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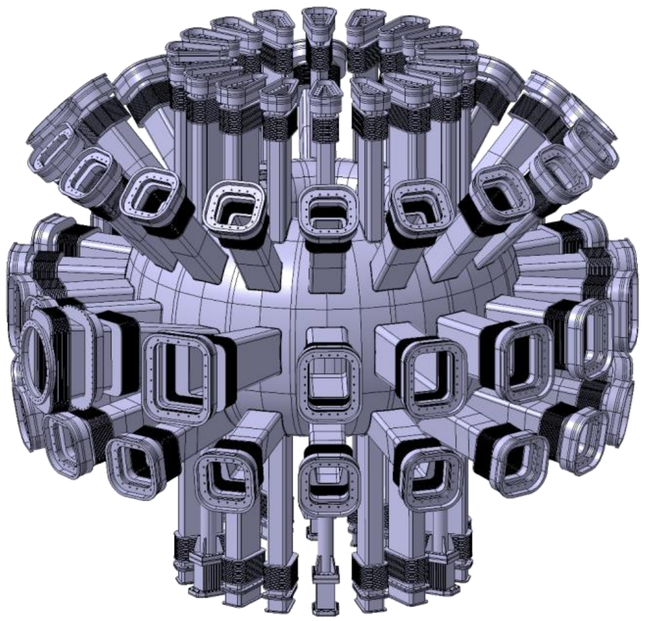
VVP tender: technical issues, planning and logistics



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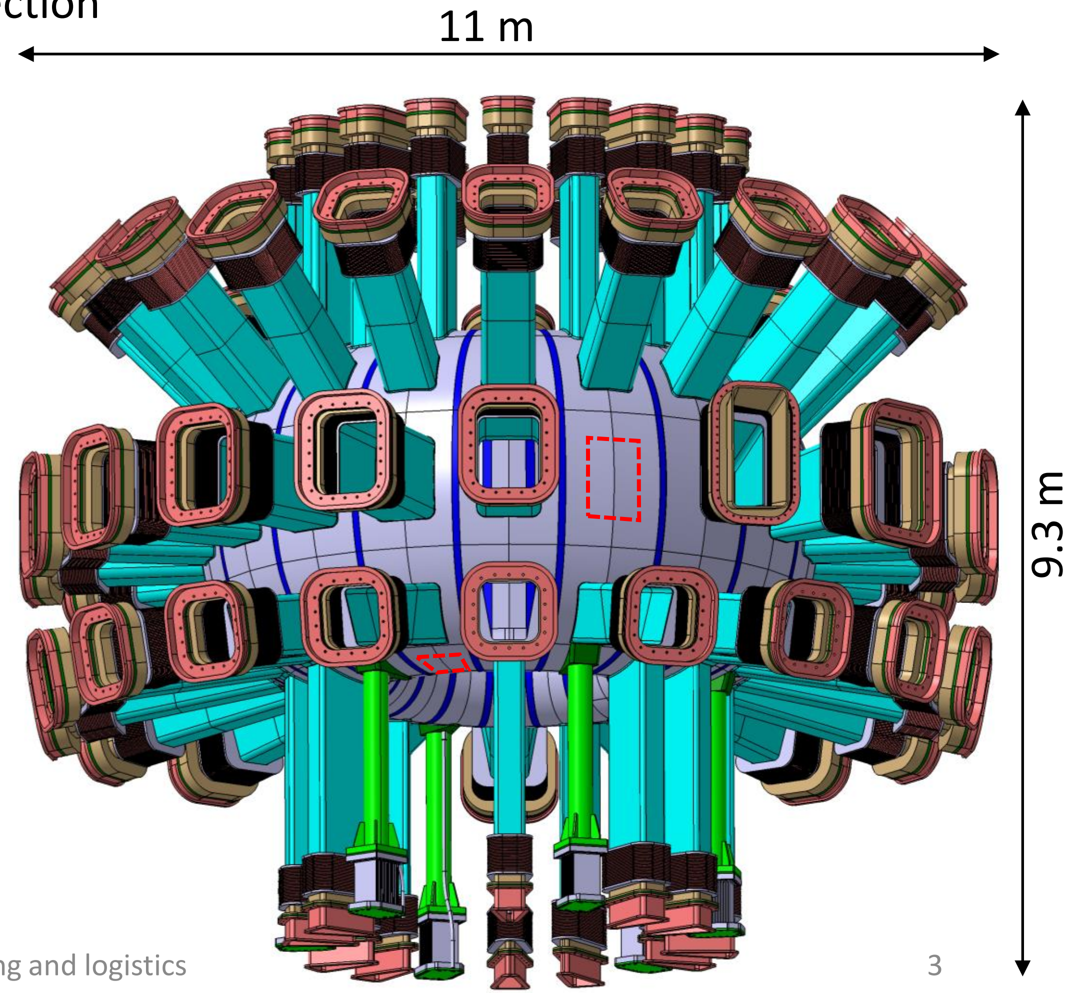
File updated on 30/09/2022

DTT INFO DAY – Procurement of the vacuum vessel, ports and related accessories

DTT vacuum vessel and ports: description

DTT Vacuum Vessel (VV) functions and characteristics:

- first vacuum boundary for the plasma
- toroidal configuration with double wall D-shaped poloidal cross section
- inter-shell filled with water (borated later) as neutron moderator during plasma operation, with nitrogen during baking (200 °C)
- division in 3 sectors (2 x 170° + 1 x 20° toroidally)
- inclusion of 82 ports located:
    - every 20° in the toroidal direction
    - in 5 poloidal positions enumerated from the top (port #1) to the bottom (port #5)
- inclusion of 6 gravity supports with spring plates for radial displ.
- In-vessel sensors integration: field welds (on site) of supports



port #3 of toroidal position #6 and
ports #5 of toroidal positions #3, #4, #6, #9, #12, #15, #18
are not foreseen

DTT vacuum vessel and ports: main parameters

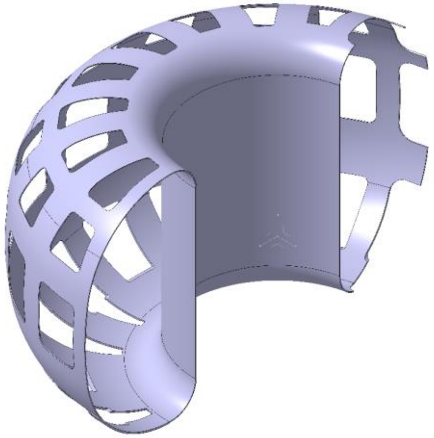
Parameter	Unit	Value
Torus outboard diameter	[mm]	6960
Torus inboard diameter	[mm]	2530
Torus height	[mm]	3910
Inner volume of the VV - plasma side	[m^3]	75
Material	--	1.4406 or 1.4429 (316LN) Co < 0.05 wt%
Weight	[ton]	37 (main vessel body) 185 (overall procurement)
Shell thickness (inboard, outboard) minimum	[mm]	15
Distance between shells (inboard)	[mm]	90
Distance between shells (outboard)	[mm]	200
Ports thickness	[mm]	15-20
Thickness of inter-shell ribs	[mm]	10-20
Inter-shell volume	[m^3]	13.5
External surface of the vacuum vessel (holes subtracted)	[m^2]	112

DTT vacuum vessel and ports: manufacturing strategy

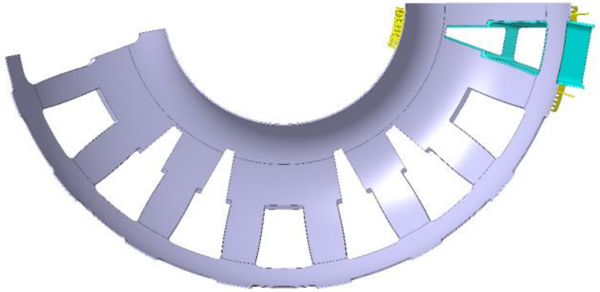
The inner shell will be the first fabricated part of the vacuum vessel double walled structure because of the following reasons:

a) double curvature inner shell;
b) the weld root can face the UHV (plasma) side (made through the reliable and clean TIG process);
c) large size of inner shell plates to be joined thus reducing the welds (coolant-vacuum boundaries);
d) two side accessible for visual (VT), surface (PT), helium leak (LT), and volumetric (RT) tests after welding of the shell plates;
e) high flexibility in positioning the other welded joints of the supports of in-vessel components and in-vessel sensors.

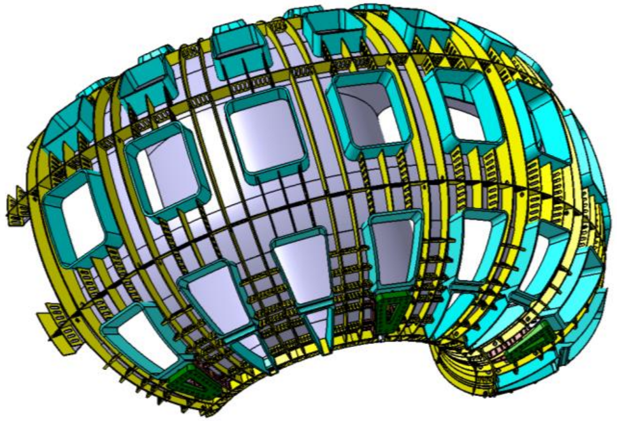
All welded joints realising coolant-vacuum boundaries shall be full penetration joints.



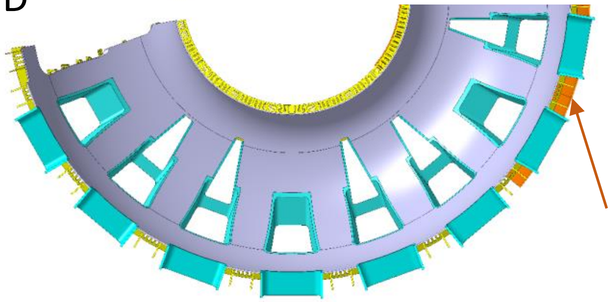
a) Inner shell manufacturing and inspection (double curvature)



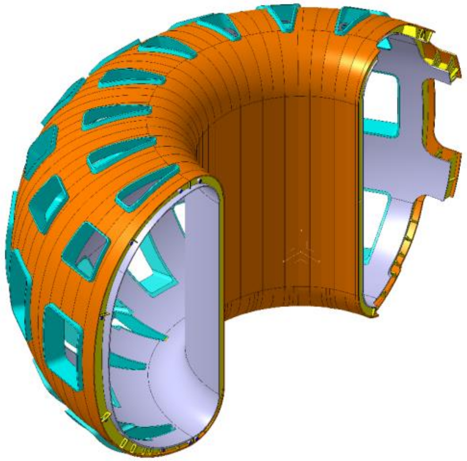
b) Welding and inspection of port stubs and reinforcing ribs



Intermediate inspections are repeated, in particular dimensional tests with 3D metrology system

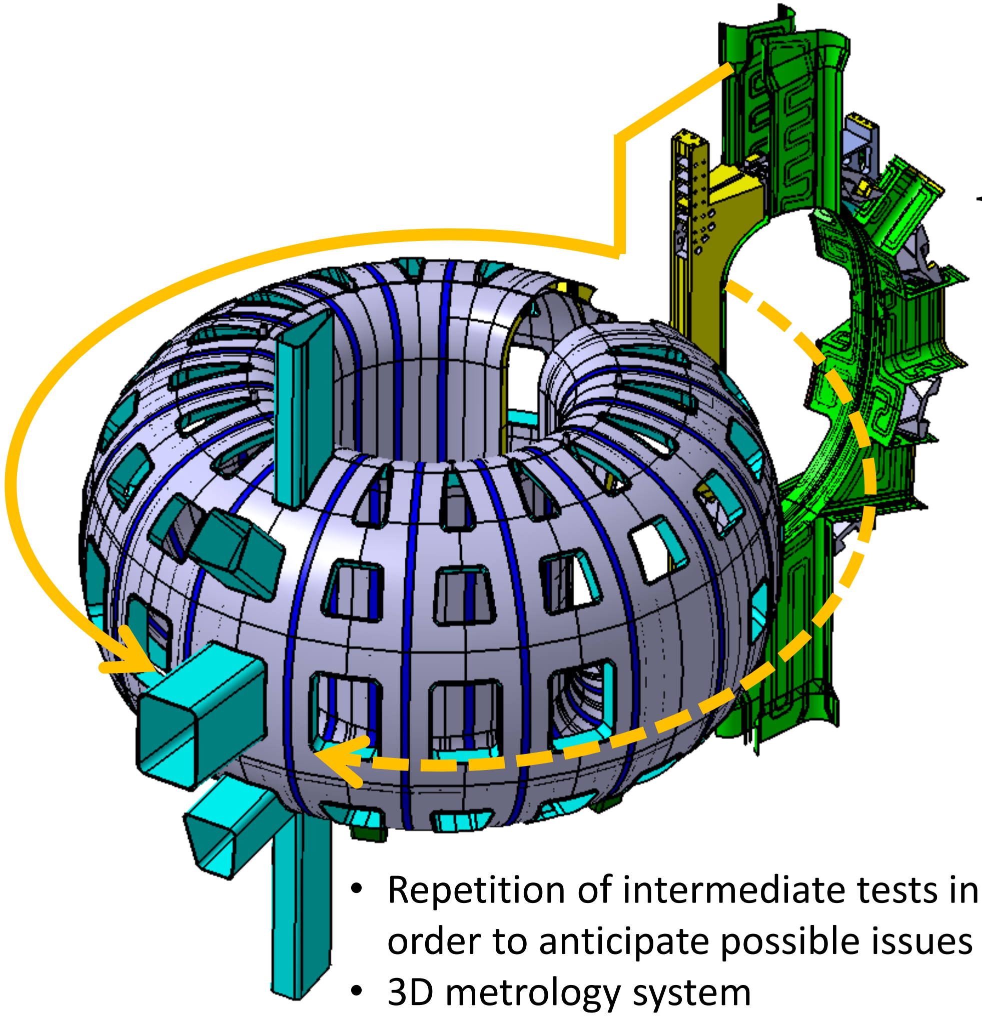


c) Welding and inspection of the **outer shell** plates (single curvature)

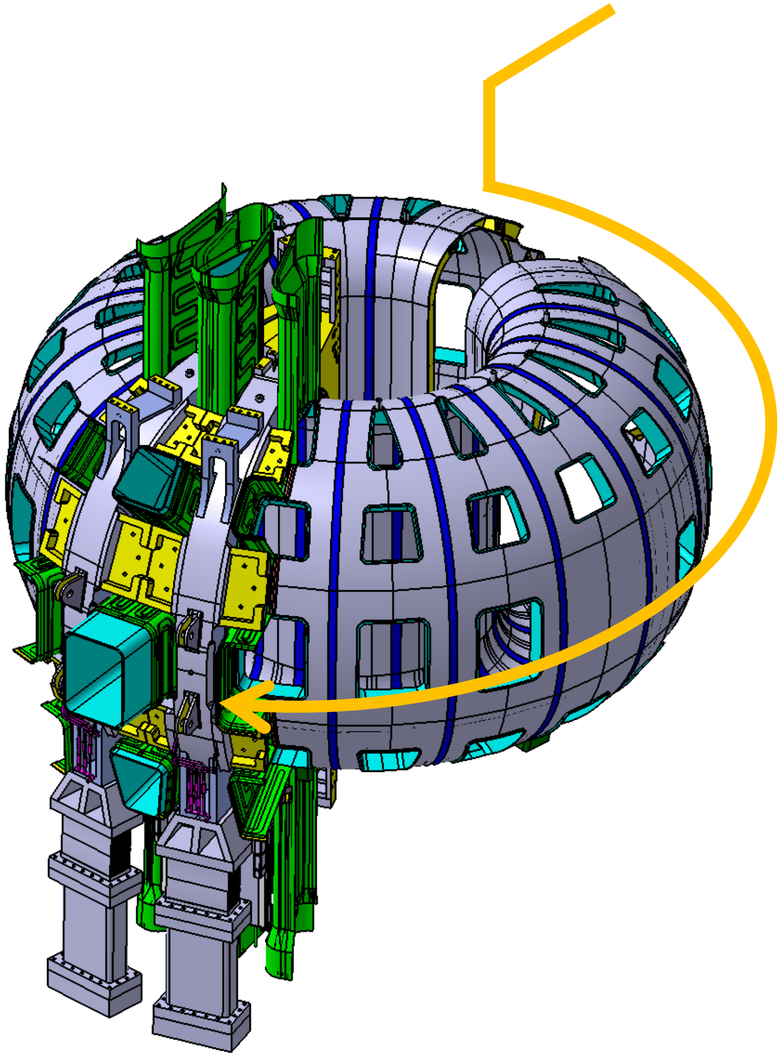


d) Acceptance tests of the vessel sector

DTT assembly sequence



1. Vessel sectors #1 & #2 are welded & tested to form 340° of the vessel
2. Vessel thermal shield is mounted on the vacuum vessel
3. TFCs are inserted using vessel temporary gravity supports
4. TFC gravity supports are mounted
5. Vessel permanent gravity supports are mounted
6. Poloidal Field Coils are positioned and the Inter-coil Structures are mounted
7. Vessel sector #3 (20°) is integrated and the full vessel is tested
8. Port ducts, preassembled with bellows and port thermal shield, are positioned and welded on port stubs



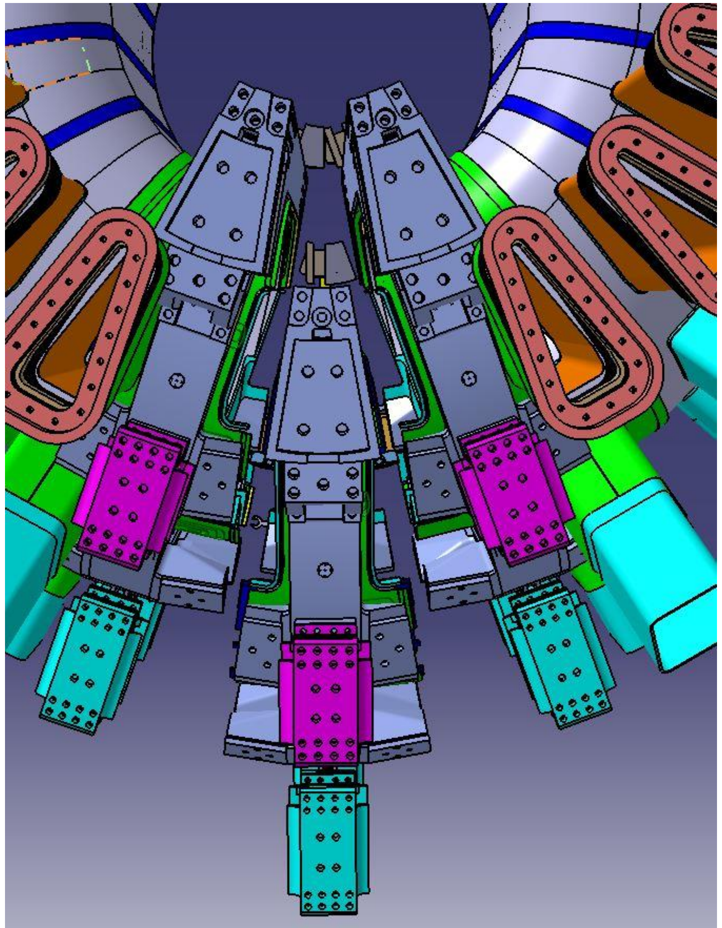
- Repetition of intermediate tests in order to anticipate possible issues
- 3D metrology system
- Estimation, test, and measurement of weld distortions

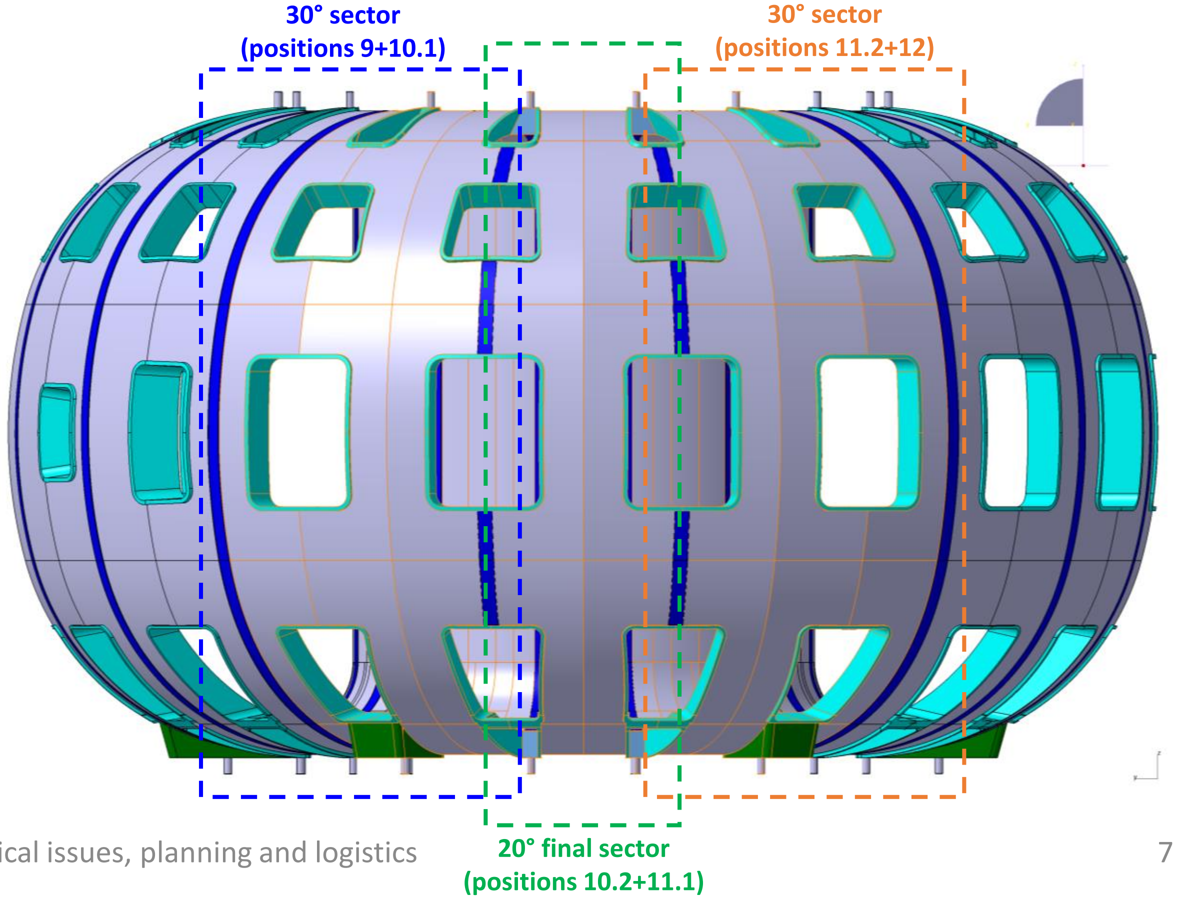
Final sector

The final sector with mounted the toroidal field coil (TFC) will be integrated on site after positioning the other TFCs

The sector integration process will progress from the outboard to the inboard due to accessing requirements, then the first and second passes at the weld root of the inner shell will not be faced to the UHV (plasma) side

Bevel details for field welds (on site) need to be defined for machining → **assistance on site is required during first phases of on site assembly**



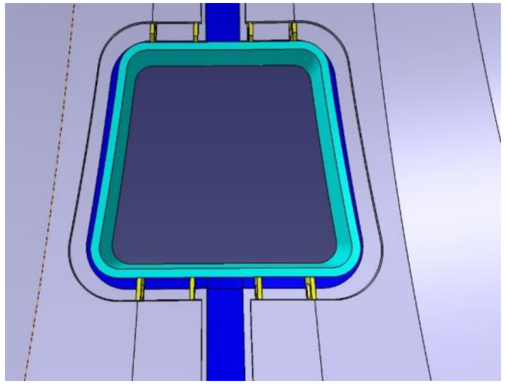


On site integration

Main requirements:

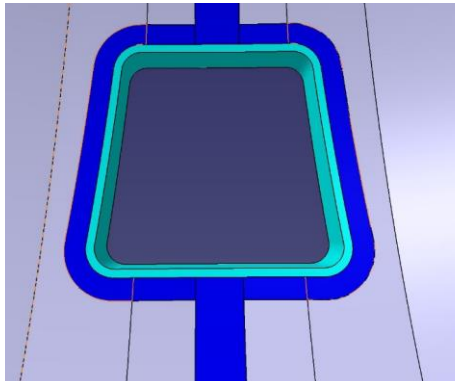
- in-vessel attachments as permanent supports of the in-vessel components will be welded in correspondence of the inter-shell reinforcing ribs
- also plates as temporary attachments of the internal jig will be welded in correspondence of the inter-shell reinforcing ribs for sector handling during manufacturing and assembly
- new welds shall be located sufficiently far from the heat affected zone of pre-existing welds
- non destructive tests of weld attachments will be required with VT, PT, and UT (specific requirements will be prepared as for vessel construction welds)

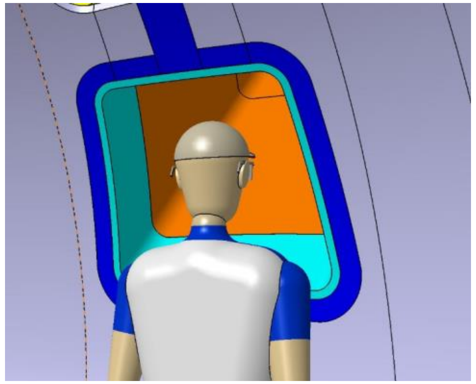
Integration in the final sector of port stubs made of a single part and welding of splice frame and splice plate:



Poloidal rib welding from the inner side

Welding of splice frame and splice plate from the inner side





Welding and inspection of the port duct

Design and fabrication

The vessel shall be manufactured consistently with the requirements of Codes and Standards applying the design basis and loading conditions

Code:

- ASME Boiler and Pressure Code (BPVC), Section VIII, Division 2 apply to the DTT vacuum vessel
- Design, Service, and Test Limits are defined in “NCA-2142.4 Design, Service, and Test Limits” of BPVC Section III, Subsection NCA (limits are shared with Section VIII)

The procurement shall comply with the regulation of the Pressure Equipment Directive (PED):

- Classification: The DTT vacuum vessel fall within PED (category III)
- The VV manufacturer shall assume responsibility for the compliance of the pressure equipment with the requirements laid down in the PED and shall release the EU declaration of conformity stating that the fulfilment of essential safety requirements set out in Annex I of PED has been demonstrated

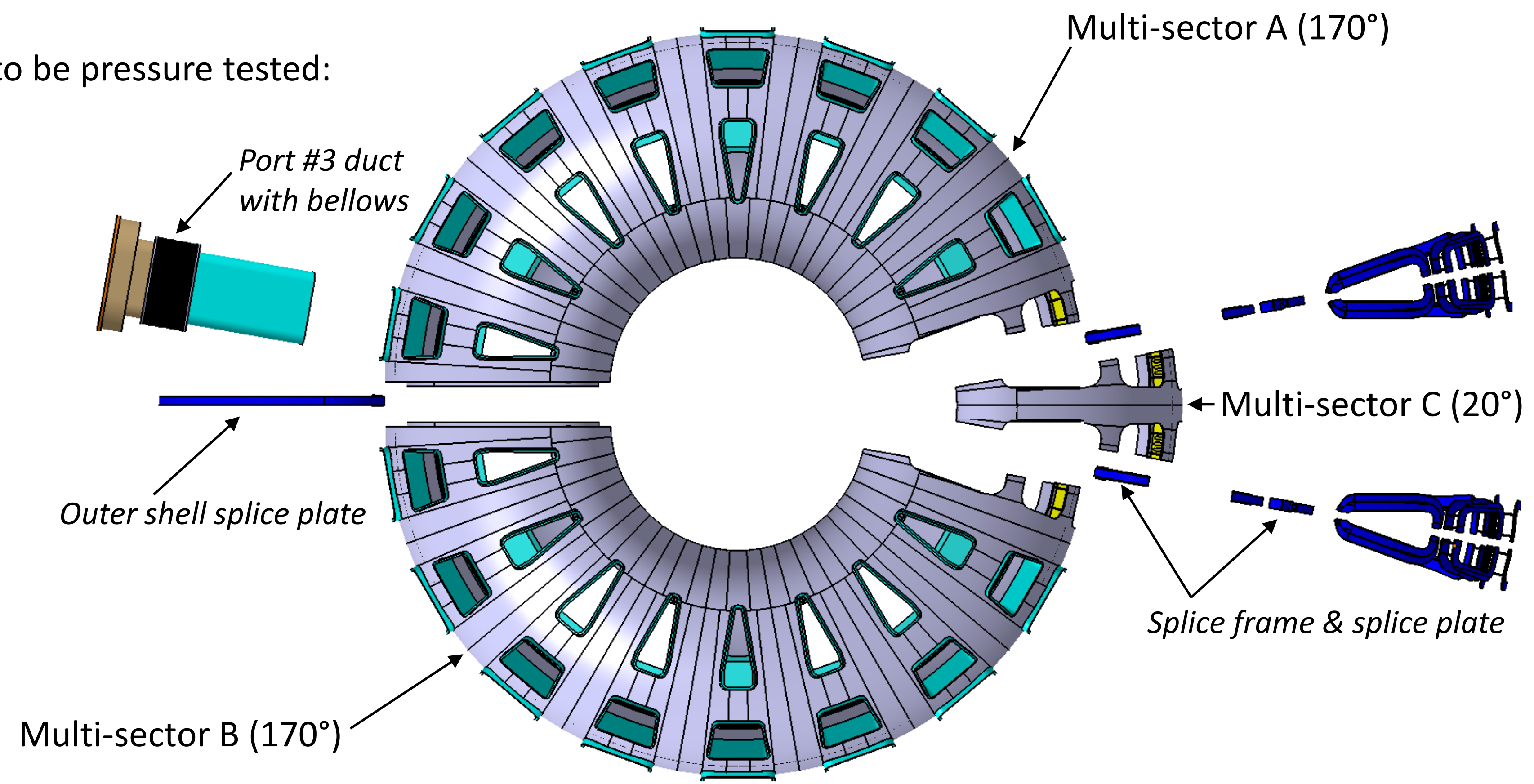
Vacuum vessel pressure test

Inter-shell, volume V = 13 m^3 included between the inner shell and the outer shell that is circulated by fluid:

- Plasma operation: water @ 20-110 °C
- Baking: nitrogen @ 200 °C

The vessel inter-shell is the only volume to be pressure tested:

- p = 4 bar(a) → p_{test} = 7 bar(a)
- Pneumatic pressure test is required for compatibility with helium leak test
- Pressure tests with accessible welds for inspection:
  - Pressure test 1: A
  - Pressure test 2: B
  - Pressure test 3: A+B
  - Pressure test 4: A+B+C



Technical specification structure

Technical specification main document

General provisions, Quality mgmt., Interfaces

Annex A	Annex B	Annex C	Annex D	Annex E	Annex F
Prototype sector	Vacuum Vessel	Expansion Joints	Machine Sensors	Internal Jig	Transportation & Rotation Tool

Advantages of this structure: No requirements mixing

Clear work package definitions

Easy work breakdown build up

Useful if subcontracting is used

Simpler requirements management

Procurement deliverables

Hardware deliverables:

- Prototype sector
- Vacuum Vessel sectors including:
    - vessel ports
    - gravity supports
    - machine sensors
- Splice plates and splice frame (please see slide 22): field welding (on site) for sector integration thus providing structural continuity and forming the vacuum boundary
- Expansion joints (82 flanged bellows)
- Internal Jig to be used for sector handling and integration
- Transportation & Rotation Tool

Documentation, logistic, and assistance deliverables:

- Manufacturing Readiness Review
- Risk Register
- Qualification File
- Intermediate dimensional inspection using 3D metrology (laser tracker/ photogrammetry) integrated with manufacturing
- Manufacturing File with Drawings
- FAT (Plan and Report)
- Packing, Transport and Delivery
- SAT (Plan and Report)
- Operation and Maintenance Manual
- As built drawings and 3D CAD
- Welding Book including distortion management (Plan and Report)
- EU declaration of conformity
- Assistance in the first phase of on-site assembly

Procurement of raw material
Delivery conditions of semi-finished products

Flat products:

- procured in accordance with EN 10028-7 “Flat products made of steels for pressure purposes - Part 7: Stainless steels” with process route 1D as surface finish.

Tooling, supports, jigs:

- procured in accordance with EN 10088-4 “Stainless steels - Part 7: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes”.

Bars, rods, sections:

- procured in accordance with EN 10088-5 “Stainless steels - Part 5: Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes” with process route 1D as surface finish.

Surface finish for cleanliness, leak testing, vacuum compatibility:

- Ra ≈ 6.3 µm: consistent with process route 1D

Dimensional tolerances

Mandatory tolerances for construction:

1. General tolerances for machined products: class mK of ISO 2768-1 and ISO 2768-2

Table 1 — Permissible deviations for linear dimensions except for broken edges
(external radii and chamfer heights, see Table 2)

Values in millimetres

Tolerance class		Permissible deviations for basic size range							
Designation	Description	0,5[a] up to 3	over 3 up to 6	over 6 up to 30	over 30 up to 120	over 120 up to 400	over 400 up to 1 000	over 1 000 up to 2 000	over 2 000 up to 4 000
f	fine	± 0,05	± 0,05	± 0,1	± 0,15	± 0,2	± 0,3	± 0,5	—
m	medium	± 0,1	± 0,1	± 0,2	± 0,3	± 0,5	± 0,8	± 1,2	± 2
c	coarse	± 0,2	± 0,3	± 0,5	± 0,8	± 1,2	± 2	± 3	± 4
v	very coarse	—	± 0,5	± 1	± 1,5	± 2,5	± 4	± 6	± 8

[a]For nominal sizes below 0,5 mm, the deviations shall be indicated adjacent to the relevant nominal size(s).

Table 1 — General tolerances on straightness and flatness

Values in millimetres

Tolerance class	Straightness and flatness tolerances for ranges of nominal lengths					
	up to 10	over 10 up to 30	over 30 up to 100	over 100 up to 300	over 300 up to 1 000	over 1 000 up to 3 000
H	0,02	0,05	0,1	0,2	0,3	0,4
K	0,05	0,1	0,2	0,4	0,6	0,8
L	0,1	0,2	0,4	0,8	1,2	1,6

2. General tolerances for welded constructions, class BF in accordance with EN ISO 13920

Table 1 — Tolerances for linear dimensions

Tolerance class	Range of nominal sizes l in mm										
	2 to 30	Over 30 up to 120	Over 120 up to 400	Over 400 up to 1 000	Over 1 000 up to 2 000	Over 2 000 up to 4 000	Over 4 000 up to 8 000	Over 8 000 up to 12 000	Over 12 000 up to 16 000	Over 16 000 up to 20 000	Over 20 00 0
	Tolerances t in mm										
A		± 1	± 1	± 2	± 3	± 4	± 5	± 6	± 7	± 8	± 9
B	± 1	± 2	± 2	± 3	± 4	± 6	± 8	± 10	± 12	± 14	± 16
C		± 3	± 4	± 6	± 8	± 11	± 14	± 18	± 21	± 24	± 27
D		± 4	± 7	± 9	± 12	± 16	± 21	± 27	± 32	± 36	± 40

Table 3 — Straightness, flatness and parallelism tolerances

Tolerance class	Range of nominal sizes l in mm (relates to longer side of the surface)									
	Over 30 up to 120	Over 120 up to 400	Over 400 up to 1 000	Over 1 000 up to 2 000	Over 2 000 up to 4 000	Over 4 000 up to 8 000	Over 8 000 up to 12 000	Over 12 000 up to 16 000	Over 16 000 up to 20 000	Over 20 000
	Tolerances t in mm									
E	0,5	1	1,5	2	3	4	5	6	7	8
F	1	1,5	3	4,5	6	8	10	12	14	16
G	1,5	3	5,5	9	11	16	20	22	25	25
H	2,5	5	9	14	18	26	32	36	40	40

Inner shell typical tolerance: ± 5 mm
Vessel sector typical tolerance: ± 10 mm

Prototype sector - 1/2

One prototype sector used for **qualification of processes during the procurement for manufacturing production sectors**:

- welding procedures (TIG on UHV side, same or different process on non-UHV side)
- weld repairs (next slide)
- sequence of welds to minimize weld distortions on shells and ports
- measurement of post welding distortions (same tolerances of production sectors)
- verification of accesses for weld execution and testing
- integration of port stubs and alignment tool for port ducts
- Non Destructive Testing, in particular LT, PT, RT, and ultrasonic test (UT) of welded joints
- re-pickling, re-passivation, and cleaning treatments of the welded joints in the inter-shell
- measurement of the magnetic permeability at the completion of the fabrication processes

} Evaluations are required to the manufacturer (weld distortion management plan) before fabrication can commence

The prototype sector will be delivered for **qualification of processes on site**:

- integration of port ducts with bellows
- test of automated welding processes
- frequency of intermediate dimensional tests for dimensional control
- integration of divertor and first wall supports

Prototype sector - 2/2

Welding procedures: TIG on UHV side, same or different process on non-UHV side

Base material:

Standard 316LN (without limitation in the cobalt content) is specified for the protype sector (classified as austenitic stainless steels with Cr ≤ 19%, P-number.group number = 8.1) [Table QW/QB-422 of ASME BPVC.IX and ISO 15608]

Filler metal:

- Bare electrodes or rods of nonmagnetic and with high Mn-content to stabilize the austenitic microstructure and to aid in hot cracking (minimal ferrite content)
- The same filler metal will be used for welding the production sectors
- The tensile properties, bend ductility, and soundness of welds will be determined during welding procedure qualification
- Procedures of tests for mechanical properties will be specified in accordance with Standard Methods for Mechanical Testing of Welds in QW-202 of ASME BPVC.IX and AWS B4.0M

Alternative base material for manufacturing the prototype sector:

- In case 316LN will not be available on the market in order to manufacture the prototype sector within the required schedule, 316L can be procured instead because it belongs to the same base material group (8.1)
- Also using 316L, welds will be qualified for both prototype and production sectors as maintaining constant the welding variables that are critical to making acceptable welds (essential variables)

Magnetic permeability measured on welded 316L base metal should be carefully evaluated before considering as a significant measurement for the production of vessel sectors

Magnetic permeability and decontamination requirement

Main requirements for hardware deliverables:

1. vacuum vessel and ports:
    - 316LN (steel number 1.4406 and 1.4429, lower ferrite content)
    - spring plates and gravity supports: possibility to accept 316L (1.4404, 1.4435)
    - bellows: 316L (1.4404, 1.4435), 316LN (1.4406, 1.4429), 321 (1.4541), 316Ti (1.4571)
2. internal jig and transportation & rotation tool:
    - parts in contact with the vessel sectors shall be made of low carbon austenitic stainless steel

The Supplier shall take actions to limit the magnetic permeability during fabrication of point 1 parts. Recommended value after welding and at the completion of the fabrication is 1.05. Local values in small areas shall be lower than 1.1

Magnetic permeability measurements shall be performed on raw materials and in the regions of the weld seams and in the heat affected zones

Preventive action: filler metal for welding with minimal ferrite content

Records of magnetic permeability measured during the manufacturing of VV are required in a map

Tools, rigs, equipment used in contact with the stainless steel parts shall be made of low carbon austenitic stainless steel thus avoiding contamination by contact with carbon steel

Inspection and testing

Inspection and testing performed before and during manufacturing:

- procurement of semi-finished products
- dimensional inspection performed with direct and indirect tools (e.g. laser trackers/scanners, photogrammetry)
- welding inspection via RT, UT, PT, LT, VT
- pressure test of the inter-shell on the two welded sectors, 7.2 bar(a) pneumatic test with plugs to be removed after passing the leak test and before on-site vessel integration
- all vacuum boundary welded joints shall be helium leak tested:
  minimum detectable leakage of 1E-9 mbar l/s by applying the hood method on the inter-shell volume (EN 20485, ASTM E 1603-99, ASME V Art. 10)
- cleanliness conditions verified through wipe and visual methods

Welded joints

Distortion management plan

- Defines the order of execution of operations and inspections
- Defines auxiliary jigs (if any)
- Contains evaluation of expected distortions (to be consistent with tolerances)
- Outlines recovery procedures for deformations (if any)
- Collects consideration on the welding sequence in the evaluation of the deformations

Qualification test for repairs of welds

- Repaired welds shall be “new” welds
- Precise parametrization shall be provided
- Qualification tests shall be performed to avoid detrimental effects
- Any test previously performed on the part shall be repeated

Quality levels for imperfections (under definition)

- Level B as per EN ISO 5817 (all fusion-welded joints except beam welding) and ISO 13919-1 (beam welding joints, if any)
- Level 1 in accordance with ISO 10675-1 (RT)

Post-welding treatments of the welded joints in the inter-shell:

- re-pickling (acid solution applied to remove the heat affected layer)
- re-passivation (oxidizing acid promoting the formation of the chromium-rich passive film)

All processes on vacuum surfaces shall be followed by appropriate cleaning of the surface (please see next slides)

Types, non destructive tests, and repairs of welds

A. VT:
   i. after completion of the root pass (first TIG passes)
   ii. after completion of the repair

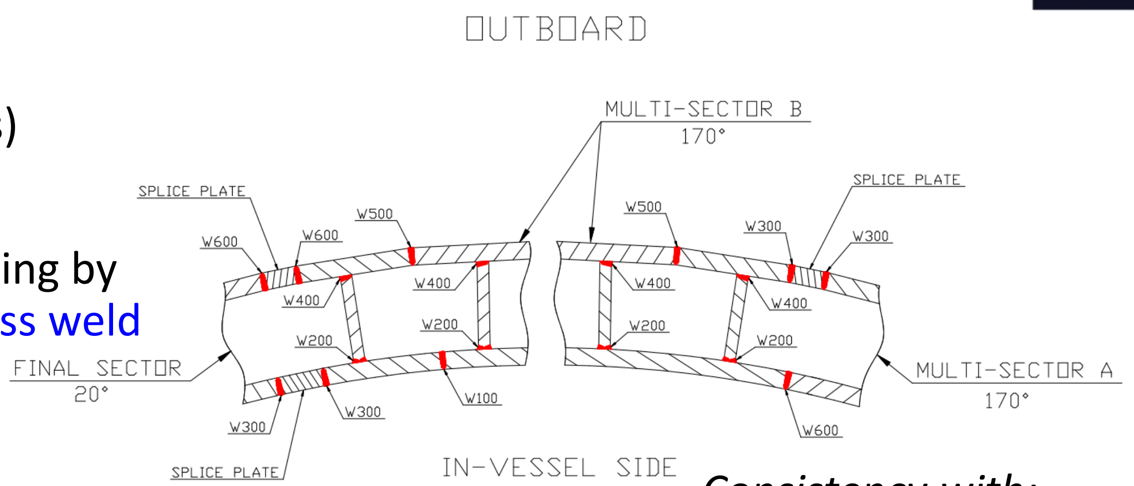
B. Detection of surface discontinuities: PT, weld cap dressing by removing the cap elements on the completed multi-pass weld

C. Volumetric test on the completed multi-pass weld:
   i. RT will be performed
   ii. where RT is impractical → UT (phased-array) will be performed, weld cap dressing by removing the cap elements
   iii. where UT is impractical → production proof samples (PPS):
      - VT
      - PT
      - examination via sectioned macrographs and micrographs

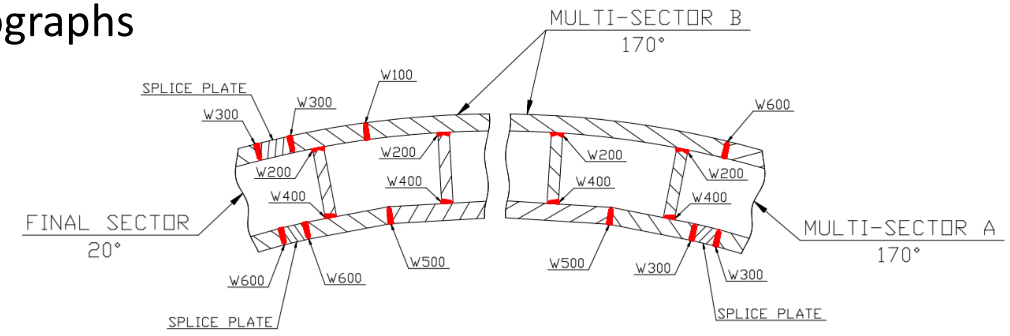
D. LT after completion of the root pass

E. Pressure test after completion of the repair

F. LT after completion of the repair



Consistency with:
- *manufacturing-assembly*
- *coolant-vacuum boundaries*
- *test accessibility*
- *accuracy of volumetric test*
- *structural integrity verification*



Volumetric inspection of welded joints

- The UT is usually performed on procured semi-finished products.
- Qualification of UT on welded austenitic stainless steel is needed with calibration on reference drilled holes and in welding coupons/test pieces in order to successfully perform the volumetric inspection where RT is impractical.
- Each UT qualification will represent a specific type of weld.
- Phased-array probes can provide improved volume coverage and offer the ability to interrogate the weld volume with multiple angles. In general, phased-array dual probes can provide improved signal to noise ratio for the inspection of coarse-grained materials.
- The extent of volumetric inspection can be reduced (e.g. from 100% to 20%) when automated welding process is implemented.
- Production proof samples (PPS) will be performed as laboratory tests when both RT and UT are not practical (e.g. when double side access is not allowed for RT film placement and when joint geometry is not compatible with UT like fillet welds).
- Each PPS will only represent a specific type of weld and must use the same material, thickness and set-up as the production weld in order to be representative of the production welding/actual products.
- The PPS will be subjected to VT, PT and examination via sectioned macrograph and micrograph.

Expansion joints (bellows) specifications

- Helium leak rate 1.0E-9 mbar l/s including inter-ply connections for leak check/monitoring during bellows construction and during DTT operation
- Number of cycles for bellows design: 2000
  - plasma disruption oscillations: 1750
  - baking cycles: 150
  - seismic oscillations: 100
- Temperatures:
  - maximum expected operation temperature: baking temperature
  - minimum expected operation temperature: room temperature
- Expansion joint construction:
  - multi-ply bellows design
  - Inter-ply testing integrated in the construction
  - external sleeve as protective cover and passive screen for thermal insulation
- Bellows and flange material:
  - 316L (1.4404, 1.4435), 316LN (1.4406, 1.4429), 321 (1.4541), 316Ti (1.4571)
  - cobalt limitation (Co<0.05 wt%) could be negotiated considering the total mass of bellows material in the tokamak and the maintenance strategy
- Assumption about bellows expected expansions:
  - thermal expansions and shock loads obtained by simulations

Ports and expansion joints

vessel sector	port/ bellows	inner poloidal size [mm]	inner toroidal size [mm]	outer poloidal size [mm]	outer toroidal size [mm]	building length [mm]
Vessel standard sectors	port #1	794	288	824	318	-
	bellows #1	845	320	985	460	450
	port #2	530	600	560	630	-
	bellows #2	620	660	760	800	450
	port #3	900	680	940	720	-
	bellows #3	950	730	1090	870	450
	port #4	650	599	680	629	-
	bellows #4	720	700	860	840	450
	port #5	750	321	780	351	-
	bellows #5	780	360	920	500	450
Vessel special sector #7	port #3	-	-	-	-	-
	bellows #3	1200	800	1340	940	450
Vessel special sector #8	port #3	-	-	-	-	-
	bellows #3	1090	1110	1230	1250	450

Cleanliness for construction and testing

Working environment requirements:

- Clearly identified clean area (equivalent to class ISO 8 before and during preparation of packaging)
- Segregation from contaminants (e.g. rust, machining, chemical treatments, exhausts)
- Access control (people & materials)
- Trained personnel, in particular for non-destructive testing (level 2 or 3 in accordance with ISO 9712)

Supplier demonstration of good/sound practice with:

- Dedicated tools
- Cleaning routines and checklists
- Helium leak testing using external calibrated leak attached to the vessel sector (EN 20485, ASTM E 1603-99, ASME V Art. 10)

A cleaning procedure shall be proposed by the supplier and submitted to DTT for approval

Machine sensors

Function	Location	Total measurement points	Number of sensors per sector	Total Sensors
Temperature condition monitoring	Inner VV	144	16	900
	Outer VV	180	20	
	VVP	90	10	
	VVS	36	/	
Temperature load characterization	Inner VV	360	40	1980
	Outer VV	360	40	
	VVP	270	15	
Displacement	Outer VV	108	12	1692
	VVS	18	/	
	VVP	720	80	
Deformation	Outer VV	72	8	912
	VVS	24	/	
	VVP	360	40	
Acceleration	Outer VV	54	/	852
	VVP	360	40	
	VVS	12	24	

DRAFT: quantity and position of sensors are under review

Schedule

Main schedule constraints:

- Manufacturing Readiness Review (MRR) + manufacturing drawings: 7 months duration starting after KoM
- Procurement of raw materials: 6 months duration starting after MRR
- Tools & equipment + internal jigs + Transportation & rotation tool: 6 months duration starting after MRR
- Qualification of processes (manufacturing, welding, testing) + sector prototype (manufacturing, welding, testing): 18 months duration after KoM
- Update of drawings considering outcomes of qualification and prototyping: 2 months duration
- Production of the 3 sectors: 18 months duration after update of drawings
- Production of port stubs and bellows, installation of sensors: 12 months duration and developed in parallel to the production of sectors

Schematic schedule

#	Activity	Dur.	month -4	month -3	month -2	month -1	month 0	month 1	month 2	month 3	month 4	month 5	month 6	month 7	month 8	month 9	month 10	…	month 18	month 19	month 20	month 21	month 22	…	month 27	month 28	…	month 34	month 35	month 36	month 37	month 38
1	Independent EM analyses and structural verifications	2																														
2	**Design Review with External Panel**	1																														
3	Technical Specification Activity	2																														
4	Call for Tender + Evaluation of the tender submissions	1																														
5	Selection of vendor & Award of contract	2																														
6	KoM + Manufacturing Readiness Review	2																														
7	Manufacturing Drawings	6																														
8	**Procurement of raw materials**	6																														
9	Tools & equipment	6																														
10	Internal jig + Transportation & rotation tool	6																														
11	**Qualification of processes (manufacturing, welding, testing)**	3																														
12	**Manufacturing & testing of the sector prototype**	12																…														
13	**Drawing updated with outcomes from prototyping**	2																														
14	VV sector #1 (170°), fabrication+FAT+delivery+SAT	8																						…								
15	VV sector #2 (170°), fabrication+FAT+delivery+SAT	7																									…					
16	**VV sector** #3 (20°), fabrication+FAT+delivery+SAT	4																														
17	**Gravity supports**	6																						…								
18	**Port ducts + Bellows + Sensors**	12																									…					

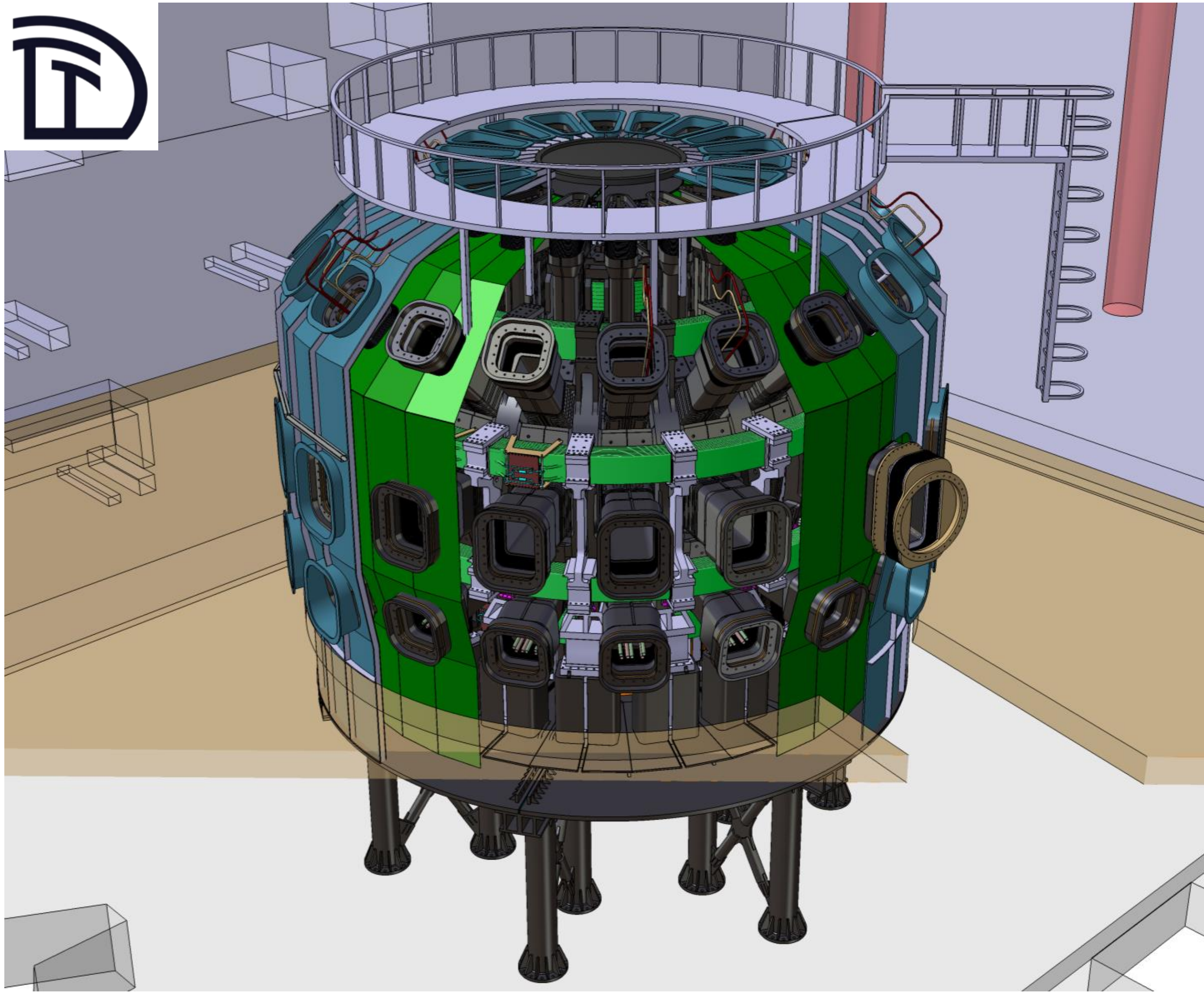
Risk treatment

A risk register shall be prepared by the supplier.

Main identified risks are:

- *Tec*: dimensional and shape errors on shells and ports due to weld distortion produced during the welding sequence → tolerances from experience, measurements on the prototype sector
- Tec: sequence of welds to minimize weld distortions on shells and ports → distortion plan, measurements on the prototype sector
- *Tec*: welded joints in the inter-shell: re-pickling, re-passivation, and cleaning for helium leak testing → prototype sector
- *Tec*: in-port reduced access to integrate on site supports for services (cooling tubes, coils feeders, embedded sensors, supports of cryopumps) → supports included in the procurement
- *Tec*: excessive magnetic permeability at the completion of the fabrication processes → preventive action about welding filler metal with minimal ferrite content + map of measurements at the completion of the fabrication processes
- *Man*: unavailability of qualified and certified personnel (levels 2 and 3 in accordance with EN ISO 9712) required to the supplier for qualification of Non Destructive Testing, in particular helium LT, UT, RT, PT of welded joints, 3D measurement systems (photogrammetry or laser tracker to be used for frequent intermediate dimensional tests) → specific requirements
- *Man*: unavailability of personnel during the procurement follow-up in particular to manage promptly non-conformities → stable and permanent working Team at manufacturer premises

VVP tender:
technical issues, planning and logistics



Thank you for attention and patience
(if the case)