

Technical Specifications (In-Cash Procurement)

Technical Specification for Design, Manufacturing and Qualification of VVPSS Valves

This technical specification outlines the requirements for the design, fabrication, inspection, testing and qualification of valves and actuators procured for the ITER Vacuum Vessel Pressure Suppression System (VVPSS). The scope covers all activities necessary to ensure the delivery of fully compliant and qualified VVPSS valves, meeting the project's structural, functional and regulatory requirements.

The valve's datasheet is provided as an attachment.

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1 PREAMBLE

This Technical Specification is to be read in combination with the General Management Specification for Service and Supply (GM3S) – [AD- 57] that constitutes a full part of the technical requirements.

In case of conflict, the content of the Technical Specification supersedes the content of [AD- 57].

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.

The supply of the VVPSS Valves is divided into six procurement lots. Depending on the bidder's capability they may submit a bid covering one or several procurement lots:

- **Lot#1: Manual & Pneumatic Ball Valves** - 24 valves
 - Size [DN15 ... DN100]
 - End connection: Welded, Top Entry
 - Stem Seal Type: Packing BH
- **Lot#2: Manual & Pneumatic Gate Valves** – 45 valves
 - Size [DN15 ... DN100]
 - End connection: Welded
 - Stem Seal Type: [Packing BH, Bellow sealed]
- **Lot#3: Manual & Pneumatic Globe Valves** – 82 valves
 - Size [DN15 ... DN80]
 - End connection: Welded
 - Stem Seal Type: [Packing BH, Bellow sealed]
- **Lot#4: Manual & Pneumatic Butterfly Valves** – 7 valves
 - Size DN150 – Triple Offset
 - End connection: Flanged
 - Stem Seal Type: Packing BH
- **Lot#5: Self-Contained Pressure Reduction Regulator & Needle Valves** – 7 valves
 - Size [DN25, DN40]
 - End connection: Welded
 - Stem Seal Type: Packing BH
- **Lot#6: Non-Return Valves** – 37 valves
 - Size [DN15 ... DN80]
 - End connection: Flanged
 - Type proposed [Lift Check Valves, Swing Check Valves]

The Contractor shall refer to the valve datasheets for classification details of each valve, with particular attention to the PED/ESPN Class and Protection Important Class. As outlined in Section 5.1, the applicability of this technical specification—whether in full or in part—depends on the valve classification.

3 **ACRONYMS**

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
ASME	–	American Society of Mechanical Engineers
ASN	–	Autorite de Surete Nucleaire (French nuclear safety authority)
ASTM	–	American Society for Testing and Materials
DN	–	Nominal Diameter
DTR	–	Drain Tank Room
DW	-	Dead Weight
EN	–	European Standard
ESP	–	Equipements Sous Pression
ESPN	–	Equipements Sous Pression Nucléaires
HRA	-	Hazard and Risk Analysis
I&C	–	Instrumentation and Controls
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
NCR	-	Non Conformity Report
NDE	–	Non-destructive Examination
NPMA	-	Nuclear Particular Material Appraisal
NO	-	Normal Operation
PBS	–	Plant Breakdown Structure
PED	–	Pressure Equipment Directive (equiv. ESP)
PIA	–	Protection Important Activity
PIC	–	Protection Important Component
PQR	–	Procedure Qualification Record
RTPO	-	Recognized Third Party Organization
SEP	-	Sound Engineering Practice
QA	–	Quality Assurance
QP	–	Quality Plan
SIC	–	Safety Importance Class
VVPSS	–	Vacuum Vessel Pressure Suppression System
WPS	–	Welding Procedure Specification

4 **APPLICABLE DOCUMENTS & CODES AND STANDARDS**

The orders, directives, codes and standards 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 Applicable and Reference Documents, the last approved version applies. IO will notify the Contractor if any of the documents listed in the table below will be updated.

Table 1, List of Applicable Codes and Standards

Codes and Standards		
[AD- 1]	EN 13480-1:2017	Metallic industrial piping – Part 1: General
[AD- 2]	EN 13480-4:2017	Metallic industrial piping - Part 4: Fabrication and installation
[AD- 3]	EN 13480-5:2024	Metallic industrial piping – Part 5: Inspection and testing

[AD- 4]	EN 593:2017 / A1:2021	Industrial valves – Metallic butterfly valves
[AD- 5]	EN 1983:2013	Industrial valves – Steel ball valves
[AD- 6]	EN 1984:2017	Industrial valves – Steel gate valves
[AD- 7]	EN 13709:2010	Industrial valves – Steel globe, globe stop and check valves
[AD- 8]	EN 1092-1:2018	Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories PN designated – Part 1: Steel flanges.
[AD- 9]	EN 12627:1999	Industrial Valves – Butt welding ends for steel valves.
[AD- 10]	RCC-E:2022	Design and Construction Rules for Electrical and I&C Systems and Equipment
[AD- 11]	RCC-M:2022	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-1:2022	Quality Assurance Requirements for Nuclear Facility Applications
[AD- 13]	ISO 724:1993	ISO general-purpose metric screw threads – Basic dimensions
[AD- 14]	ASME B18.21.1:2009	Heavy Helical Spring Lock Washers
[AD- 15]	EN 10204:2004	Metallic products – Type of inspection documents
[AD- 16]	EN 1591:2013	Flanges and their joints - Design rules for gasketed circular flange connections - Part 1: Calculation
[AD- 17]	ISO 17025:2017	General requirements for the competence of testing and calibration laboratories
[AD- 18]	ISO 9001:2015	Quality management systems - Requirements
[AD- 19]	ISO 9712:2021	Non-destructive Testing - Qualification and Certification of NDT Personnel
[AD- 20]	SSPC-1:2015	Solvent Cleaning
[AD- 21]	SSPC-2:2018	Hand Tool Cleaning
[AD- 22]	SSPC-5:2007	White Metal Blast Cleaning
[AD- 23]	SSPC-10:2007	Near-White Metal Blast Cleaning
[AD- 24]	IEC/IEEE 60980-344	Nuclear facilities – Equipment important to safety – Seismic qualification
[AD- 25]	EN 12570:2000	Industrial valves: Method for Sizing the Operating Element
[AD- 26]	EN 12266:2012	Industrial valves – Testing of valves – pressure tests, test procedures and acceptance criteria
[AD- 27]	EN 13555:2014	Flanges and their joints – Gasket parameters and test procedures relevant to the design rules for gasketed circular flange connections
[AD- 28]	EN 10269:2013	Steels and nickel alloys for fasteners with specified elevated and/or low-temperature properties
[AD- 29]	EN 3834-2:2021	Quality requirements for fusion welding of metallic materials - Part 2: Comprehensive quality requirements
[AD- 30]	EN 15614-1:2017	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 9692:2013	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 2516:1989	Aerospace series - Passivation of corrosion-resisting steels and decontamination of nickel base alloys
[AD- 33]	EN 17637:2016	Non-destructive testing of welds - Visual testing of fusion-welded joints
[AD- 34]	EN 17636:2022	Non-destructive testing of welds - Radiographic testing - Part 1: X- and gamma-ray techniques with film

[AD- 35]	ISO 10675-1:2022	Non-destructive testing of welds — Acceptance levels for radiographic testing — Part 1: Steel, nickel, titanium and their alloys
[AD- 36]	EN 11666:2018	Non-destructive testing of welds - Ultrasonic testing - Acceptance levels
[AD- 37]	EN 17640:2018	Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment
[AD- 38]	EN 9606-1:2017	Qualification testing of welders – Fusion welding – Part 1: Steels
[AD- 39]	EN 4126-1:2013	Safety devices for protection against excessive pressure - Part 1: Safety valves
[AD- 40]	IEC 60947-5-1:2016	Low-voltage switchgear and control gear - part 5 control circuit devices and switching elements - section 1, electromechanical control circuit devices
[AD- 41]	EN 12982:2000	End-to-end and centre-to-end dimensions for butt welding end valves
[AD- 42]	EN 1515-4:2009	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_22MFG4	Quality Requirements for IO Performers
[AD- 44]	ITER_D_VT29D6	Instruction for Seismic Analysis
[AD- 45]	ITER_D_35BVV3	Instructions for Structural Analyses
[AD- 46]	ITER_D_2LTQ96	Radioprotection guide for ESPN application
[AD- 47]	ITER_D_XB5ABP	Equipment Qualification Program
[AD- 48]	ITER_D_KTU8HH	Software qualification policy
[AD- 49]	ITER_D_28QDBS	ITER Numbering System for Components and Parts
[AD- 50]	ITER_D_X3NEGB	Working Instruction for the Delivery Readiness Review (DRR)
[AD- 51]	Attachment of ITER_D_833S4E	Valve list for VVPSS system
[AD- 52]	ITER_D_44SZYP	Working Instruction for Manufacturing Readiness Review
[AD- 53]	ITER_D_22F53X	Requirements for DA / Supplier / Subcontractors Deviations & Nonconformities
[AD- 54]	ITER_D_258LKL	Quality Assurance for ITER Safety Codes Procedure
[AD- 55]	ITER_D_4EUQFL	Overall supervision plan of the chain of suppliers for Safety Important Components, Structures and Systems and Safety Related Activities
[AD- 56]	ITER_D_22MFG4	ITER Procurement Quality Requirements
[AD- 57]	ITER_D_82MXQK	General Management Specification for Service and Supply (GM3S)
[AD- 58]	ITER_D_74C73Q	Guideline for allowable loads for valves with flanged connection
[AD- 59]	ITER_D_XB5ABP	Qualification of Protection Important Components (PIC)
[AD- 60]	ITER_D_ADCXXD	Guidelines for qualification of mechanical equipment
[AD- 61]	ITER_D_98JL4W	Test method for ITER equipment for static magnetic fields
[AD- 62]	ITER_D_ADD99Y	Guidelines for qualification of electrical and I&C equipment
[AD- 63]	ITER_D_22F53X	Procedure for Management of Nonconformities
[AD- 64]	ITER_D_AKFUMQ	Guidelines for qualification by analysis
[AD- 65]	ITER_D_AGL2QP	Technical Specification for the Experimental Seismic Qualification of Active Electrical and Mechanical Components

Table 3, List of Applicable Orders and Directives

Applicable Regulatory Documents		
[ARD- 1]	PED/ESP	European Pressure Equipment Directive 2014/68/EU of 15 th 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 30 th of December 2015 on nuclear pressure equipment. Consolidated version after the 1 st 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 Intervenors
[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
[RD- 17]	ITER_D_BK7Y2G	Template for Equipment Identification file
[RD- 18]	ITER_D_AQKXEH	Template for Qualification Strategy
[RD- 19]	ITER_D_BXTPJP	Template for Qualification Dossier
[RD- 20]	ITER_D_BXTNRJ	Template for Qualification follow-up document
[RD- 21]	ITER_D_BXTLMX	Template for Qualification Preservation Sheet
[RD- 22]	ITER_D_B9HR4D	Template for Qualification Plan
[RD- 23]	ITER_D_BXTDJE	Template for Qualification Synthesis Report
[RD- 24]	ITER_D_BXD2SS	Template for Qualification Test Specifications
[RD- 25]	ITER_D_BXTMAL	Template for Reference File
[RD- 26]	ITER_D_BXSQE9	Template for Qualification Test Report
[RD- 27]	ITER_D_AGL2QP	Technical Specification for the Experimental Seismic Qualification of Active Electrical and Mechanical Components
[RD- 28]	ITER_D_2ERTXQ	Load Specifications for Buildings with Safety Requirements
[RD- 29]	ITER_D_UXX829	Loads Case Specification VVPSS -RL

5 SCOPE OF 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 executing this Contract. At the tender stage, the contractor shall present a proposal to meet the ultimate goal of this specification, 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 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 and provide the following information:
 - Confirmation of the most suitable valve type and geometry selected, ensuring compliance with the VVPSS process and structural integrity requirements.
 - Selection of the end connections (e.g. butt-welded joints or flange type, class, bolts and design parameters), all of which comply with the VVPSS process and structural integrity requirements.
 - Choice of gasket type, geometry and material that demonstrate compliance with the VVPSS leak-tightness requirements.
 - Sizing and selection of the valve actuators.
 - Submission of all geometry data, models and drawings required for the integration of the valve into the VVPSS CAD model.
 - Provide all the mandatory qualification documentation, according to the required maturity level.
 - Provide all the mandatory documentation needed for the Final Design Review.
- **Task 2: Manufacturing** – The Contractor shall manufacture the VVPSS valves in line with the approved valve's drawings, design codes and ESPN regulations.
 - Approval of all the mandatory documentation needed for the Manufacturing Readiness Review.
- **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 to certify 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 begin after the approval of the internal ITER design gate. It is anticipated that the contract will be put on hold after the completion of Task 1, until the ITER Final Design Review, which is an internal ITER process, is completed. The target timeframe for the VVPSS Final Design Review is set from Q1 to Q3 of 2026.

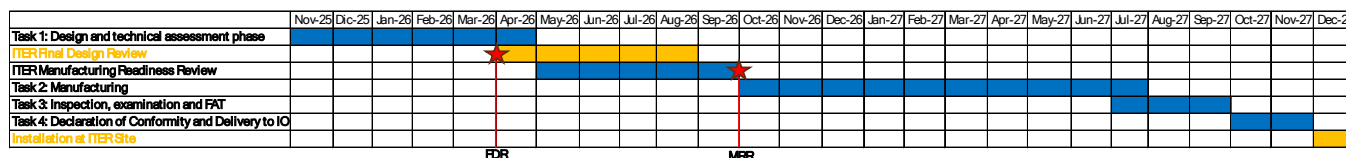


Figure 1, Estimated timeline for the delivery of IO-qualified valves

5.1 APPLICABILITY OF THE TECHNICAL SPECIFICATION

This technical specification refers to approximately 200 valves, categorised by various types, regulatory, and safety classifications. The table below outlines the applicability of each section of this specification based on the valve type and class.

Three categories have been identified:

1. ESPN Valves;
2. Protection Important Valves – Non-ESPN;
3. Non-Protection Important Valves.

Table 5, Applicability of the technical specification for each valve group

Tech Spec Section	ESPN Valves	PIC, Non-ESPN Valves	Non-PIC Valves	Comments
§5.2.1	X	Part	Part	For non-ESPN valves, only PED rules apply.
§5.2.2	X	X	X	
§5.2.3	X	X		
§5.2.4	X	X	X	
§5.2.5	X	X		For Non-PIC Valves, the valve datasheet applies.
§5.2.6	X	X		For Non-PIC Valves, structural integrity shall be maintained during SL-2 seismic events. No damage to SC-1 equipment (e.g. the actuator must remain securely attached to the valve, and no structural failures) shall occur. For Non-PIC Valves, environmental conditions shall be taken into account, as per the valve datasheet.
§5.2.7	X	X	Part	For Non-PIC Valves only one Type 3.1 certificate is sufficient. Control on sensitisation ASTM A262, Practice A is required.
§5.2.8	X	X	X	
§5.2.9	X	X	Part	For Non-PIC Valves, PED requirements apply.
§5.2.10	X	X		For Non-PIC Valves, the MRR only consists of the approval of the valve datasheet, drawings and material certificates.
§5.2.11	X	X	Part	For Non-PIC Valves, PED requirements apply.
§5.2.12	X	X		
§5.2.13	X	X	Part	For Non-PIC Valves, only the Pressure Test according to PED rules is required.
§5.2.14	X	X		For Non-PIC Valves, the Contractor shall only provide specific dimensional requirements for the maintenance of the valves.
§5.2.15	X	X		
§5.2.17	X	X		
§5.2.18	X	X		For Non-PIC Valves, EN standards apply.
§5.2.19	X	X	Part	For Non-PIC Valves, only packing requirements apply.
§5.3.1	X	X	X	
§5.3.2	X	X		
§5.3.3	X	X	X	
§5.3.4	X	X		
§8.1	X	X		
§8.2	X	X	Part	For Non-PIC Valves, the following documents are required. Assembly, 3D models and detail drawings; Bill of Materials. All the documents required for the PED declaration of conformity.
§8.3	X	X	Part	For Non-PIC Valves, the manufacturer shall only take into account the presence of ITER Design Gates, as described in Section 5, 5.2.10.

§9	X	X	X	
§10	X	X		

5.2 GENERAL REQUIREMENTS APPLICABLE TO VALVES AND ACTUATORS

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

All VVPSS valves shall be considered pressure accessories and shall be assessed for their conformity to PED/ESPN rules before being sent to IO.

5.2.1 Declaration of Conformity to PED – ESPN regulations

- According to the ESPN classification, see valve datasheet [AD- 51], 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”, 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 and proven relevant certification.

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 before their undertaking and reports submitted in the manufacturing dossier.

5.2.2 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. IO shall accept the alternative codes.

5.2.3 Qualification of ITER Protection Important Components

As stated in [AD- 59], this procedure applies to all active and passive PICs.

Equipment shall be qualified according to the following methods:

- Qualification by testing;
- Qualification by analysis (analogy/similarity, calculation, FEM);
- Qualification by the combination of both above methods.

Note, the Contractor is invited to provide information regarding its qualification experience and capabilities during the bidding process.

As a general rule, the qualification should be performed considering the last day of ITER operation life when the PIC equipment is aged. If the effects of ageing are demonstrated to be negligible, the ageing test could be avoided.

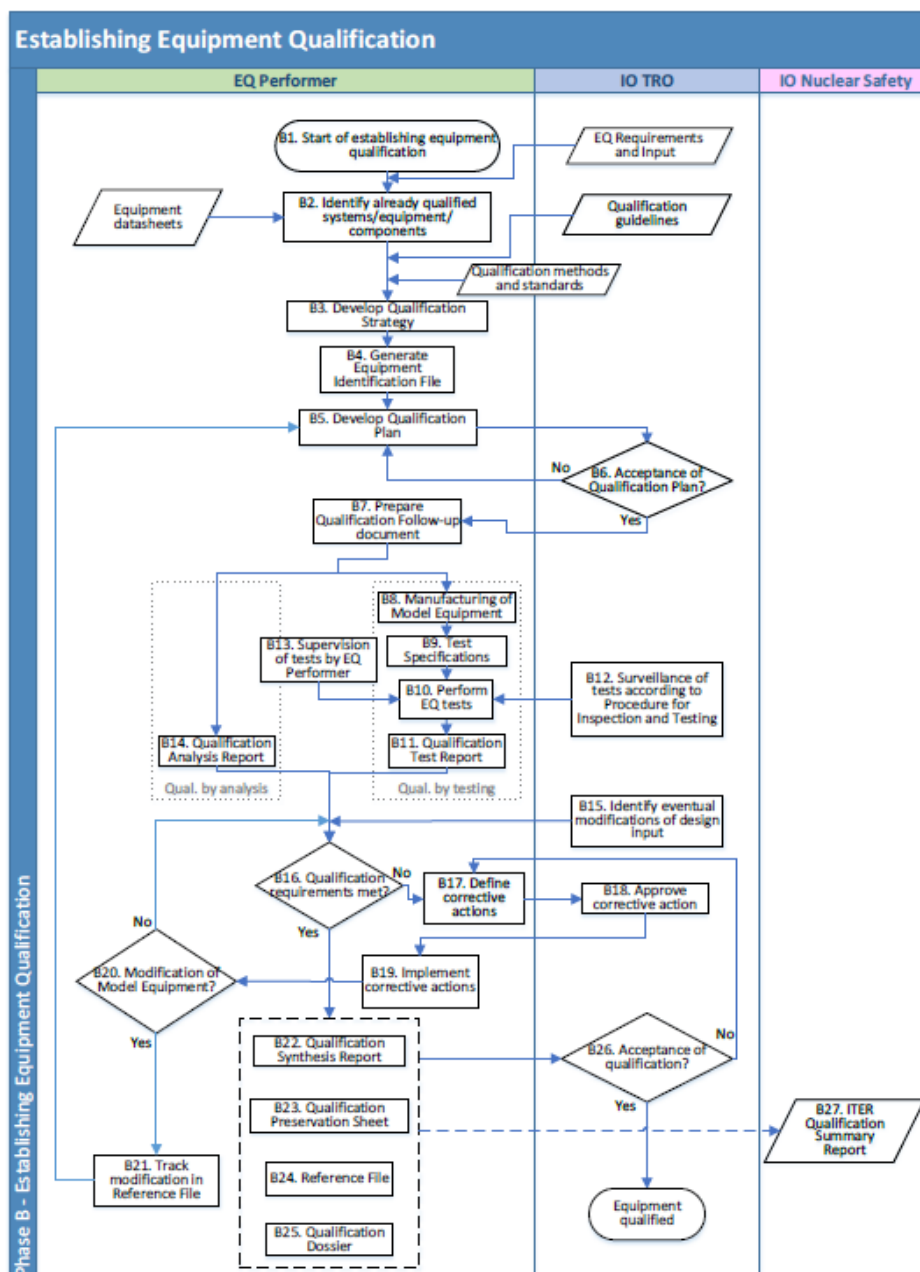
It is the responsibility of the IO to provide the Contractor with all the design input data.

Table 6 provides the qualification documents maturity at the end of the design phases.

Table 6, Qualification documents maturity

Output	Final Design Review	Manufacturing Readiness Review, see 5.2.10
List of equipment to be qualified	Complete	
Identification File	Preliminary	
Qualification plan	Preliminary	
Qualification Test Specifications		Complete
Qualification Test Report		Complete
Qualification Analysis Report		Complete
Qualification Synthesis Report		Complete
Qualification Preservation Sheet		Complete
Reference file		Complete

Once the design input data are submitted, the Contractor, as Equipment Qualification Performer, shall follow the following steps:



5.2.3.1 Qualification of ITER Mechanical Components

Guidelines for the qualification of ITER mechanical components are available in [AD- 60].

Note, IO recommends the use of RCC-M, Volume Q [AD- 11] to complement what is indicated in [AD- 60].

- The Contractor shall identify the equipment or assembly in the Identification File.
- Associated components shall be included in the scope of the qualification (Q3000 of RCC-M), such as:
 - Drive elements;
 - Auxiliary components;
 - Interface between components.

Note, to reduce time and cost, it is possible to test a specimen to cover different dimensions of the same equipment. It requires a justification that the qualification of the parent reference specimen can be extended to other specimens. The Contractor shall refer to Table 2 of [AD- 60], which defines the rules for the extension (analogy) of the qualification for various valve technologies.

- The Contractor shall justify the compliance between the qualified model and series production (Q 1500, Q 1600 and Q 1700 of RCC-M).

5.2.3.2 Qualification of ITER Electromechanical Components

Guidelines for the qualification of ITER mechanical components are available in [AD- 62].

Note, IO recommends the use of RCC-E [AD- 10] to complement what is indicated in [AD- 62].

5.2.4 Lifetime

Equipment shall have a design life of 25 years excluding items such as gaskets and packing.

From a qualification perspective, the lifetime starts at the end of manufacturing and so the duration spent in the warehouse and installation can be considered as follows:

- Storage at the ITER warehouse: up to 3 years – equipment in standby - not energised, not operated. Storage Level C is considered.
- Installation: up to 2 years – equipment in standby (not energised, not operated).
- Operation: up to 20 years.

State	Storage - Level C	Installation	Operation
External Pressure	Atmospheric pressure		As per the valve datasheet
Internal Pressure			
Temperature	-8°C to +40°C indoor, no temperature control		
Humidity	0 to 100% (not controlled)		
Electromagnetic field	N/A		
Seismic	As per the valve datasheet		
Fire	As per the valve datasheet		

5.2.4.1 Ageing

The ageing of VVPSS valves is not addressed in this technical specification for the following reasons:

- All VVPSS valves are located in the ITER B11 facility, which maintains a controlled temperature and humidity environment.
- The VVPSS system is not continuously operational within ITER; it is estimated that the valves are cycled less than 100 times over their lifetime.
- The VVPSS system experiences only low levels of vibration, typical of a standard industrial environment.
- While VVPSS valves are exposed to irradiation during ITER plasma operation, neutron qualification is required only when electronic devices are incorporated.

5.2.5 Operating Conditions

- Operating and design conditions to be satisfied, for each valve application, are given on the valve datasheet [AD- 51] and the table below. The design of each valve/actuator shall satisfy the requirements of this specification as a minimum.

- 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.

5.2.5.1 Relevant VVPSS Load Specification

For components classified as Protection Important (PIC), qualification is carried out taking into account all accidental events.

Load Case	Internal Pressure [bara]	External Pressure [bara]	Temperature [°C]	Service Level
Hydrostatic test	Column <i>Pressure test</i>	1	30	A
Design conditions (PS, T _d)	Column <i>Maximum Allowable Pressure (PS)</i>	1	Column T _d	A
External DTR accident	Column P _{ope}	Column <i>Max Ambient P</i>	Column <i>Max Ambient T</i>	A
Fire in DTR	Column P _{ope}	1.05	Environment <i>Max Fire T</i>	C (2h)
Normal Operation+SMHV	Column P _{ope}	1	Column T _{ope}	A
Normal Operation+SL-2	Column P _{ope}	1	Column T _{ope}	Column SC Where (SF): A Where (S): C
Normal Operation+SL-3	Column P _{ope}	1	Column T _{ope}	Column SC Where (SF): A Where (S): D

5.2.6 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.
- Analysis reports shall be produced according to the template for the ITER 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.

5.2.6.1 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- 45].
- The allowable loads for valves with flanged end-connection shall be calculated by the Contractor (an example is provided in [AD- 58]). The contractor is responsible for designing/selecting the flanges to ensure the VVPSS leak tightness according to EN 1591-1.
- 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- 48]. All files in ANSYS or other software to make a calculation shall be submitted to IO.

5.2.6.2 Seismic Qualification

It is recommended that the Contractor provides since the beginning a detailed quotation and planning of the activities that consider the selected 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- 51], the following classification is provided:

- SC-1 (SF) = Structural and functional performance both after and/or during the earthquake. Specific functions for each valve are provided in the valve datasheet.
- SC-1 (S) = Structural stability/integrity maintained during an earthquake.
- SC-2 = No damage to SC-1 equipment (e.g. the actuator must remain securely attached to the valve, and no structural failures should occur).

For VVPSS valves, the IO defines two seismic levels according to [RD- 30]:

- SMHV: Maximum historical probable earthquakes – a factor of 0.8 will be applied to the SL-2 FRS.
- SL-2: Design Response Spectra is defined by two spectra: SMS (Séisme Majoré de Sécurité – safety enhanced earthquake) and paleo spectra. In IEC/IEEE 60980-344 this is referred to as Safe Shutdown Earthquake.
- SL-3: Design Extension Earthquake (Séisme Noyau Dur – SND).

The methodology for seismic qualification of valves can be obtained from the guidelines for qualification by analysis [AD- 66] and the ITER Instruction for Seismic Analysis [AD- 44]. The methodology for performing seismic qualification by testing can be obtained from [AD- 67].

Qualification to seismic resistance can be performed by tests, analysis or mixed/combined methods.

Note, the qualification by analysis alone is recommended only for the analysis of the structural integrity of the equipment and its mounting; it is not recommended for analysing equipment functionality.

Appendix 1 provides the Contractor with either the Floor Response spectrum or an envelope acceleration regime.

5.2.6.2.1 Seismic Qualification Test Sequence

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/IEEE 60980-344 Nuclear facilities – Equipment important to safety – Seismic qualification [AD- 24]. For seismic tests, it is recommended to use seismic spectra with 5% damping for all kinds of equipment.

The seismic tests will have to be implemented after ageing preparation and tests.

The test sequence to be respected is described in [RD- 31].

5.2.6.2.2 Acceptance Criteria

	Structural Integrity	Leak Tightness	Operability
Isolation Valves	No broken parts, no deformation, no overturning.	No leaks out of the pressure boundary. Nozzle connection is maintained during and/or after the earthquake.	Flows normally. Valve disc is free to move. Voltage of motor. Open to Close and reverse.
Check Valves		No leak backwards Nozzle connection is maintained during and/or after the earthquake	Flows normally.

5.2.6.3 Load and Environmental Qualification

5.2.6.3.1 Static Magnetic Field

The tests should be conducted according to the ITER test method [AD- 63].

- Environmental qualification of the valves shall be performed at the bounding environmental conditions, as specified in the valve datasheet [AD- 51], 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- 51].

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.

5.2.6.3.2 Fire

- The contractor shall guarantee the structural integrity of PIC components 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- 51]. 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- 51].
- 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.

5.2.6.3.3 Neutron irradiation

The valves and actuators are subjected to irradiation during ITER plasma operation. The irradiation dose is provided in the valve datasheet [AD- 51]. The Contractor should avoid having any electronic devices.

- The Contractor shall demonstrate that the supplied valve is qualified against this threshold 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.

5.2.7 Materials

- The material selected for the VVPSS valves is 304L Austenitic Stainless Steel.

Valve materials		
Cast items	ASTM A351 CF3	EN 10213 Grade GX2CrNi19-11 (1.4306)
Forged items	ASTM A182 F304L	EN 10222-5 Grade X2CrNi18-9 (1.4307)
Items fabricated from plate material	ASTM A240/A240M	EN 10088-2 Grade X2CrNi18-9 (1.4307)

- Any deviation from this material shall be agreed with IO and, in any case, compatible with the VVPSS piping assembly, which is EN piping made of 1.4307 stainless steel, grade 304L.
- To ensure the VVPSS meets the radioprotection guidelines as stipulated in the Radioprotection Guide for ESPN Application [AD- 46], 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 7, Impurities maximum compositions

Location	Composition, % (maximum, unless otherwise indicated)			
	Co	Nb	Ta	B
11-L1-CNB	< 0.05	< 0.1	< 0.01	Recommended < 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 decreased 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].

5.2.7.1 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.

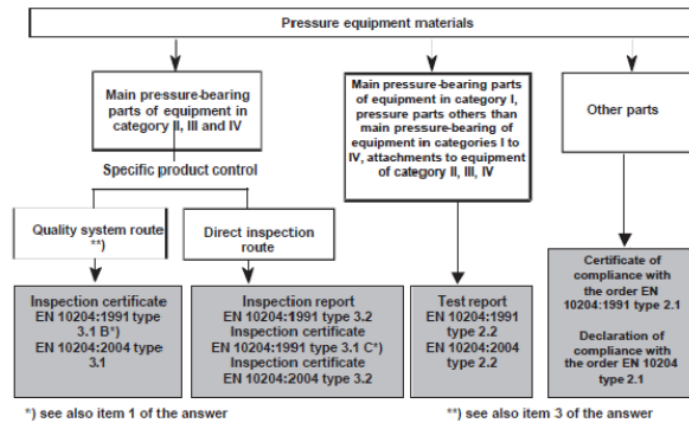
5.2.7.2 Material Testing Requirements

- 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], certified by a competent body established within the EU and having undergone a specific assessment for materials.
- 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.

Note, Considering the function of gaskets, inspection documents should be the type 2.2 [AD- 15]. As the gasket is not the main pressure-bearing part of the equipment, it is not necessary to have type 3.1 or 3.2 in terms of this regulatory framework.



5.2.7.3 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-51], 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.

5.2.7.4 Sensitization

- The contractor must ensure that intergranular corrosion is completely avoided. The Contractor shall perform at least ASTM A262, Practice A, E and finally provide a detailed view of microstructures with SEM observations.

5.2.8 Flanged Connections

Above all other requirements of this technical specification, the Contractor shall ensure that flange-connected valves comply with the leak tightness requirements specified in the valves datasheet.

- 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 confirming the pressure class of the selected flanges, based on the Maximum Allowable Pressure (PS) and Maximum Allowable temperature (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 shall be provided with two counter-flanges, and adequate bolts/studs, 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 5.2.12.2.
 - The Contractor shall be able to identify minimum gasket compression stress for assembly (Qa), testing (Qmin) and operation/accidents (Qsmin), as per [AD- 16].

5.2.8.1 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.
- The minimum strength of the material used for the nuts and bolts shall meet the requirements of EN 3506-1 [AD- 28].

5.2.9 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.
- 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].
- All base metal repair welding shall be treated through IO NCR, according to [AD- 65]. The size and location of the repair shall be specified in the as-built drawings.
- 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 2.2 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.
- The welding procedure qualification record and welder shall be approved by the Notified Body or RTPO.

5.2.9.1 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].
- 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 50 mm 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.

5.2.9.2 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 6.3 µm.

- All coating systems must be applied following the Contractor's recommendations.

5.2.10 Manufacturing Readiness Review

- Following the approval of the MIP, a Manufacturing Readiness Review (MRR) shall be conducted in line with [AD- 52] 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 approve the start of manufacturing. For the final approval, the following documentation shall be presented:

- Procedures for special processes;
- All manufacturing drawings;
- Qualification documentation;
- Material test certificates;
- Engineering analyses;
- Personnel qualification.

5.2.11 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 (MIP) shall be prepared by the Contractor that meets the requirements of ITER MIP [AD- 43]. All testing shall be recorded as required by the referred standard for the relevant testing method. If testing is not recordable, the testing quality shall be ensured by quality control of the testing process.

Note, 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- 43].
- Non-destructive examinations shall be performed on the cast, forged, rolled, wrought or fabricated material after heat treatment required by the material specification.
- Examination personnel shall be qualified and certified by ISO 9712 [AD- 19].
- NDE reports shall be catalogued according to the weld maps.

Note, the IO reserves the right to inspect all Non-Destructive Examination (NDE) reports for auditing purposes.

Testing method		Visual Inspection	Magnetic Particle	Liquid Penetrant	Radiography	Ultrasonic
ESP SEP (gas, liquid)		Code ¹				
ESP I, II, III (gas, liquid)						
ESPN 0, I, II,	N3					
III (gas, liquid)	N2				100% RT or 100% UT	
1Code shall mean ASME B31.3 or EN13480-3 except if stringent requirements due to hazard analysis are specified in the Contract Documentation.						

5.2.11.1 Visual Inspection

The visual examination is considered a "Special Process".

- All finished welds shall be subject to visual examination.
- 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 on 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.

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

5.2.11.2 Volumetric Examination

- For PED/ESPN N2 components, all pressure boundary welds shall be 100% volumetrically inspected. The Contractor may choose Radiography or Ultrasonic inspection as appropriate.
- Full volumetric inspection shall also be performed on end-connections. The Contractor shall ensure that the weld configuration allows the 100% volumetric inspection at the ITER site.
- For PED/ESPN N3 components, the rules of EN13480-3 applies.

5.2.11.2.1 Radiography Inspection

The 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.

5.2.11.2.2 Ultrasonic Inspection

The 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.

5.2.11.3 Surface Examination

The 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.

5.2.11.4 Wall Thickness Measurements

The dimensional inspection is considered a "Special Process".

- The wall thickness of the pressure boundary shall be measured.
- 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.
- The Contractor shall ensure that the sizing of critical pressure parts takes into account the worst-case tolerance analysis

5.2.11.5 Acceptance Criteria

The acceptance criteria shall meet the requirements of EN ISO 17635.

Defect	Permitted Maximum
Inclusions – Tungsten or Copper	Not permitted
Elongated pores / wormholes	Not permitted
Linear porosity	Not permitted
Profile Defect - Undercut	some intermittent undercut is permitted if the depth does not exceed 0.5mm for $t > 3\text{mm}$ or 10% for $t < 3\text{mm}$. Undercut shall blend smoothly with the parent material

5.2.12 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:

- Assembly (external) leak test;
- Valve closure and leak (internal) 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.

5.2.12.1 Assembly (External) Leak Test

Leak testing is considered a "Special Process".

- The acceptability leak-rate threshold is indicated in the valve datasheet [AD- 51]. The Contractor shall demonstrate compliance with the required leak threshold according to EN 1591. The Contractor shall provide IO with the necessary gasket compression rate.
- **Independently from what is defined in the valve datasheet, the Contractor, for those valves classified as Tritium Class TC-2A, shall ensure that the total leak rate does not exceed $10^{-5} \text{ Pa.m}^3.\text{s}^{-1}$ at design conditions**, see the ITER Tritium Handbook para. 7.1 [RD- 3].
- A helium 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.

5.2.12.2 Valve Closure and Leak Tightness Test

- The valve seat leakage rate shall conform to the requirements defined in the valve datasheet.
- The Contractor shall define the valve's maximum and minimum closing time to avoid damages/wedging.

5.2.12.3 Functional Test

- All manual and power-operated actuators shall be subjected to functional qualification tests at the design service pressure as stated in the valve datasheet [AD- 51].
- 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- 51]. 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.

5.2.13 Final Assessment Procedure

As part of the PED/ESPN conformity assessment, the following sequence of actions shall be performed and recorded:

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

5.2.13.1 Document Check

- As defined in Section 5.2.1, the Contractor shall be responsible for producing all relevant PED/ESPN documents, which will enable the conformity assessment procedure. The full list of documents to be produced during the different design, manufacturing and testing phases is provided in [RD- 1].

5.2.13.2 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. 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.
- For those valves performing the function of "isolation" or classified as "last pressure barrier", the internals shall be also pressure tested.
- The minimum test pressure shall conform to the PED Annex I, 7.4 [ARD- 1].
- All joints, including welds, shall be left uninsulated and exposed for examination during the test.
- The hydrostatic test pressure shall be maintained for at least 30 minutes.

5.2.13.3 Visual Examination

- Visual examination shall be performed according to Section 5.2.11.1.

- The visual inspection must be conducted on every part of the equipment, both internally and externally, during manufacturing only when it becomes impossible to examine during final inspection.

5.2.14 In-service Inspection and Maintenance

- The minimum periodicity for preventative maintenance shall be 4 years.
- The minimum periodicity for in-service inspection shall be 40 months.
- The Contractor shall provide specific dimensional requirements for the maintenance of the valves.
- 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).

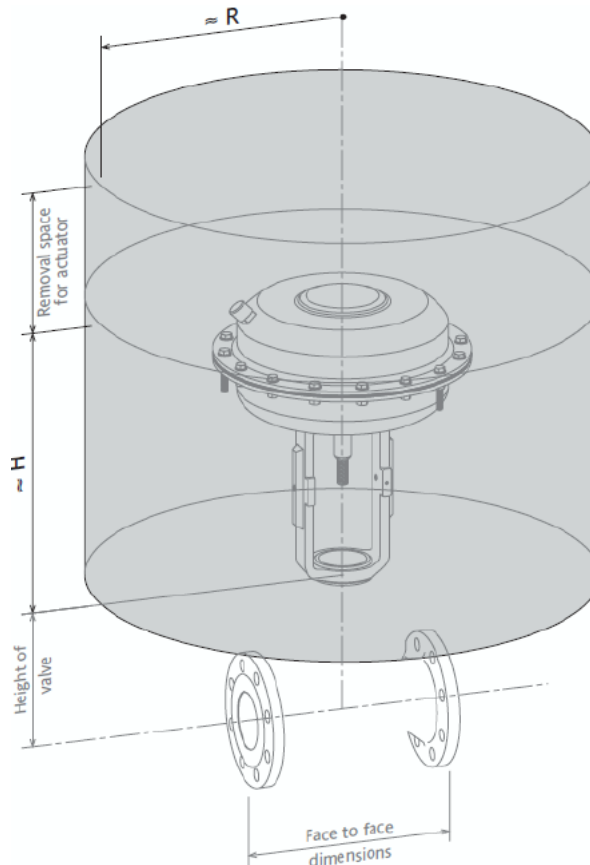


Figure 2, Valve clearance area for maintenance activities

5.2.15 Obsolescence Management

- The Suppliers shall have in place a policy of technical continuity regarding product lifecycle management.
- The Suppliers shall indicate in their proposal:
 - o End date of the commercial availability of the product version,
 - o End date of the commercial availability of the spare parts,
 - o End date of the product support by the original equipment manufacture

5.2.16 Spare Parts

- The Contractor shall recommend parts that should be stocked as spare parts for the first two years of the valve's operation. 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 of the part or similar pieces of equipment, and the 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.

5.2.17 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.

5.2.18 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.

5.2.19 Cleanliness and Packaging

5.2.19.1 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 cleanliness.
- The exterior surfaces of the valves and actuators shall meet the requirements for ASME NQA-1 [AD- 12] Table 302.5 Class C cleanliness 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.

5.2.19.2 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.

- The nameplate shall have suitable information as per the PED Essential Safety Requirement 3.3.

5.2.19.3 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.

5.3 VALVE ACTUATORS

The actuator, as part of the valve, should be able to perform its safety function in same conditions as the valve shall operate.

The Contractor shall design, fabricate, assemble, test and deliver the valve actuators described in the valve datasheet [AD- 51] including the required accessories, spare parts, special tooling, and documentation to the IO.

The actuator qualification should comply with electric qualification requirements gathered in [AD- 64].

5.3.1 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- 51].
- 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 supply 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 5.2.6.3.

5.3.2 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.

5.3.3 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.

5.3.4 Declaration of Conformity to Machinery Directive/EMC Directive

- 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].

6 LOCATION FOR SCOPE OF WORK EXECUTION

The Contractor can perform the work at their own location.

7 IO DOCUMENTS & IO FREE ISSUE ITEMS

7.1 IO DOCUMENTS

Under this scope of work, IO will deliver the following documents by the stated date:

Ref	Title	Doc ID	Expected date
1	Valves datasheet	Attachment of ITER_D_833S4E	Document for tender

8 LIST OF DELIVERABLES

8.1 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].

8.2 MANUFACTURING DOSSIER

All the following documents shall be submitted to IO for acceptance.

Contract Documentation

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

Design Documentation

- List of standards used and solutions adopted to meet the applicable requirements;
- Preliminary Qualification Dossier

- Qualification Strategy, using template [RD- 18];
- Equipment Identification Files, using template [RD- 17];
- Qualification Plan, using template [RD- 22].
- 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;
- Hazard and Risk Analysis.

Material Documentation

- Material test reports;
- Material supplier's quality system certificate;
- Consumable list;
- Destructive test report;
- Nuclear Particular Material Appraisal.

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 – technical note justifying thickness in the case of a design by calculation;
- As-built drawings;
- Approval of welding documentation by RTPO or NB;
- 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, using template [RD- 19];
 - Surveillance of tests;
 - Identification and definition of corrective actions;
 - Qualification Test Specifications, using template [RD- 24].
 - Qualification Follow-Up, using template [RD- 20];
 - Qualification test reports, using template [RD- 26];
 - Qualification analysis reports, using template [AD- 66];
 - Qualification synthesis reports, using template [RD- 23];
 - Qualification preservation sheets, using template [RD- 21];
 - Reference file, using template [RD- 25]
- ESPN dossier;
- 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.
- Certificate of Conformity, issued by the Notified Body.

8.3 LIST OF DELIVERABLES

Table 8, list of deliverables

Deliverable	Description	Estimated due date	Contract Gate?	Percentage of Payment
D1.1	Kick-off meeting minutes	T0 + 3 days	No	-
D1.2	Approval of documents related to the " Contract documentation " section	T0 + 1 month	No	-
Hold Point (T1)	Approval of the Technical Note on the selection of valves and compliance with IO requirements. Approval of all the qualification documents needed for the Final Design Review and Preliminary Qualification Dossier	T0 + 3 months	Yes	5%
Completion of Task 1				
D2.1	Approval of documents related to the " Design documentation " section, excluding the Seismic analysis report	T1 + 4 months	No	-
D2.2	Approval of documents related to the " Material documentation " section	T1 + 5 months	No	-
Hold Point (T2)	Closure of the Manufacturing Readiness Review and approval of the Seismic analysis report. Approval of all the qualification documents needed for the MRR.	T1 + 6 months	Yes	20%
Completion of Task 2				
D3.1	Completion of the FAT	T2 + 12 months	No	-
D3.2	Approval of Manufacturing Dossier	T2 + 12 months	Yes	40%
Hold Point (T3)	Approval of ESPN dossier, which enables the shipment of the equipment	T2 + 12 months	No	-
Completion of Task 3				
D4.1	IO acceptance of the delivered equipment	T3 + 1 month	Yes	35%
Completion of Task 4				

9 QUALITY ASSURANCE REQUIREMENTS

For ESPN and PIC VVPSS valves, the Quality class under this contract is QC1, For Non-PIC VVPSS valves, the Quality class under this contract is QC2.

[AD- 59] GM3S section 7 applies in line with the defined Quality Class.

10 SAFETY REQUIREMENTS

The scope under this contract covers PIC and/or PIA and/or PE/NPE components, [AD- 59] GM3S section 5.3 applies.

11 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- 43] 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- 50], 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- 49]. 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.

12 SPECIFIC GENERAL MANAGEMENT REQUIREMENTS

The requirements defined in [AD- 57], Section 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.

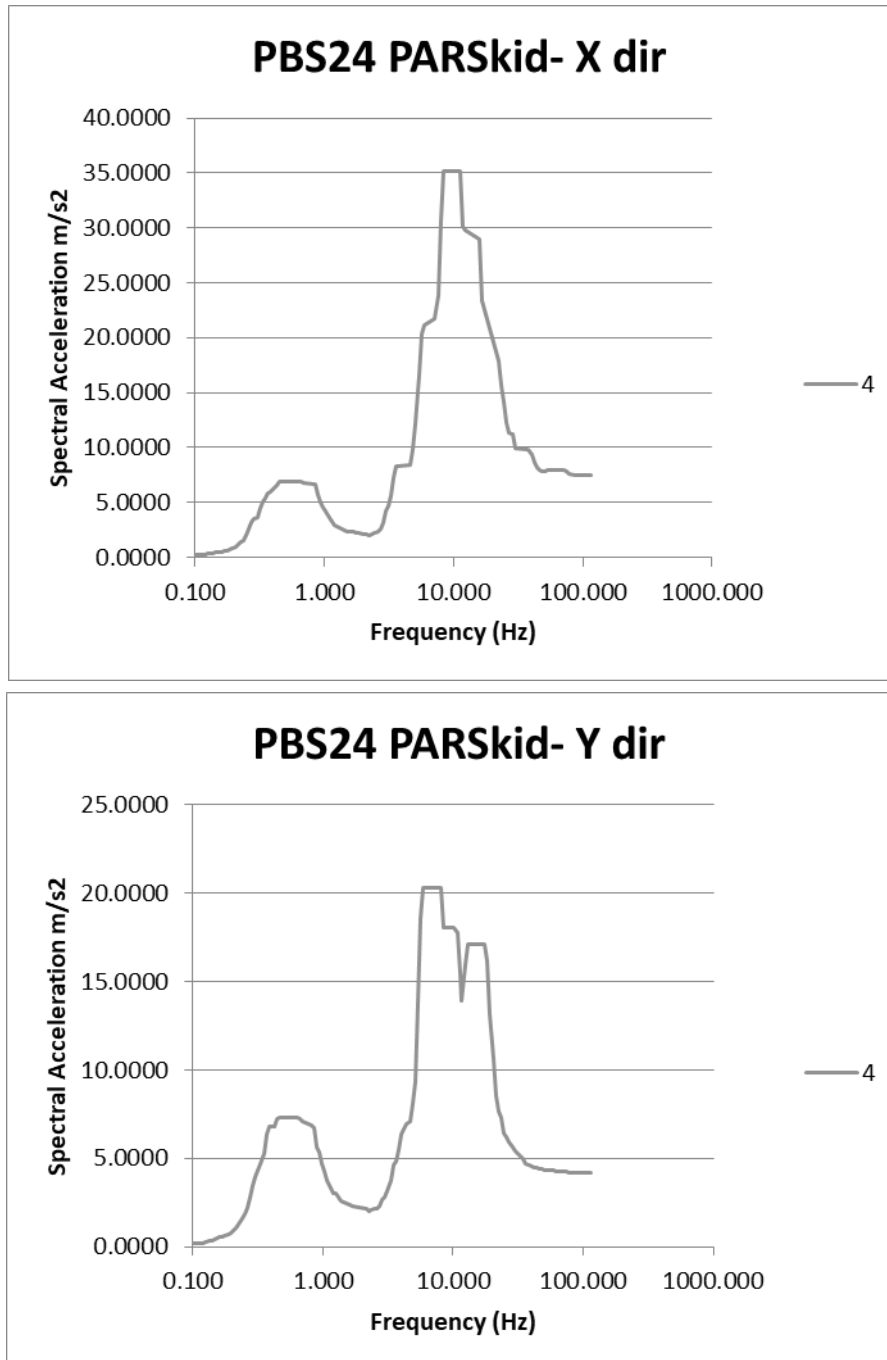
The Contractor shall provide the Deliverables corresponding to the Task assigned by IO in due time. The content of such Deliverables is described in Section 8.3.

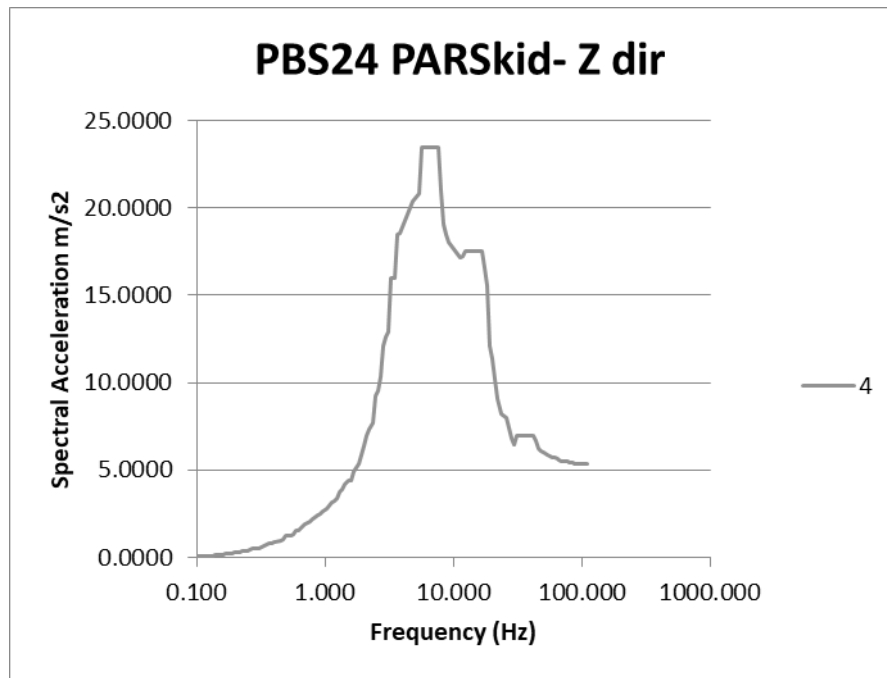
APPENDIX 1: FLOOR RESPONSE SPECTRA

VALVES LOCATED IN THE DRAIN TANK ROOM (11-B1/B2-01)

The tables below provide the Floor Response Spectra for SL-2 seismic events, in different locations. SL-3 events can be estimated by multiplying the SL-2 FRS by a factor of 1.5.

Seismic event SL-2





VALVES LOCATED IN 11-L3-02E

Seismic event SL-2

