator datasheets provided for procurement may not exactly match the products available from the Contractor. Therefore, in all cases, the Contractor shall provide engineering analysis documenting how the supplied valves meet or exceed the requirements supplied in the datasheets. Alternatively, the Contractor may provide engineering recommendations as to available alternatives, including engineering analysis justifying their use in the intended application.
- The Contractor should use FEA or analytical calculation to address all those design provisions not fully validated by the design code selected.
- Reports for all analyses performed for the selected valve shall be submitted to the IO for review and approval before the start of fabrication.
- Analysis reports shall be produced by the template for Structural Analysis Report [RD- 15].
- All the equations used for the sizing of the valves shall be explicitly described in the calculation note by the Contractor.

Additional engineering analyses can be requested from IO. These analyses can include, but are not limited to fatigue/stress analyses due to thermal stratification/cycles, actuator discharge air piping network design/sizing, dynamic behaviour, etc. These analyses can be stand-alone requests, or they may impact the downstream sizing/design characteristics of the procured valves.

- Valves will be qualified to the requirements of this specification (seismic, fire, radiation, electromagnetic, temperature, pressure, etc.). Specific requirements for each valve will be provided in the final valve datasheet. Bounding qualification profiles may be provided to simplify the qualification process.
- The valves shall have a design life of 25 years at the specified conditions.

6.4.1 Stress Analysis

- The Contractor shall demonstrate the structural integrity of the pressure confinement boundaries by using the structural analysis to verify that the components can withstand all identified loads to the required service level. The structural analysis shall be undertaken in compliance with Instructions for Structural Analyses [AD- 47].
- The allowable loads for valves with flanged end-connection shall be calculated according to [AD- 60].
- The analysis shall include stress calculations, which can be performed analytically or via FEM, using ANSYS or ABACUS software and complying with the Software Qualification Policy [AD-50]. All files in ANSYS or other software to make a calculation shall be submitted to IO.

6.4.2 Seismic Qualification

- The valves and actuators shall be capable of withstanding the accelerations associated with the seismic events without loss of functional performance or confinement. In [AD- 53], the following classification is provided:
    - SC-1 (SF) = Structural and functional performance shall be ensured
    - SC-1 (S) = Structural performance shall be ensured

The methodology for seismic qualification of valves can be obtained from the ITER Instruction for Seismic Analysis [AD- 45].

The seismic qualification tests, applicable only to those extended structures for which the analytical qualification is deemed not sufficient, shall be performed according to the standard IEC 60068-3-3 [AD-24].

It is recommended for the Contractor to provide a detailed quotation and planning of the activities that consider the selected seismic qualification.

6.4.3 Load and Environmental Qualification

6.4.3.1 Electromagnetic field

- Environmental qualification of the valves shall be performed at the bounding environmental conditions, as specified in the valve datasheet [AD- 53], to evaluate the function of the valve component whose failure could prevent the valve from performing the intended function.
- All equipment with limit switches shall be qualified to ensure they will operate satisfactorily in their electromagnetic environment. Electromagnetic field strength is listed in the valve datasheet [AD- 53].

Note, the static magnetic field can also have an impact on the valves if an additional load is generated when the mobile part gets in contact with the static part. The Contractor should assess the impact of the static magnetic field on the operability of the valve procured. As a general remark, IO recalls that the static magnetic field applied for the qualification test shall be between 1.4 and 2.0 times higher than the one experienced by the equipment during operation.

6.4.3.2 Fire

- The contractor shall guarantee structural integrity during and after a fire accident. Integrity is demonstrated with no-external leaks and operability with the possibility to move the disc position after a fire event. Accidental environmental conditions are defined in the valve datasheet [AD- 53]. The valves shall withstand a fire event for at least 2 hours, maintaining integrity under the stress criteria corresponding to Service Level C. The maximum temperature achieved during a fire event is given in the valve datasheet [AD- 53].
- The Contractor shall either design the valve for the maximum fire temperature achieved or specify the required thickness of the fire protection to be installed to protect the structural integrity of the valve.

6.4.3.3 Neutron irradiation

- The valves and actuators are submitted to irradiation during ITER plasma operation. The irradiation dose is provided in the valve datasheet [AD- 53]. The Contractor shall demonstrate that the supplied valve is qualified against this threshold, particularly if equipped with electronic devices. The doses provided by IO shall be used as input for the development of the Maintenance Plan, as it is part of the input data needed from ESPN point of view.

6.4.3.4 Dust

- For a small number of valves, activated beryllium or tungsten particles may be present in the gaseous stream. The dust is very fine with an average particle diameter of 2 μm and a maximum particle size of 44 μm.
- Where appropriate, the Contractor shall demonstrate that the valve can operate for 60h under a fluid containing the dust concentration defined in the valve datasheet [AD- 53].

6.5 MATERIALS

- The material selected for the VVPSS valves is 304L Austenitic Stainless Steel. Any deviation from this material shall be agreed with IO and, in any case, compatible with the VVPSS piping assembly, which is EN 1.4307, grade 304L.

- The body, bonnet or cover, body joint bolting, and body-bonnet or cover bolting, shall be constructed of materials as listed in the respective EN specifications. The stainless steel material shall be suggested by the Contractor and submitted to IO for review and approval.
- To ensure the VVPSS meets the radioprotection guidelines as stipulated in the Radioprotection Guide for ESPN Application [AD- 48], strict requirements are placed on the chemical composition of Cobalt, Niobium, and Tantalum in the materials for the valves. Strict requirements are placed on the composition of Boron to prevent adverse effects on weldability.

As a general remark, it is important to highlight the fact that the requirements for the chemical composition of Cobalt, Niobium, and Tantalum apply to all components and not only to the “wet parts”.

Table 5 sets additional requirements for the impurities’ maximum concentration.

Table 5, Impurities maximum compositions

Location	Composition, % (maximum, unless otherwise indicated)			
	Co	Nb	Ta	B
11-L1-CNB	< 0.05	< 0.1	< 0.01	< 0.0018
11-B1-01 11-B2-01	< 0.2	< 0.1	< 0.1	
Other	As per ASTM standard			

NOTE, IO may consider deviation from this requirement where the Contractor can demonstrate the component to have a small mass (i.e. bolts, nuts, washers, etc.) and the cost of achieving the above low activation requirements would be excessive compared to the decrease in overall cobalt, niobium or tantalum. No deviation is allowed on large items, such as body or bonnet.

- All material shall conform to the Essential Safety Requirements of the PED [ARD- 1] and ESPN [ARD- 2].

6.5.1 Prohibited Materials

- The Contractor shall be aware of the following requirements, related to the prohibited materials:
  - Mercury shall not be used in any manner, including the construction of the valve, which can result in the 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 nitrided 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. This requirement applies to all components, including gaskets and other non-metallic materials. Any deviation from non-zero halogen content in any of the materials used for the valve shall be reported to IO and its use shall be subjected to IO approval.
  - The use of materials containing asbestos shall be prohibited.

6.5.2 Material Testing Requirements

- As part of the conformity assessment, the Contractor shall provide a Nuclear Particular Material Appraisal, as defined in [ARD- 2]. This document shall address those testing requirements defined by the PED [ARD- 1] and ESPN [ARD- 2] Essential Safety Requirements as well as those defined by the design code selected.

Note, as per PED Essential Safety Requirements, the Offset Yield Point (Proof Stress) shall be evaluated at 0.2% and 1% plastic deformation.

- Certificates (test reports) showing that required tests have been carried out at the source should be submitted. Type 3.1 certificate of EN 10204 [AD- 15] shall be provided for main pressure-retaining materials. The chemical Co, Nb and Ta concentration evaluation shall be included as a result in the Type 3.1 certificate. If the impurities maximum concentration test is performed separately, the Agreed Notified Body shall be involved in this process to confirm the test results.

- **A second material testing certificate, submitted by an independent certified laboratory, shall be included in the list of documentation submitted to the Contractor, after the placement of the supply order.**
- Inspection Certificate Type 3.2 must be provided by the Contractor that does not have a Quality Assurance System in line with the requirements of ISO 9001 [AD- 18].
- Materials shall be clearly marked so that they are always readily identifiable with their test certificates and reports. Marking shall be transferred to all pieces when a part is cut to make more than one component. Material without identification shall not be used in the manufacture of the valves. The method of marking and marking procedures are subject to IO acceptance.

6.5.3 Impact and Tensile test

- Mechanical properties shall be obtained from test specimens representing the final heat-treated condition of the material required by the specification. As specified in the valve datasheet [AD-53], the tensile and impact tests shall be carried out at all operating temperatures, up to their design temperature.
- As abovementioned, as part of the conformity assessment, the Contractor shall demonstrate compliance with those testing requirements defined by the PED [ARD- 1] and ESPN [ARD- 2] Essential Safety Requirements as well as those defined by the design code selected.
- All tests shall be carried out by an ISO 17025 [AD- 17] accredited laboratory.

6.6 FLANGED CONNECTIONS

- For preparing flanged ends with flange facing, nut-bearing surfaces, outside diameter, thickness, and drilling, IO recommends using EN 1092-1 [AD- 8]. The Contractor is responsible for providing the pressure class of the selected flanges, based on the PS/TS.
- Flanges furnished with tapped holes shall provide full effective thread engagement, not including the chamfered thread, for a length at least equal to the nominal diameter of the bolt thread.
- IO recommends the use of weld-neck type flanges, which provide a smooth transition between the valve and the pipeline and minimize the pressure drop. The Contractor shall define the most appropriate type of flange and the final selection shall be approved by IO.
- Flanged ends shall be prepared with flange facing, nut-bearing surfaces, outside diameter, thickness, and drilling by EN 1092-1.
- Valves that are listed as being supplied with flanged ends per Appendix A shall be provided with two counter-flanges, and adequate bolts, nuts, washers, and gaskets as described below:
  - Counter-flanges: Counter-flanges shall be supplied with each flanged valve. The counter flanges shall match the valve's class and for their procurement/fabrication, IO recommends using EN 1092-1.
  - Bolts: Bolting for the flanged connections shall be supplied with each flanged valve and should conform to EN 1515 [AD- 42]. The material selection shall be based on the assembly requirements to achieve leak tightness. The Contractor shall calculate the bolt torques to provide proper assembly.
  - Nuts: Nuts for the flanged connections shall be supplied with each flanged valve and should conform to EN 1515. The material selection shall be based on the assembly requirements to achieve leak tightness.
  - Washers: Washers (lock or Belleville) shall be supplied with each flanged valve, as described in ASME B18.21.1 [AD- 14].
  - Gaskets: Gaskets shall be supplied with each flanged valve. The gaskets should conform to EN 1591 [AD- 16] to ensure compliance with leak tightness requirements, as defined in section 6.10.2.
- The items provided shall be adequate for the valve's class with which they are supplied.

6.6.1 Threaded Fasteners

- Threaded fasteners shall have M series threads conforming to ISO 724 [AD- 13].
- All threaded pressure-retaining fasteners shall be provided with corrosion-resistant locking devices.
- All nuts and bolts shall have hexagonal heads unless otherwise specified.
- The minimum strength of the material used for the nuts and bolts shall meet the requirements of EN 3506-1 [AD- 28].

6.7 WELDED JOINTS

Welding activities are considered “Special Processes”.

- Each welding procedure that is to be followed in fabrication shall be included or cross-referenced in the Manufacturing and Inspection Plan (MIP) and weld map. Additionally, the procedures shall be included in the Weld Data Package.
- For end-to-end dimensions and face-to-face dimensions for butt welding-end valves and flanged-end valves, IO recommends using EN 12982 [AD- 41]. Each valve shall be examined to ensure it meets the dimensional requirements of this section.
- All piping end-connection shall be full penetration butt-welded, according to EN 12627 [AD- 9].
- No threaded joints or socket welds shall be used for pressure confinement boundaries.
- During the welding process for the stainless steel piping, the inside of the root shall be protected by purging with a suitable inert gas to prevent oxidation.
- During manufacturing, particular attention shall be given to cleanliness, especially the removal of weld spatter, debris and other foreign matter, particularly from the coolant passages. All surface treatment, cleaning, mounting, and vacuum acceptance testing of the valves shall be considered and accounted for in the design.
- All repairs, re-work, or scrapping shall be documented and records maintained for each specific item. The records shall relate repairs with the procedure used. A maximum of one weld repair cycle shall be permitted on austenitic stainless steel. The IO shall be notified in the event the weld repair is unsuccessful. The repairing procedure shall follow prescriptions stated in section 10.3 of EN 13480-4 [AD- 2].
- Production welding operations may only be undertaken provided the following requirements are met:
    - Personnel satisfy the requirements of EN 13480-4 (Section 9.1) and EN 3834-2 [AD-29];
    - The filler materials shall have Inspection Certificate type 3.1 as per EN 10204 [AD- 15];
    - Welding procedures have been qualified in accordance with EN 15614-1 [AD- 30];
    - The edges to be welded shall be prepared in accordance with EN 13480-4 [AD- 1];
    - All the welds shall be identified with a unique number and shall be traceable back to the welder/operator and WPS used;
    - Any visible defect liable to affect the correct execution of the next pass shall be removed.
    - Cracks or cavities visible on the surface shall be removed by chipping and by grinding and/or milling.

6.7.1 Preparation for Welding

- Preparation of welding should comply with EN 13480-5 [AD- 3] and ISO 9692 [AD- 31].
- Weld over thicknesses shall not exceed the tolerances given in EN 13480-4 [AD- 2]. If they exceed grinding or machining should be applied.
- The edges to be welded shall be kept in the position, either by mechanical means temporary attachments, by tack welding or by a combination. Requirements of EN 13480-4 Section 8.1 apply. Inspections before and after alignment shall be carried out as specified in section 7.3.2 of EN 13480-5 [AD- 3].
- The cleaning of internal and external surfaces should conform to EN 2516 [AD- 32]. The surface within 50mm from the area of the weld shall be smooth, free from cracks, fins, tears and other discontinuities, which would affect the quality of the welding.

6.7.2 Surface Preparation Requirements

Selection, qualification, and application of coating materials should follow applicable sections of the Steel Structures Painting Council (SSPC) specifications. Surface preparation activities should be by the following standards or recommended practices as applicable: SSPC-SP-1 [AD- 20], SSPC-SP-2 [AD-21], SSPC-SP-5 [AD- 22], and SSPC-SP-10 [AD- 23].

- Surface roughness (Ra) shall not exceed 12.5 µm.
- All coating systems must be applied following the Contractor’s recommendations. The blast-cleaned surfaces shall be coated with the base coat within 4 hours after blasting and before rusting occurs. All surface preparation and painting work shall be done after the visual examination, as part of the final assessment, and be subjected to the approval of IO. Colour selection shall be subject to IO's approval before the topcoat application.

6.8 MANUFACTURING READINESS REVIEW

- Following the approval of the MIP, a Manufacturing Readiness Review (MRR) shall be conducted in line with [AD- 54] and closed (by the IO) before the start of manufacturing activities. This MRR shall be included on the MIP as a Hold Point.

The MRR is a joint ITER-Contractor meeting to give approval for the Contractor to start manufacturing. For the final approval, the following documentation shall be presented:

- Procedures for special processes;
- All manufacturing drawings;
- Material test certificates;
- Engineering (Structural) analysis;
- Personnel qualification.

6.9 MANUFACTURING INSPECTION AND TESTING

- Inspection, examinations and tests shall be conducted to provide compliance with PED/ESPN Essential Safety Requirements.
- A Manufacturing and Inspection Plan shall be prepared by the Contractor that meets the requirements of ITER MIP [AD- 44].

The MIP is a listing of the chronological sequence of manufacturing operations affecting quality encompassing the whole scope of the subcontract and ranging from verification of materials, manufacture, inspection and test to delivery. For PIC elements, the MIP also clearly identifies the PIA. It will be used to monitor quality control and acceptance tests.

- Before the Manufacturing operations, the MIP shall be generated by the procedure provided in the ITER MIP [AD- 44] and available to the IO.
- Non-destructive examinations shall be performed on the cast, forged, rolled, wrought, or fabricated material after heat treatment required by the material specification. Surfaces shall be clean and free of surface conditions that may mask unacceptable indications.
- Examination personnel shall be qualified and certified by ISO 9712 [AD- 19].
- The IO reserves the right to inspect all Non-Destructive Examination (NDE) reports for auditing purposes. NDE reports shall be catalogued according to the weld maps. Additional documents outside this specification’s scope will provide detailed instructions for the commissioning of the components.

6.9.1 Visual Examination

Visual examination is considered a “Special Process”.

- Visual and dimensional control shall be conducted according to EN 17637 [AD- 33] before the execution of non-destructive examination after possible heat treatment and before any machining or grinding operations of weld surfaces.
- During welding, each pass shall be visually examined, after the complete removal of the slag, if necessary.
- 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, marks and/or other detrimental discontinuities. All finished welds shall be subject to visual examination.

The Contractor is responsible for filling the gap between the design code selected and the PED/ESPN Essential Safety Requirements.

6.9.2 Volumetric Examination

- For PED/ESPN components, all pressure boundary welds shall be 100% volumetrically inspected. The Contractor may choose Radiography or Ultrasonic inspection as appropriate.
- Full volumetric inspection shall be performed also on end-connections. The Contractor shall ensure that the weld configuration allows the 100% volumetric inspection at the ITER site.

Radiography inspection

Radiography examination is considered a “Special Process”.

- IO recommends the use of EN 17636 [AD- 34] and ISO 10675-1 [AD- 35] for the radiographic procedures and acceptance criteria.

The Contractor is responsible for filling the gap between the design code selected and the PED/ESPN Essential Safety Requirements.

Ultrasonic inspection

Ultrasonic examination is considered a “Special Process”.

- IO recommends the use of EN 11666 [AD- 36] and EN 17640 [AD- 37] for the ultrasonic examination of casting products.

The Contractor is responsible for filling the gap between the design code selected and the PED/ESPN Essential Safety Requirements.

6.9.3 Surface Examination

Surface examination is considered a “Special Process”.

- When an item is classified non-ESPN and 100% volumetric inspection is not required, all exterior and all accessible interior surfaces of bodies, bonnets, and covers shall be given a surface examination.

6.9.4 Wall thickness measurements

Dimensional inspection is considered a “Special Process”.

- The wall thickness of the pressure boundary shall be measured. The minimum thickness shall be nominal - allowable tolerance.
- The Contractor shall take several measurements and record the location of the measurements on the drawings.
- The 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.

6.10 FACTORY ACCEPTANCE TESTING

The Contractor shall perform the functional tests of the valves for the normal operating conditions of the VVPSS system including as a minimum:

- Shell leak test;
- Valve closure and leak tightness test;
- Functional Test.

- The Contractor shall provide a report for each test and demonstrate compliance with the requirements specified in this technical specification. This program shall provide documented evidence that the equipment is able to fulfil its safety functions in all postulated normal and accidental conditions in which it is required and during the required operating period.

6.10.1 Assembly (Shell) leak test

Leak testing is considered a “Special Process”.

- A shell leak test shall be conducted on each valve. IO recommends following the requirements of EN standards referenced in [AD- 27]. Testing shall be performed prior to any painting or coating of the valves.
- The acceptability leak-rate threshold is defined in the valve datasheet [AD- 53], according to the valve classification and ITER Tritium Handbook para. 7.1 [RD- 3].

6.10.2 Valve closure and leak tightness test

- Each valve shall be given a closure test. IO recommends complying with the requirements of EN standards [AD- 27].
- The valve seat leakage rate shall conform to the requirements defined in the valve datasheet.
- The valve’s maximum and minimum closing time shall be defined by the Contractor to avoid damages/wedging.

6.10.3 Functional Test

- All manual and power-operated actuators shall be subjected to functional qualification tests, with a typical “test” valve, at the design service pressure as stated in the Valve datasheet [AD- 53].

- Before testing, all power-operated valves shall be fully calibrated including the setting of limit switches, mechanical stoppers, position indication, etc., as applicable.
- During valve operation, the limit switch setting and valve seat leakage shall also be checked.
- The opening and closing times of valves shall be recorded.
- The tests shall meet the following requirements:
  - The valve shall be cycled three times from fully opened to fully closed at the maximum differential pressure specified on the Valve datasheet [AD- 53]. During each test, the valve cycle time shall be monitored and recorded. The valve shall operate without chatter.
  - Verify the operation of position switches.
  - Verify the fail position of the valve upon loss of air pressure.
  - Should damage occur to the actuator or valve during a performance test, or should the valve fail to open, close, or perform correctly, the damage shall be reported and repaired or the malfunction corrected and the test shall be rerun in its entirety.

6.11 FINAL ASSESSMENT PROCEDURE

As part of the PED/ESPN conformity assessment, the following sequence of tests shall be performed.

- Document check;
- Visual examination before the pressure test;
- Pressure test;
- Final visual examination after the pressure test.

6.11.1 Document Check

- As defined in Section 6.1, the Contractor shall be responsible for the PED/ESPN conformity assessment procedure. The full list of documents to be produced during the different design, manufacturing and testing phases is provided in [RD- 1].

6.11.2 Pressure Test

Pressure testing is considered a “Special Process”.

- The parts of the valves operated under pressure shall be pressure tested in agreement with EN 12266 [AD- 26] requirements. When a different code is selected, the Contractor shall provide IO with a justification note. Testing may be done in the component or assembled conditions. All process volumes shall be connected to provide equal pressure in all process volumes. These tests shall be conducted after all machining and welding operations on the parts have been completed. The Contractor shall prepare and submit the pressure test procedures for the IO review and approval.
- The minimum test pressure shall conform to the PED Annex I, 7.4 [ARD- 1].

6.11.3 Visual Examination

- Visual examination shall be performed according to Section 6.9.1.

6.12 IN-SERVICE INSPECTION AND MAINTENANCE

- The scope of this specification shall include technical field support and consultation services during the installation, initial operation of all equipment furnished, performance testing and training of IO operating and maintenance personnel.
- The 100% visual examination must be performed on all external and internal surfaces of equipment for which essential safety requirements shall be applied and for which conformity may be visually inspected.
- The valve design shall allow easy access to the valve’s internal and external surfaces. For areas considered accessible, a visual inspection will always be preferred. Tools such as magnifiers, mirrors, endoscopes, or television systems may be employed if the optical path is interrupted between the inspected surface and the controller's eye.
- Valves shall be designed to permit inspection, satisfying the requirements provided in ESPN Annex 5 Para 3.4 [ARD- 2] and the guidelines in ASN Guide No. 8 Appendix 3 Section “Maintenance – In-Service Inspection” [RD- 1].
- The minimum periodicity for preventative maintenance shall be 5 years. The minimum periodicity for in-service inspection shall be more than 18 months.

- For those surfaces classified as “non-visually inspectable areas”, the Contractor shall propose the IO equivalent areas to be inspected.
- The Contractor shall include in the operation and maintenance manual instructions on how the internal and external inspections can be undertaken. Any tools required to perform the above inspections shall be included in the scope of supply of this contract (excluding cameras or endoscopes).

6.13 SPARE PARTS

- The Contractor shall recommend parts that should be stocked as spare parts for the first two years of operation of the valve. The recommendation for spare parts stock levels should take into consideration the lead time for delivery of replacement parts after order, the design life of the part, the wear-out rate the of part or similar pieces of equipment, and operating conditions to which the equipment will be subjected. IO will issue a separate purchase order for spare parts after a review of the Contractor’s parts list.
- Delivery of the spare parts selected by IO will be specified at the time of order. The Contractor shall identify all spare parts as such by securely attaching a tag showing the following information to each part:
  - IO Valve Item Number and Contractor’s Part Number
  - Part Name and Part Description
  - Drawing Reference and Part Item Number
  - Contractor shall provide information regarding alternative Contractors of subcomponents when they are available.

6.14 SPECIAL TOOLING

- The Contractor shall provide all special tools required for the handling, maintenance, and repair of the valves. If the same tool(s) can be used for a series of similar valves, then 1 tool per every 50 valves shall be supplied.
- Valves above 20 kg shall be provided with a method of handling, such as lugs or eyebolts, to allow easy removal/maintenance and limit the exposure of workers to radioactive material. The valves shall be designed for transporting and lifting in both vertical and horizontal positions.
- Each hanging/lifting lug shall be designed to support 175% of the dry weight of the respective component.

6.15 SAFETY LIMIT SWITCH

- Low Voltage Switchgear shall comply with IEC 60947-5-1 [AD- 40].
- Safety switches should be no “flexible members” within the drive train operating the positive operating contacts. Wobble or flexible actuators shall not be used.
- The operating performance of each switch shall be tested according to Chapter 3 of IEC 60947-5-1.

6.16 CLEANLINESS AND PACKAGING

6.16.1 Cleanliness Requirements

- The interior surfaces of the valves and actuators shall meet the requirements for ASME NQA-1 [AD- 12] Table 302.5 Class B cleanness.
- The exterior surfaces of the valves and actuators shall meet the requirements for ASME NQA-1 [AD- 12] Table 302.5 Class C cleanness before packaging.
- During cleaning, particular attention shall be given to the removal of weld spatter, debris and other foreign matter, particularly from the coolant passages and sealing surfaces. Final cleaning shall ensure effective cleaning without damage to the surface finish, material properties or metallurgical structure of the materials. The Supplier shall submit to the IO the proposed cleaning procedure for approval/acceptance.
- Any expendable materials that come in contact with the valves/actuators shall minimize the impact on operating chemistry and shall not cause degradation (e.g., by cross-contamination with carbon steel). Use of expendable material shall be controlled by written procedure.

- Before the start of fabrication, when such materials are used, a listing of proposed materials and products to be used on the valves/actuators for the expendable products covered by this specification, along with a Certified Product Report for each product, shall be submitted to the IO and ANB for approval. This list shall include grinding wheels, adhesives, dye penetrant materials, rust preventatives, tapes, temperature indicating sticks, paint sticks or inks, ultrasonic testing couplants, weld purge dams, welding/cutting compounds, wrapping materials including temporary insulating materials, desiccants, plugs, caps, layout dyes, machining coolants and lubricants, cleaning agents, and solvents.

6.16.2 Marking and Labelling

- The Contractor shall employ a material marking system that ensures the control of the material used in the manufacture of the valves.
- For stainless steel materials, electrochemical etching may be used. Etching must be performed to a written procedure and the fluids used must be certified to contain less than 100ppm of total halogens, lead and sulphur. The process must result in marking with demonstrated legibility and durability.
- All components and the main subcomponents shall be clearly marked permanently and in a visible place with the IO official numbering system according to the document “Specification for Labelling of Equipment on ITER Project” [RD- 8].
- Final nameplate information shall be approved by IO.

6.16.3 Packaging Requirements

- After the Factory Acceptance Test, the components shall be partially disassembled to the maximum size that can be shipped. All components requiring re-assembly at the ITER Site shall be clearly labelled and tagged.
- All valve assemblies shall be prepared for shipment so that handling and unloading may be facilitated. At no time are valves, actuators, or accessories to be shipped in a disorderly arrangement or situation of disarray to promote damage or hamper inspection of the valves when received on the job site.
- The supplier shall design and supply appropriate packaging, adequate to prevent damage during shipping lifting and handling operations. Where appropriate, accelerometers or other sensors shall be fitted to ensure that limits have not been exceeded. When accelerometers are used, they shall be fixed onto each box and shall be capable of recording the acceleration along three perpendicular directions.
- Shock-absorbing material shall be used.
- Each shipment shall be accompanied by a Delivery Report shall be prepared by the Supplier, stating as a minimum:
  - The packing date;
  - The full address of the place of delivery and the name of the person responsible for receiving the package, as well as the Supplier’s name and full address;
  - Bill of Materials
  - Security Measures
  - Release Note;
  - Packing List;
  - Material Safety Sheet;
  - The declaration of integrity of the package;
  - The declaration of integrity of the components;
  - Any additional relevant information on the status of the components.

Valves

- The packaging for valves shall meet the minimum requirements of ASME NQA-1, Para. 302.3 Level B [AD- 12], for overseas shipment, and the additional requirements stated herein.
- Packaging of the valves shall be provided to ensure adequate protection, yet still allow adequate thermal breathing, during transport and delivery, on-site storage before installation, and during the idle period after the valves are installed and awaiting operations.
- Packaging and shipping details, including drawings, shall be prepared by the Contractor and submitted for review and acceptance before shipment.

- Materials intended for use in preservation, packaging, and shipping, such as tape, wood, plastic caps, sheets, vapour corrosion inhibitor coverings or other covers which are applied directly to stainless steel and nickel-based alloys shall be compatible with the materials to which they are applied.
- The interior of the valve shipping package shall provide moisture control during shipping. A maximum allowable relative humidity of 60% shall be required.
- For valves, any open ends shall be properly cleaned and then securely fitted with plastic or wooden caps. The valve shall then be enclosed in clean, heavy-duty plastic and openings tightly sealed. Small openings such as couplings, threadolets, and nipples shall be sealed by use of small light stainless steel metal or plastic inserts pressed in and retained with a seal of waterproof tape.

Actuators

- The packaging for the valve actuators shall meet the minimum requirements of ASME NQA-1, Para 302.3 Level B [AD- 12], for overseas shipment.
- For valve actuators, any open ends shall be properly cleaned and then securely fitted with plastic or wooden caps. A method of moisture control shall be provided for the packaging of the valve actuators. The valve actuator shall then be enclosed in clean, heavy-duty plastic and openings tightly sealed. Small openings such as coupling, threadolets, and nipples shall be sealed by use of small light stainless steel metal or plastic inserts pressed in and retained with a seal of waterproof tape.

7 VALVE ACTUATORS

The Contractor shall design, fabricate, assemble, test and deliver the valve actuators described in the Valve datasheet [AD- 53] including the required accessories, spare parts, special tooling, and documentation to the IO.

Under Order 7 February 2012 [ARD- 3], these SIC components are classified as protection important components (PIC) and require control and guarantee of the quality of the PICs during the design and manufacturing phase to ensure their safety functions can be maintained in all postulated situations. This is accomplished through the guidelines provided for in the Management of Propagation of Nuclear Safety Requirements in the Supplier Chain [RD- 6].

7.1 ACTUATOR SIZING

- The Contractor shall propose a valve actuator that meets all the operations and geometrical requirements defined in this technical note, including all required accessories, spare parts and special tooling.
- All valve actuators shall be sized to open and close against the maximum differential pressure given in the datasheets [AD- 53].
- The Supplier shall perform the sizing calculation for the actuator based on the sum of the maximum shut-off pressure, resulting torque requirements, and the minimum supplied pressure. Each valve actuator shall have ample capacity for accurate seating, unseating, and positioning of the valve when subjected to the most severe operating condition, including any mechanical friction. The force necessary to compress the actuator spring at 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.
- Compressed air for the actuation is supplied at a minimum of 7 bar(g). Air consumption characteristics shall be submitted with each valve. The compressed air supply to the actuator can be at a lower pressure if required.
- The valve actuator shall have a design life of 25 years at the specified conditions.
- 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.
- 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 actuator housing or valve components will be considered acceptable.
- The actuator shaft shall be of noncorrosive material 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.

- For the actuator's fixed mechanical fail-safe function, the fail-safe direction of movement can be either clockwise or counter-clockwise (extend or retract for linear) and shall be clearly and permanently indicated on the actuator housing. The fail position of the actuator for the HMS Isolation Valve assembly is closed.
- All equipment with limit switches shall be qualified to ensure they will operate satisfactorily in their electromagnetic environment, as described in Section 6.4.3.

7.2 MECHANICAL STOPS

- Adjustable mechanical stops shall be provided to prevent over-travel of the valve (both linear and quarter-turn types) in the open and closed position.
- All mechanical stops shall be designed to absorb the full operator torque.

7.3 MANUAL OPERATED

- The manual force required to operate the manual operator shall meet the requirements of EN 12570 Section 5.1 [AD- 25].
- Pressure Regulation Valve actuators shall be furnished with a manual override to open or close the valve in the event of loss of motive power. For safety reasons, it is required that a manual declutch mechanism be included. Engaging the declutch mechanism changes the operation from pneumatic powered to manual (handwheel) operation. The declutch mechanism may be provided with a locking device to prevent unauthorized manual operation. In most applications, the handwheel should not turn while in pneumatic powered operation as a safety precaution.

7.4 DECLARATION OF CONFORMITY TO PED – ESPN REGULATIONS

- The Supplier shall affix the "CE" marking on the actuator, guaranteeing that the actuator conforms to the requirements of the Machinery Directive 2006/42/EC [ARD- 4] or the EMC Directive 2004/108/EC [ARD- 5]. The "CE" marking shall conform to the requirements of Article 16 of the Machinery Directive [ARD- 4] or Article 8 of the EMC Directive [ARD- 5].
- The declaration of conformity shall be drawn up in accordance with Annex II, Part 1, Section A per the Machinery Directive [ARD- 4] or Annex IV, Part 2 per the EMC Directive [ARD- 5].

8 PRESSURE RELIEF VALVES

This section provides additional technical requirements for the Pressure Relief Valves (PRVs) used in the VVPSS. These valves are safety accessories in accordance with PED, hence are classified as PED category IV, according to Article 2, point 4 [ARD- 1].

Pressure Relief Valves shall be designed according to EN 4126 [AD- 39].

The Supplier shall design, fabricate, assemble, test and deliver the Pressure Relief Valves described in the Valve datasheet [AD- 53] including the required accessories, spare parts, special tooling, and documentation to the IO.

The pressure relief valve's primary function is to provide overpressure protection of the piping system and the equipment above its design pressure. The characteristics of the process fluid are described in the Valve datasheet [AD- 53].

8.1 TECHNICAL DETAILS

- PRVs shall be of the direct spring-loaded type.
- PRVs shall be designed and constructed such that when installed the valves will operate without chattering and shall not flutter at the flow-rated pressure in a way that would either interfere with the rated capacity or result in damage.
- The PRVs shall be designed to meet the required relieving capacities, which are specified in the Valve datasheet [AD- 53].
- PRVs components of the same type and size shall be mutually interchangeable.
- Valve seats, plugs and wear components shall be designed to allow re-lapping and be capable of being replaced in the field with the valve "in-line".
- All replaceable parts of the valve shall be replaceable with the valve installed and without cutting metal, except for seat rings seal-welded in the valve body.

- PRVs shall be furnished with a test gag to block the valve disc during hydrostatic testing. PRVs shall be furnished with a tool for periodic testing of the valve set point.
- O-rings and gaskets used in sealing the joints of the PRVs to prevent the leakage of the process fluid to the outside environment shall be constructed from a metallic material. For non-metallic O-rings and gaskets used in other services, qualification shall be performed for the radiation and environmental conditions of the PRVs.
- The PRVs may be designed either with or without adjusting rings. If provided with adjusting rings, then the position of the rings shall be factory set to meet overpressure and blowdown requirements.

8.2 SET PRESSURE TEST

- Each PRV shall be tested to demonstrate its popping or set pressure per EN 4126.
- The valve pressure shall be increased until it opens with a “pop” when it reaches the set pressure. Afterwards, the valve pressure shall be decreased until the valve disc re-establishes contact with the seat or when the lift becomes zero. This shall occur when the pressure reaches the reseating pressure of the valve. It shall be verified that the reseating pressure is the same as the one recorded during the capacity certification test performed. Three successive and successful opening and closing tests shall be performed. Any disassembly or altering of valve adjustments requires repetition of the tests.
- The set pressure tolerance shall not exceed the values provided in EN 4126.

9 DOCUMENTATION

All documentation shall conform to the following requirements:

9.1 GENERAL REQUIREMENTS

- All documents shall be submitted to the ITER Document Management System (IDM). A dedicated project area will be created for the purpose.
- The documents produced by the Contractor may be bi-lingual. The primary language is English and the secondary language is that of the Contractor. The English text shall have the same technical meaning as the Contractor text. When bi-lingual text is used, it shall apply to all texts on the drawing.
- All documents shall be clean and legible white prints with uniform background density suitable for electronic scanning and subsequent reproduction from an electronic format. In addition, all documents shall be submitted in PDF files and native format, or another electronic format if mutually agreed upon. Hard copies may be submitted in addition to electronic transmission.
- Documents not meeting the quality requirements specified herein will be returned to the Contractor without IO review for correction and resubmission. Rejected documents will not be a basis for approving schedule extensions or cost increases.
- All documents shall utilize IO’s Valve Item Number and Contractor’s part number for valve and component identification.
- All or part of the Contractor’s documents, sketches, or instructions (or the Contractor’s subcontractor’s) may be copied or reproduced as necessary by IO for project use. This shall include documents that are labelled “Copyright”.
- The Contractor is responsible for the document requirements. This includes documents from subcontractors. This responsibility may not be delegated or passed on to any other subcontractor.
- Contractor’s as-built record drawings shall be updated to reflect changes made during shop fabrication. All as-built drawings (both physical copies and in native format) shall be provided prior to shipment of the equipment.
- The Contractor shall provide all the documentation required to clean, start up, test, operate, and maintain all Contractor-supplied valves and accessories.
- Acceptance by IO of any of Contractor’s documents neither certifies nor warrants Contractor’s conformance to any of its obligations under the Purchase Order.
- Shall the Contractor, upon receipt of documents as commented by the IO, for whatever reason, not incorporate every of IO’s comments as so marked by IO on the Contractor’s documents, the Contractor shall so advise the IO in writing the reason for not incorporating these comments.

Note: Release for material procurement and fabrication shall be in writing and not dependent on document status.

- The Contractor shall review and approve under its QA program drawings and/or documents submitted by the Contractor's subcontractors before submitting these documents to the IO for review. Specific cases in which parallel review by the IO and Contractor would be advantageous to the project schedule will be considered on a case basis.
- Before the Release for Manufacture, the documentation shall be submitted to the IO for review and acceptance. No material orders or fabrication shall begin until released by the IO.

9.2 WELD DOCUMENTATION REQUIREMENTS

The following welding documentation shall be retained in the Contractor's shop and available for IO review.

- Administrative procedures for the control of the welding program, which includes qualification of Welding Procedure Specifications, qualification and assignment of welders, filler metal control, the performance of post-weld heat treatment (PWHT), control of welding work, specification of workmanship requirements, and other information related to the administrative control of welding.
- Records of Welder Performance Qualification and updates/renewal of qualification for the welders who will be assigned to the work, according to EN 9606 [AD- 38]. Additional requirements of EN 13480-4 [AD- 2] section 9 shall be applied as well.
- Drawing(s) depicting examination surface configuration and the surface finish for pressure retaining and integrally attached welds and adjacent base material subject to the volumetric examination shall be provided by the Contractor.

Welding and NDE documentation listed above shall comply with the requirements of Annex I – section 3.1.2 and 3.1.3 of the PED [ARD- 1].

10 MANUFACTURING DOSSIER

At the completion of the contract, all the following documents shall be submitted to IO for acceptance.

Contract Documentation

- Final technical specification;
- Quality Plan;
- NDT/Inspection personnel certifications;
- Full supplier list;
- List of documents.

Design Documentation

- Structural analysis report;
- Special process procedures;
- Hydraulic characteristics;
- Verification and validation of software documents;
- Assembly, 3D models and detail drawings;
- Bill of Materials;
- Manufacturing Inspection Plan.

Material Documentation

- Material test reports;
- Material supplier's quality system certificate;
- Consumable list.

Fabrication Documentation

- Weld maps and weld repair procedures (if applicable);
- Heat treatment report, including temperature measurement data;
- NDT reports;
- Surface roughness measurement report;
- Inspection report with complete dimensional and tolerance evaluation;
- Certificate of cleanliness;

- List of special tools, if any;
- Hanging/lifting lug load test report.

Qualification and Procedure Documentation

- Permanent marking and labelling procedures;
- Qualifications of the personnel for manufacturing special processes;
- Qualification dossier;
- ESPN dossier, bilingual English and French;
- Deviation requests and non-conformity requests;
- Installation, operation and maintenance manual – Instruction manual, bilingual English and French.

Delivery Documentation

- Cleaning and packing report;
- Final inspection report;
- Delivery report;
- Packing list;
- Preservation manual;
- Contractor Release Note;
- Photographs of packaged components;
- Any document/drawing/procedure that needs prior approval by the IO as mentioned elsewhere in this specification;
- Manufacturer Declaration of Conformity, bilingual English and French.

11 QUALITY ASSURANCE

- Quality Requirements shall be by the “ITER Procurement Quality Requirements” [AD- 48].
- The Contractor shall have an ISO 9001 accredited quality system or an IO approved QA Program.
- Before the commencement of any work under this Contract, a “Quality Plan” (QP) [AD- 43] shall be produced by the Contractor and Subcontractors and submitted to the IO for approval, describing how they will implement the ITER Procurement Quality Requirements.
- Before the commencement of any manufacturing, a “Manufacturing and Inspection Plan” (MIP), according to [AD- 44], shall be produced by the Contractor and Subcontractors and approved by the IO, who will mark up any intended intervention point. MIPs are 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 the IO. The right of the IO listed above shall apply in relation to any Subcontractor and in this case, the IO will operate through the Contractor. The overseeing of the quality control operation by the IO shall not release the Contractor from his responsibility to meet any aspect of this Technical Specification.

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 IO.

All requirements of this Technical Specification and subsequent changes proposed by the Supplier during the execution of this Contract are subject to the Deviation Request process described in “Contractors Deviations and Non-conformities Procedure” [AD- 55].

- Documentation developed as the result of this Contract shall be retained by the Contractor for a minimum of 5 years and then may be discarded at the direction of the IO. The use of computer software to perform a safety-based task activity such as analysis and/or modelling, etc. shall be reviewed and approved by the IO before its use, by “Quality Assurance for ITER Safety Codes Procedure” [AD- 56].
- In case of Contracts concerning SIC components and/or a Safety Related Activity, or PIC and/or Protection Related Activities, the Quality Assurance Programme of the Supplier shall comply with the requirements of the INB Order and the subsequent ASN decisions linked to this Order. For this purpose, the Supplier and Subcontractors carrying out contracts placed under the Contract shall comply with the QA requirements under the relevant QA classifications as defined in “Quality Classification Determination” and additional requirements of the INB Order and the subsequent ASN decisions linked to this Order.

- In particular for SIC, the IO, as the Nuclear Operator, will supervise the whole production cycle of the Supplier and Subcontractors by the document “Overall supervision plan of the chain of Suppliers for Safety Important Components, Structures and Systems and Systems and Safety Related Activities” [AD- 57], which shall be identified in the MIP.

12 PROPAGATION OF SAFETY REQUIREMENTS

ITER is a nuclear facility (an “INB”, for *Installation nucléaire de base*, “Basic nuclear installation” in French regulation) identified in France by the number “INB no. 174” [ARD- 3].

- Contractors and Sub-contractors must be informed that:
  - The INB Order applies to all protection important components and the protection of important activities.
  - Compliance with the INB Order must be demonstrated in the chain of external Contractors.
  - 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 subcontractors).
- The IO shall inform the Contractor that the equipment being procured is considered protection important components (PIC). Under Order 7 February 2012 [ARD- 3], the PICs require control and guarantee of the quality of the PICs during the design, manufacturing and transportation phase to ensure its safety functions can be maintained in all postulated situations.
- In the contracts passed down to the subcontractors, it is clearly stated that in addition to technical requirements, and defined requirements on PIC, IO shall ensure the surveillance of the Protection Important Activities (PIA). The contractor shall ensure technical control. The subcontractor must possess a quality system in agreement with the importance of the item being delivered and in particular for the follow-up of the PIA corresponding to the PIC to be provided under the contract. The contractor shall provide documented information on how to perform the technical control (each protection-important activity undergoes technical monitoring), to ensure that the activity is carried out in compliance with the requirements defined for the activity and, if necessary, for the protection-important components concerned and that the appropriate corrective and preventive actions have been defined and implemented. This system shall be included in the MIP or Quality Plan.
- The list of PIA for ITER is described in the “List of ITER-INB Protections Important Activities” [RD- 16]. Additionally, the generic safety requirements to be implemented to satisfy the requirements of the INB Order are identified in “Provisions for implementation of the generic safety requirements by the external interveners” [RD- 6].
- This applies to all levels of subcontractors. Additionally, the Contractor shall inform the IO of all subcontractors at all levels involved in the supply.

12.1 ROLE OF AGREED NOTIFIED BODY

- The manufacturer and the ANB contracted by the Contractor shall be allowed to perform inspections in the facilities of the fabricator. No proprietary processes or information shall inhibit the ANB/manufacturer from performing its functions. This applies to all levels of subcontractors.

12.2 AUDITS

- Contractor shall inform its Subcontractors that IO is a nuclear facility identified in France by the number INB-174. Certain items that are subject to this Specification are classified as PIC to which the French Order dated 7th February 2012 applies and are subject to IO and regulatory body inspections. PIA shall be identified for PIC to comply with the requirements of the safety function.

- The IO, ANB and French regulator (for PIC) reserve the right to conduct announced or unannounced inspections and audits, at the Contractor's facilities to verify conformance of the work being performed to the requirements of the supply order and this Specification. The ANB shall have free access to perform any inspections there that it deems necessary to check compliance with the requirements stemming from the risk analysis or as applicable that the Contractor properly meets the obligations of the approved quality system. Both the Contractor and its Subcontractors are subject to such inspections and audits. No proprietary processes or information shall inhibit IO, ANB, or other official parties from performing its audit or inspection function. The IO, ANB, and French regulator exercise of, or failure to exercise, this right to inspect or witness shall not relieve the Contractor of its obligation to comply with the terms and conditions of the supply order.
- IO reserves the right to verify the validity of the Certificate of Compliance during the performance of audits of the Contractor or by independent inspection or test of the item(s).

12.3 ACCESS TO CONTRACTOR'S PREMISES

- The Contractor shall grant access rights to the IO, ANB and French regulator (for PIC) to its facilities, records, proprietary processes and/or information and those of its Subcontractors for surveillance of defined requirements during the construction/manufacturing of a PIC. This surveillance shall also include the examination of all protective-important actions and the follow-up and verification of all corrective actions which are to be implemented.
- The IO and Host regulatory body representatives shall have the authority to refuse release for shipment if the requirements of this Specification have not been fulfilled. Copies of required inspections and certified test reports shall be available for review. Final acceptance of material or components shall be performed on the ITER site.

13 PROJECT MANAGEMENT

- The Contractor shall designate a Contract Responsible Officer, within 5 working days after the award of the contract (AOC), who will be responsible for the overall design, manufacture, factory testing, installation, performance testing, schedule, cost control and resolution of disputes and discrepancies. The Contractor shall also identify specific individuals responsible for each aspect of the Work. The Contractor's proposal shall provide an outline of the management structure and resumes of the team members for the project.

13.1 PROJECT SCHEDULE

- The Contractor shall provide a schedule within 10 working days after receipt of each Supply Order. It shall identify the submittals to and approvals from IO of the Contractor's and Subcontractors' specifications, drawings, procedures, and other types of documents as appropriate.
- As a minimum the schedule shall include task descriptions with start and finish dates for each task. Separate detailed task breakdowns shall be provided for design, procurement, fabrication, and factory testing phases and end with a Scheduled Jobsite Delivery Date.
- The project schedule must be provided to IO for approval prior to the implementation of any Work. The Contractor shall consider potential schedule conflicts due to previous or pending commitments to supply services or material to other customers. Anticipated deviations from the schedule must be identified to IO as soon as possible to evaluate the impact of changes on the master project schedule.

13.2 LIST OF DELIVERABLES

Table 6, list of deliverables

Deliverable	Description	Estimated due date
D1.1	Kick-off meeting minutes	T0 + 3 days
D1.2	Approval of documents related to the "Contract documentation" section	T0 + 1 month

Hold Point (T1)	Approval of the Technical Note on the selection of valves and compliance with IO requirements.	T0 + 3 months
Completion of Task 1		
D2.1	Approval of documents related to the “Design documentation” section, excluding the Seismic analysis report	T1 + 3 months
D2.2	Approval of documents related to the “Material documentation” section	T1 + 4 months
Hold Point (T2)	Closure of the Manufacturing Readiness Review and approval of the Seismic analysis report	T1 + 4 months
Completion of Task 2		
D3.1	Completion of the FAT	T2 + 2 months
D3.2	Approval of Manufacturing Dossier	T2 + 4 months
Hold Point (T3)	Approval of ESPN dossier, which enables the shipment of the equipment	T2 + 5 months
Completion of Task 3		
D4.1	IO acceptance of the delivered equipment	T3 + 1 month
Completion of Task 4		

14 DELIVERY

- The transport of the valves and/or actuators shall be the responsibility of the Contractor. The selection of the transport company shall be at the contractor’s discretion and the Contractor shall be responsible for the transport to the delivery location.
- Before the shipment, a Release Note shall be prepared by the “Contractor Release Note” [AD-46] and approved by the IO. Additionally, a native file item-level packing list and a delivery report shall be provided to logistics.data@iter.org by the working instruction for the DRR [AD-52], at least 15 working days before the planned shipment date for each shipment.
- Marking shall be transferred to all pieces when a part is cut to make more than one component. The method of marking and marking procedures shall comply with the document “ITER Numbering System for Components and Parts” [AD- 51]. IO will provide a detailed ‘IO component identification standard’ together with printed label (QR-code) templates.
- Shipment and Delivery will be undertaken using the International Commercial Terms (Incoterms) 2010. The Contractor shall deliver the Valves “Delivered At Place” (DAP) to the IO Site:

  ITER Organization,
  Route de Vinon-sur-Verdon
  CS 90 046
  13067 St Paul Lez Durance
  Cedex
  France
- After packaging, the Contractor shall prepare and submit a Delivery Report [RD- 9] and Packing List [RD- 10] to the IO for review and approval. The Contractor shall sign the Declaration of Integrity and stamp it before submission to the IO. Declaration of Integrity is included in the Delivery Report.

15 SPECIFIC GENERAL MANAGEMENT REQUIREMENTS

The requirements defined in [AD- 59], §6, apply in full.

The Contractor and the IO shall meet to review the progress of the work and discuss technical issues.

The Contractor or IO can request specific meetings or communications to resolve issues. All the meetings shall be held by video conference. The Contractor shall be responsible for producing minutes of each meeting, which shall be circulated for review and approval by all attendees before formal issue.

The Contractor shall provide the Deliverables corresponding to the Task assigned by IO in due time. The content of such Deliverables is described in Section 13.2.