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Technical Specifications (In-Cash Procurement)

Procurement of the portable laser welding tool

Procurement of the portable laser welding tool for the optical fiber strain sensors

SUPPLY

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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 1] that constitutes a full part of the technical requirements.

In case of conflict, the content of the Technical Specification supersedes the content of [AD 1].

2 Background

ITER is a large-scale magnetic fusion device that aims to demonstrate the technological and scientific feasibility of fusion energy. ITER is identified in France as a Nuclear Facility according to the INB order 7th February 2012 (“Installation Nucléaire de Base”).

During its operational lifetime, ITER will test key technologies necessary for the next step: the demonstration fusion power plant that will prove that it is possible to exploit fusion energy for commercial use. ITER is based on the 'tokamak' concept of magnetic confinement, in which the plasma is contained in a doughnut-shaped Vacuum Vessel (VV). The fuel — a mixture of deuterium and tritium, two isotopes of hydrogen — is heated to temperatures in excess of 150 million °C, forming a hot plasma. Strong magnetic fields are used to keep the plasma away from the walls; these are produced by superconducting coils surrounding the vessel, and by an electrical current driven through the plasma.

The VV is a hermetically-sealed steel container that houses the fusion reaction and acts as a first safety confinement barrier. It operates at 100°C and can be baked up to 240°C to guarantee clean ultra-high vacuum needed to operate plasmas.

Internal components such as the Blanket, Divertor and First Plasma Protection Components are located inside the VV. These components, including the VV are equipped with Operational Instrumentation in order to:

- Monitor the thermal, mechanical and electromagnetic parameters of Blanket, Divertor and FPPC components;
- Monitor the Critical Heat Flux (CHF) of Blanket and Divertor components;
  Monitor the surface temperature and flow rate in Blanket and Divertor cooling water pipes;
- Estimate the residual life-time of in-vessel components and prediction of possible damages.

These measurements are performed by two types of sensors:

- Optical – strain sensors, linear displacement sensors, temperature sensors;
- Electrical – Rogowski coils, magnetic flux loops, thermocouples.

In order to ensure functional requirements are met during operation of the ITER Machine, the sensors shall be attached to the In-Vessel Components as well as on to the interior wall of the VV by using an appropriate permanent joining technique.

2.1 In-Vessel Operational Instrumentation

2.1.1 Optical Fiber Strain Sensor with temperature compensation

Optical Fiber Sensors (OFS) based on the Fiber Bragg Grating (FBG) technology are used in the In-Vessel Operational Instrumentation system for measurement of the mechanical and thermal

parameters. The OFS have advantages over the electrical sensors for application in ITER environment: like radiation resistance and immunity from the electromagnetic interference.

The following types of the OFS are used in the BOI/DOI/FOI system:

The Optical Fiber Strain Sensors with temperature compensation (OFSS) are designed with integrated temperature compensation and include a second FBG performing the compensation of slow FBG wavelength drift induced by temperature change and some other factors (radiation induced change, etc). The sensors body in the location of the second FBG is not welded to the surface to prevent transmission of the strain on it.

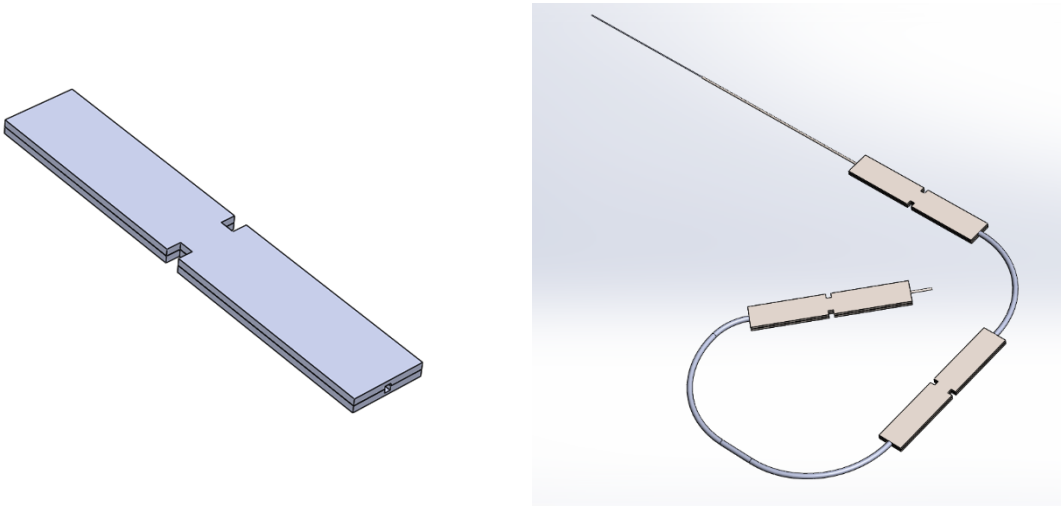


Figure 1 OFSST (left) and rosette of three OFSSTs in a single optical fiber (right)

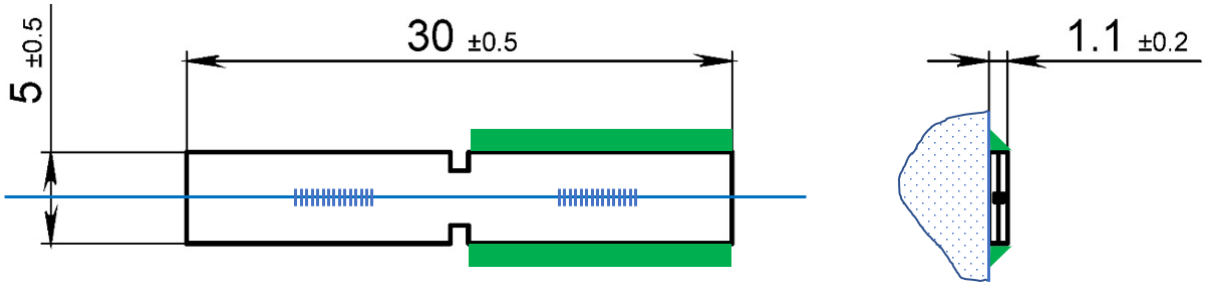


Figure 2 Dimensions of OFSST

The OFSS body is composed of two brazed 316 L stainless steel plates of 0.5 mm thickness. The sensitive optical element - fiber Bragg grating – is located in the geometrical center of the body being brazed between the stainless steel plates as shown in Fig.2. FBG length is 3 mm.

Laser welding seam shall be made along the two longer sides of the rectangular sensor body as shown by dark green on Figure 2. The length of each welding joint is 15 mm.

The distance between the laser welding spot and the optical fiber inside the sensor is as small as 2.5 mm, therefore forced external cooling of the sensor central part should be applied during the welding process.

It is assumed that the Laser Welding Tool (LWT) is equipped with a tool for pressing the OFSS to the surface under test. The same clamping tool provides the necessary heat removal from the central part of the OFSS during welding. This tool contains a build-in temperature sensor that allows measuring the temperature of the OFSS. Correct measurement of the OFSS temperature is necessary to check the quality of the OFSS welding, to determine its further performance and

to correct the initial wavelength for recalibration: OFSS recalibration procedure is indicated in a datasheet provided together with the optical sensor.

2.1.2 OFSS classification overview

Table 1 Classification of the Optical Fiber Sensors

Classification type	**Attribute**
Safety Class	Non-SIC
Vacuum Class	VQC-1B
Quality Class	QC-3
Metrology Class	N/A

2.1.3 OFSS operating conditions

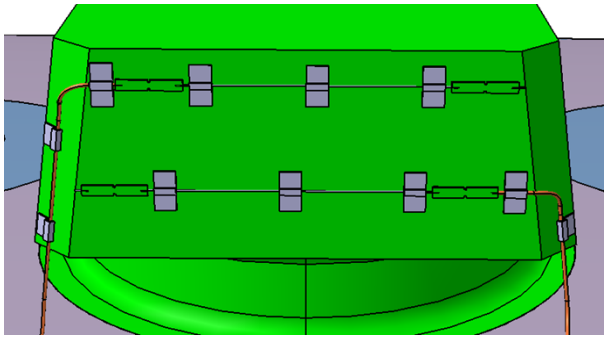
Table 2 Operation conditions of the Optical Fiber Sensors

Configuration	**Scenario**	**Temperature**	**Pressure**
Normal Operation	Start-up (D-D plasma)	100°C	$< 10^{-5}$ Pa
	Pulse (D-T plasma)	350°C	$< 10^{-5}$ Pa
Baking	Baking	350°C	$< 10^{-5}$ Pa
Maintenance	Maintenance	20°C ± 5°C	1 atm

2.2 OFSS for the Blanket System

The OFSS installed on the VV Attachments and Flexible Cartridges form the part of the Blanket Operational Instrumentation. The Blanket Modules are mounted on the on the inner wall of the VV with a set of the structural supports. The BMs 1-10 are supported on 3 keys each and BMs 11-18 are supported on 4 keys each.

The OFSS are installed on these attachments behind every instrumented BM, namely Intermodular Keys, Centering Keys, Stub Keys and Flexible Cartridges. Refer to the Appendix A for the dimensions of the main components.



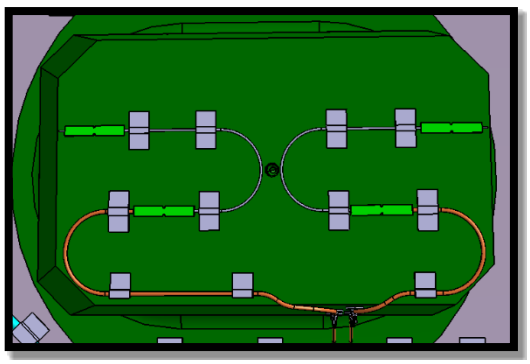


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Figure 3 OFSS on the Intermodular Keys (for illustration of position only)

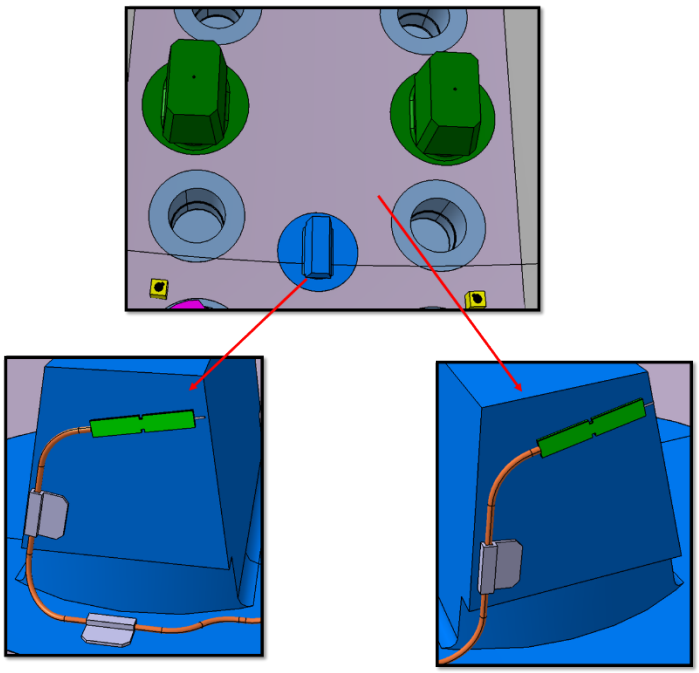

Figure 4 OFSS on the Centering Keys (for illustration of position only)

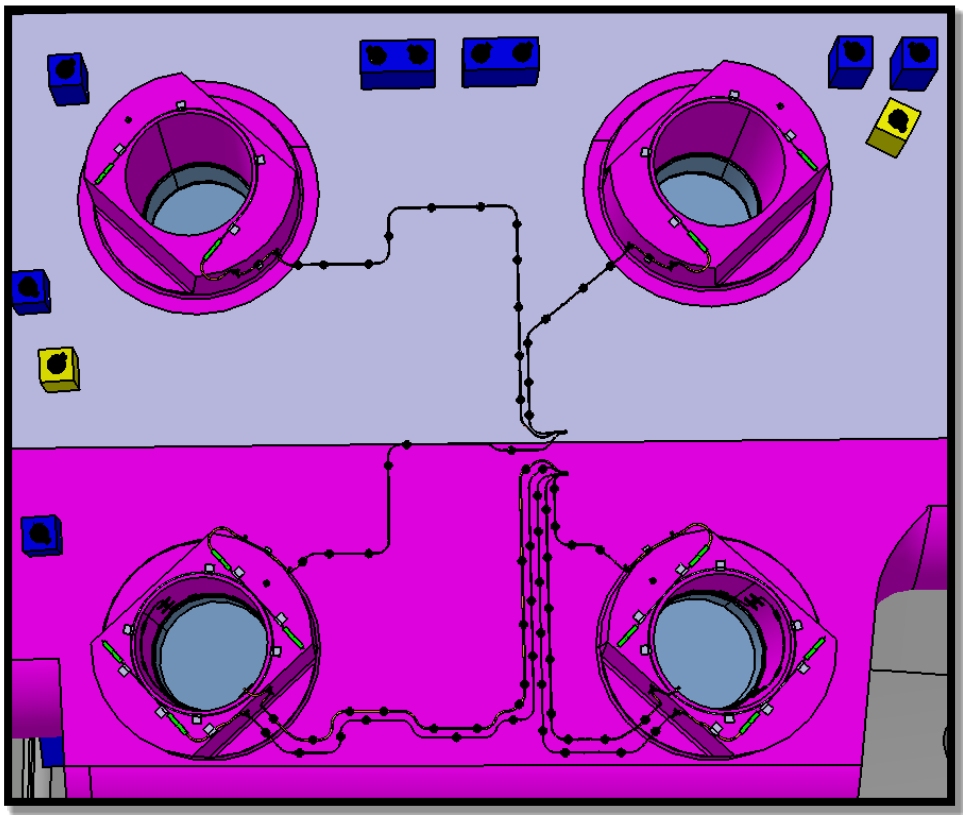

Figure 5 OFSS on the Stub Keys (for illustration of position only)

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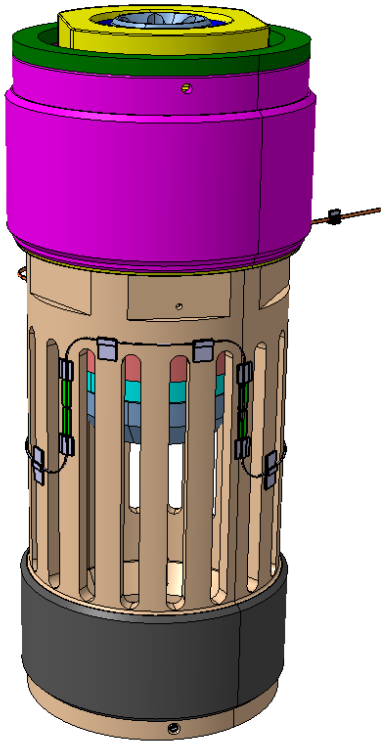

Figure 6 OFSS on the Flexible Cartridges

2.3 OFSS for the Divertor Cassette

The OFSS are installed on the Divertor Cassette Body in various locations.

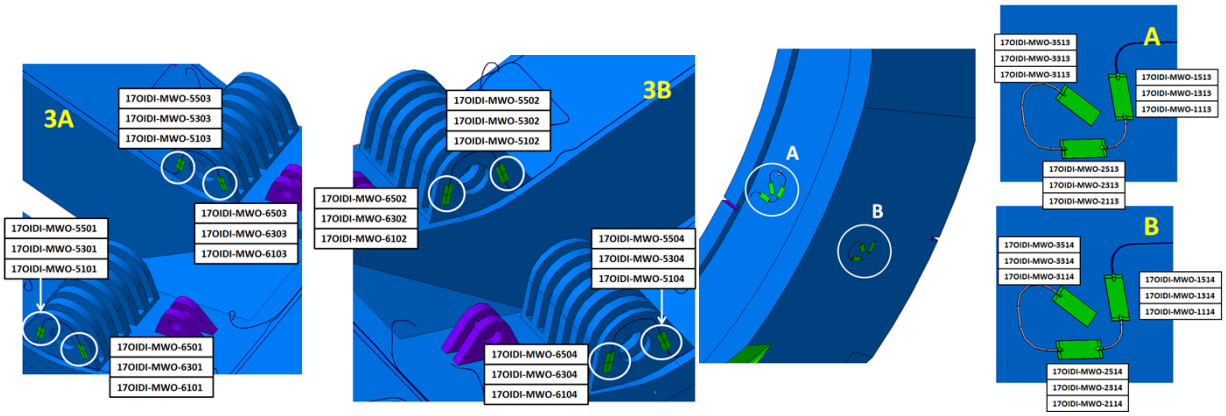

Figure 7 OFSST on the PFC lugs and Cassette Body (for illustration of position only)

3 Purpose

This Technical Specification contains technical requirements for the development of the manufacturing and qualification of the In-Vessel OFSS and OFSST (hereafter OFSS) Welding Tool. This Laser Welding Tool (LWT) is required to ensure appropriate installation of the OFSSs onto ITER In-Vessel Components and interior surfaces of ITER Vacuum Vessel.

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Installation of the concerned components will be performed at ITER premises under responsibility of The ITER Organization (IO).

The Contractor is responsible for development of the preliminary and final design of the LWT, manufacturing and qualification of the LWT, delivery to the ITER Site and on-site engineering support during commissioning of the LWT. Contractor shall ensure that the procured LWT meet requirements of the present Technical Specification.

IO will provide to the Contractor related reference and applicable IO documents and policies. IO will provide CAD models and drawings of interfacing components and systems. IO will also provide models of the environment.

4 Acronyms & Definitions

4.1 Acronyms

The following acronyms are the main one relevant to this document.

Abbreviation	Description
CRO	Contract Responsible Officer
GM3S	General Management Specification for Service and Supply
IO	ITER Organization
PRO	Procurement Responsible Officer
DET	Data Exchange Task
DRR	Delivery Readiness Review
FAT	Factory Acceptance Test
FBG	Fiber Bragg Grating
MRR	Manufacturing Readiness Review
NDT	Non-Destructive Tests
OFS	Optical Fiber Sensors
OFSS	Optical Fiber Strain Sensors
pWPS	Preliminary Welding Procedure Specification
RT	Room Temperature
WPS	Welding Procedure Specification
WPQR	Welding Procedure Qualification Records
LWT	Laser Welding Tool
ITER VHB	ITER Vacuum Handbook
VV	Vacuum Vessel
SAT	Site Acceptance Test

4.2 Definitions

Contractor: shall mean an economic operator who have signed the Contract in which this document is referenced.

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5 Applicable Documents & Codes and standards

5.1 Applicable Documents

This is the responsibility of the Contractor to identify and request for any documents that would not have been transmitted by IO, including the below list of reference documents.

This Technical Specification takes precedence over the referenced documents. In case of conflicting information, this is the responsibility of the Contractor to seek clarification from IO.

Upon notification of any revision of the applicable document transmitted officially to the Contractor, the Contractor shall advise within 4 weeks of any impact on the execution of the contract. Without any response after this period, no impact will be considered.

The last approved version is considered applicable.

Ref	Title	IDM Doc ID
[AD 1]	General Management Specification for Service and Supply (GM3S)	82MXQK
[AD 2]	ITER Vacuum Handbook	2EZ9UM
[AD 3]	ITER Numbering System for Components and Parts	28QDBS
[AD 4]	ITER Procurement Quality Requirements	22MFG4
[AD 5]	Procedure for the management of Deviation Request	2LZJHB
[AD 6]	Procedure for management of Nonconformities	22F53X
[AD 7]	Working Instruction for the Delivery Readiness Review (DRR)	X3NEGB
[AD 8]	WI for Preservation Activities during Storage, Construction and On site before turnover	WRCKZB
[AD 9]	General requirements for CAD activities for PA, TA and Contracts	TLAAJR
[RD 1]	https://lunainc.com/sites/default/files/assets/files/data-sheets/HYPERION%20si255%20Data%20Sheet.pdf	
[RD 2]	Template for Equipment Preservation Procedure	XT2VTE
[RD 3]	Inspection Plan (IP) Template	QV7GQF
[RD 4]	Release Note Template	QVEKNQ
[RD 5]	Package & Packing List Template	XBZLNG

5.2 Applicable Codes and Standards

This is the responsibility of the contractor to procure the relevant Codes and Standards applicable to that scope of work.

Ref	Title
CS1	EN ISO 6947 Welding and allied processes - Welding positions

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CS2	ISO 4063 Welding and allied processes — Nomenclature of processes and reference numbers
CS3	ISO 15614- 11:2002 Specification and qualification of welding procedures for metallic materials -Welding procedure test – Part 11: Electron and laser beam welding
CS4	ISO 13919-1:1996 "Welding - Electron and laser-beam welded joints - Guidance on quality levels for imperfections - Part 1: Steel"
CS5	ISO 15609-3:2009 Specification and qualification of welding procedures for metallic materials- Welding procedure specification-Part 4: Laser beam welding
CS6	EN ISO 9712: 2012 Non-destructive testing - Qualification and certification of NDT personnel
CS7	ISO 14732: 2013 Qualification of the welding personnel
CS8	EN ISO 3452-1:2013 Non-destructive testing – Penetrant testing – Part 1: General principles.

Contractor may propose other equivalent national or international standards provided its implementation be preceded by an acceptance from IO through a deviation request (DR) 0. The justification section of the DR shall include the differences between the quoted standard of the present specification and the standard proposed.

6 Responsibilities

6.1 IO responsibility

6.1.1 During Design development (Phase I)

- Review and approval of the Contractor's documentation listed in the para "List of deliverables"
- Review and approval of the preliminary design of the LWT
- Provide to the Contractor a set of input data listed below (non-exhaustive list)
    - CAD models and/ or 2D drawings of the technical interfaces
    - Distribution map (allocation) of the OFSS across each technical interface
    - Space constraints for tools in question and operators during assembly activities
- ITER Project documents
- Delivery of OFSS to the Contractor for the purposes of functional testing as a part of qualification of preliminary welding procedure (Deliverable #8 and #19).

6.1.2 During Manufacturing and Testing (Phase II and III)

- Review and approval of manufacturing and inspection plan / control plans
- Review of manufacturing drawings;
- Review and approval of the Contractor's documentation listed in the Section 10 "List of deliverables and due dates"
- Monitoring and follow-up of manufacturing activities including, but not limited to the control points and witnessing of critical manufacturing steps;
- Final acceptance of the items.

6.2 Contractor responsibility

During development of the design, manufacturing, testing, inspection, on-site delivery and on-site engineering support the Contractor is responsible for:

- Maintaining the IO approved quality system.
- Development of the preliminary and final design of the LWT
- Development of manufacturing design of the LWT
- Procurement of raw materials
- Manufacturing of LWTs according to manufacturing drawings
- Assembly, inspection and testing of manufactured LWTs
- Packaging and delivery of the items in IO premises
- Engineering support during on-site commissioning and acceptance

7 Scope of Work

This section defines the specific scope of work for the service, in addition to the contract execution requirement as defined in [AD 1].

7.1 Scope of work

The main function of the LWT is in-situ assembly of the OFSS and OFSST onto interfacing ITER machine systems by means of laser welding.

The LWT comprises of the structural elements to support and guide welding head during operation, laser welding machine including auxiliary equipment, interface for the lifting tools and operator interfaces.

Assembly of OFSS on the interfacing systems will be performed indicatively, in horizontal, vertical and overhead positions by means of mechanized laser welding.

Working platforms, scaffolding, hand rails, ladder etc. will be provided to enable man access during installation.

Specific provisions shall be made for safety of operators and surrounding area to enable coactivity in the vicinity of OFSS in-situ assembly.

The scope of this contract consist of two parts – Firm Part and Optional Part. The optional part will be released upon successful completion of the feasibility study.

FIRM PART

Phase 1

Feasibility study

This stage of procurement includes the following activities:

Task 1.1 Preliminary design of the LWT Prototype

- Reception of input data from IO
- Preparation of the Quality Plan
- Development of preliminary structural design of the LWT including interfaces with corresponding ITER machine systems
- Selection of laser welding equipment
- Development of the CAD model of the LWT Prototype

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- Development of the 2D drawings
- Issue of the test plan of LWT prototype
- Review of the preliminary design and test plan with IO

Task 1.2 Test of the LWT prototype

- Assessment of the welds quality
- Functional verification of the OFS
- Issue the test report

OPTIONAL PART

Phase 2 Manufacturing , qualification and testing of the LWT

This stage of procurement shall include the following activities

Task 2.1 Manufacturing Design Development

- Development of manufacturing design of LWT

Task 2.2 Qualification of the LWT

- Procurement of raw materials
- Manufacturing of the qualification mock-ups
- Production of the Welding Data Package

Task 2.3 Manufacturing and test

- Manufacturing Readiness Review
- Procurement of laser welding machine and auxiliary systems
- Manufacturing of the LWT parts
- Assembly of LWT
- Factory Acceptance Tests of LWT

Phase 3 Delivery to the ITER Site

This stage of procurement shall include the following activities:

Task 3.1 Delivery to ITER Site

- Preparation the Delivery Readiness Review
- Packing and shipment of the LWT

Task 3.2 On-site Commissioning

- On-site unpacking, commissioning and demonstration of the LWT operation

Qualification of related production welds and welding personnel qualification are outside of the scope of this Contract.

7.2 Scope of Supply

The following items belong to the scope of Contractor's supply:

- The LWT including laser source, laser cooling system, beam delivery, fume extraction and focusing optical system;
- The welding head including all structural sub-components;
- Shielding gas system;
- Control system of the laser machine including software;
- Set of spares;

- User manuals;
- Safety equipment and accessories.

7.2.1 Boundaries

Contractor's boundary:

- Items included in the scope of Contractor's supply
- Any specific jigs and fixtures required during on-site commissioning, assembly and/or disassembly of the LWT. Samples required for on-site commissioning.

IO boundary:

Access platforms, scaffolding, lifting equipment, ladders and power distribution boards.

7.2.2 Design requirements

*[REQ-1]*Design of the clamping system shall allow positioning of the laser head for welding in horizontal, vertical and overhead positions by means of mechanized laser welding

[REQ-2] Design of the LWT shall ensure execution of joints between OFSS and interfacing system. Nominal thickness of the OFSS body is 1 mm.

[REQ-3] Design of the LWT shall ensure nominal zero gap between mating surfaces during execution of welds and clamping force shall be controlled.

[REQ-4] Positioning accuracy of the OFSS shall not exceed ± 1 mm.

[REQ-5] Eventual weld geometry shall ensure functional requirements of the sensor demonstrated during qualification of the preliminary welding procedure. The reference weld leg size is 0.5 mm.

Welding Equipment reference parameters are as follows:

- Comprise mobile module for in-situ manned installation
- Reference type of the laser: Nd: YAG laser
- Beam delivery system: fiber
- Laser cooling system: water- or air cooled
- Include inert shielding gas system
- Nominal beam peak power 3000W
- Beam impulse duration: up to 20 ms
- Positioning accuracy 40 μm
- Regulated focused laser spot
- Include set of spares

[REQ-6] For verification of the OFSS functional parameters, the FBG interrogator shall be used, e.g. Luna Hyperion si255 (Table 3) with depolarized light source or similar [RD 1].

Table 3 Properties of Luna Hyperion Si255 FBG interrogator

Measurement option	Enhanced visibility, 10 Hz
Number of channels	4, 8 or 16 parallel channels
Wavelength range	1500-1600 or 1460-1620 nm
Wavelength accuracy/stability[1]	1 pm / 1pm
Wavelength repeatability[2]	1 pm, 0.3 pm at 1 Hz
Dynamic range/continuous	35 dB peak / 45 dB FS
Full spectrum measurement[3]	Included, data rate at 10 Hz

Contractor may propose to vary or deviate from stated requirements if performance characteristics and safety requirements are not affected. Any deviation shall be justified and submitted by the Contractor via a Deviation Request for the approval of IO prior to implementation.

7.2.3 Interface requirements

*[REQ-7]*Design of the tool shall take into consideration the environment during in-situ installation. IO shall provide corresponding models to allow verification of available space.

[REQ-8] Deployment of the LWT and auxiliary systems shall be compatible with in-situ displacement around technical interface.

[REQ-9] Design of the LWT shall be compatible with the limitation of the maximum weight born by scaffolding 200 kg per square meter or 150 kg point load.

[REQ-10] Compatibility of the LWT design with the design of the OFSS shall be demonstrated.

[REQ-11] Surface roughness: Clamping of the LWT shall be compatible with the maximum average surface roughness Ra=6.3 µm.

[REQ-12] Clamping system of the LWT shall exclude risk of contamination of the VQC-1A components surface.

Clamping system shall be compatible with the parent materials of interfacing ITER machine systems: Xm-19 and 316LN-IG austenitic stainless steel grades.

7.2.4 Material requirements

*[REQ-13]*Material to manufacture the lightweight structural components of the clamping system and any parts interfacing with VQC classified components shall be compatible with requirements of ITER VHB [AD 2].

[REQ-14] Application of carbon steel, lead, zinc or copper as well as any material which may hinder resistance of stainless steel to rusting is forbidden.

[REQ-15] Contractor shall procure sufficient quantities of raw materials required for manufacturing and testing of qualification mock-ups.

[REQ-16] Qualification mock-up of the VV Inner Wall shall be produced from solution annealed rolled plates or forgings of the 316LN grade.

[REQ-17] Qualification mock-up of the Flexible Cartrige shall be Inconel 718.

[REQ-18] The length of the fiber for laser beam shall be compliant with the minimal possible distance between the LWT installed on the platform and the sensors to be welded.

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7.2.5 Occupational safety requirements

*[REQ-19]*The LWT shall be equipped with laser protection elements to minimize exposure of the operators and surrounding personnel to the laser emission.

[REQ-20] The overall laser emitted power of the LWT equipped with protective guards shall correspond to the class 1.

7.2.6 Qualification requirements

*[REQ-21]*Contractor shall elaborate and submit for IO approval a Qualification Program prior to manufacturing of the Prototype. Qualification program shall include as minimum:

- Assembly drawings of the qualification mock-ups
- Description and technical specification of welding equipment
- Preliminary Welding Procedure Specification
- Welding and Inspection Plan
- Destructive Tests Plan identifying location and dimensions of test samples, including those for re-tests
- Functional tests of the sensors
- Occupational safety precautions

[REQ-22] Qualification of the preliminary Welding Procedure shall be performed on qualification mock-ups of representative design.

*[REQ-23]*Qualification mock-ups to be manufactured may have simplified design subject to acceptance of IO and provided that interfaces with the weld tool are of representative design.

[REQ-24] Qualification Mock-ups to be produced:

- mock-up of the VV Inner Wall made of stainless steel, see [REQ-16]
- mock-up of the Flexible Cartridge made of Inconel, see [REQ-17]

7.2.6.1 Welding procedure qualification

[REQ-25] Contractor shall procure sufficient quantities of raw materials required for manufacturing and testing of qualification mock-ups

*[REQ-26]*Contractor shall issue a pWPS prior to performance of qualification.

[REQ-27] The pWPS shall be comply with provisions of ISO 15609-3 and shall cover a full range of variables of the procedure to be qualified

[REQ-28] Execution of the welding procedure test shall be based on requirements of ISO 15614-11 for acceptance level B and provisions of the current Specification.

[REQ-29] Qualification shall be performed in the most difficult position, namely overhead

[REQ-30] No repair of welds during qualification is allowed.

[REQ-31] Imperfections of the welded joint shall meet requirements specified for the level B as per EN 13919-1.

[REQ-32] Scope of tests and examinations specified in ISO 15614-11 shall be complimented by dye penetrant testing.

[REQ-33] Reference acceptance level for dye penetrant testing shall be 2X as per ISO 23277 with the following additional criteria:

- linear indications are unacceptable,
- rounded indications whose greatest dimension is > 4 mm are unacceptable,
- Three or more indications in a line, less than 3 mm apart edge to edge are unacceptable;

[REQ-34] All destructive tests of test pieces shall be performed by an ISO 17025 certified laboratory

[REQ-35] Personnel performing penetrant tests shall possess level II ISO 9712 qualification.

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[REQ-36] Personnel performing possessing qualification in any NDT method, can perform direct visual examination.

[REQ-37] Upon successful completion of qualification, the Contractor shall submit for IO acceptance a Welding Procedure Qualification Record. Content of the WPQR shall comply with provision of the Annex A of ISO 151614-11.

[REQ-38] The Contractor shall perform qualitative assessment of the joint strength by performing peel and chisel tests of qualification mock-ups.

[REQ-39] The contractor shall develop the test procedure following provisions of the ISO 10447. Test procedure shall be included in the Qualification Program subject to IO approval

[REQ-40] Reference acceptance criteria for peel and chisel tests shall be as follows:

- The fractures caused by application of force to the test sample, shall occur in the base metal
- Interfacial failure of a test sample weld during peel or chisel test shall be regarded as unacceptable.

7.2.6.2 Functional Verification of the OFS

[REQ-41] The Contractor shall validate that the functionality of the OFS integrity after its welding is preserved.

[REQ-42] Temperature of the OFSS center shall not exceed 400°C during welding, the value being controlled by successive measuring the reflection spectrum of the sensor FBG during welding procedure as well as by the temperature sensor build-in in the clamping tool of the LWT. According to temperature sensitivity of the embedded FBG 17-18 ppm/K spectral displacement of the FBG long-wavelength side shall not exceed 7000 ppm (~11 nm at 1550 nm).

[REQ-43] The functional verification shall be done by the testing of the welded OFS according to the qualified WPS. The functional tests comprise the verification of:

(1) Spectral characteristics of the FBG inside OFSS;
(2) Optical (insertion and return) losses if applicable.

[REQ-44] The measured room temperature (RT) reflection spectrum of the FBG shall preserve Gauss-like distribution. FBG spectral characteristics shall be verified by comparison with the initial values given in the data sheet or measured before sensor welding. The acceptance criteria shall be as follows:

1. Initial OFS reflection spectrum shall be registered with FBG-interrogator (LUNA, Hyperion [RD 1] or similar) and the results (the measured spectrum and the calculated parameters listed below) shall be recorded. Comparison of this spectrum with the as-prepared OFS reflection spectrum shall be performed to ensure the correct OFS properties.

Four primary spectral parameters found from spectrum analysis shall be checked for comparison with their reference values:

- Central wavelength (λ_0) at T=25°C;
- Bandwidth (FWHM, $\Delta\lambda$);
- Background level ($\mathbf{P_{back}}$)
- Reflection coefficient (**R**)

2. OFS reflection spectrum shall be registered after OFS welding at RT with the same FBG-interrogator (LUNA, Hyperion [RD 1] or similar) and the results (the measured spectrum and the calculated parameters listed above) shall be recorded again. Comparison with the

initial reflection spectrum (measured just before the OFS welding) shall be performed to ensure the correct properties of the welded OFS.

The welding acceptance criteria shall be as follows:

- λ_0 does not match its previous value within ±0.5 nm (±300 ppm);
- $\Delta\lambda$ increase is more than 10%;
- $\mathbf{P_{back}}$ exceeds its previous value on more than 5 dB.
- **R** decrease is more than 10%;

The above acceptance criteria can be better clarified and agreed with IO at the R&D stage of the LWT development.

7.2.7 Factory Acceptance Tests requirements

*[REQ-45]*Demonstration of functional performance of the LWT shall be performed upon approval of the WPQR.

[REQ-46] Demonstration of functional performance shall be performed on representative strain sensors.

Contractor shall procure sufficient quantity of representative strains sensors to execute the factory acceptance tests.

7.2.8 CE Marking requirements

CE Markings shall be implemented in accordance with European directives requirements. The list of European directives concerning CE marking is available on the following web site https://single-market-economy.ec.europa.eu/single-market/ce-marking/manufacturers_en

7.2.9 Labelling and traceability requirements

*[REQ-47]*The LWT shall contain the tagging placed on the visible area of the tool. The tagging shall include:

a) Functional Reference (identification provided by IO)
b) PNI (identification provided by IO)
c) Serial Number (identification defined by the Contractor)

[REQ-48] Crates delivered to IO site by the Contractor shall have, at minimum, the following marking information:

- Title of crate,
- Purchase Order, Contract Number,
- Shipping/Crate Num.,
- Supplier Name and address,
- Net / gross weight,
- Packing Date.

7.2.10 Packing, preservation & shipping

The Delivery Readiness Review (DRR) is a Hold Point to ensure that the components can be released for shipment.

The purpose of the DRR:

- To perform the final check and the verification of components, packages and corresponding documentation before they leave the Sending Entity and transport to the IO;

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- To validate that the IO has all mandatory documentation, customs documents, and/or any other technical or logistical information that is needed so that the material can be adequately managed through transportation, reception, storage, and ultimately into ITER construction and assembly.

DRR mandatory documents:

- Contractor Release Note (CRN)
- Delivery Report
- Packing List (PL)
- Equipment Storage and Preservation Form
- Shipping Plan of Load (SPL) with a specific transportation quality plan containing special requirements for the lifting, handling, etc. – to be prepared by the Logistics Service Provider.

The DRR shall follow the procedure ITER_D_X3NEGB - Working Instruction for the Delivery Readiness Review (DRR) .

*[REQ-49]*Contractor shall specify and submit to IO the storage and handling conditions ahead of shipment.

[REQ-50] The Contractor shall provide the preservation requirements prior, during and post welding activities.

*[REQ-51]*The Contractor shall ensure that the transport organization, and the transport company are insured for damage and/or loss of the components.

[REQ-52] The Supplier shall bear the risk of loss or damages to the Items until IO Final acceptance.

[REQ-53] The items shall be delivered to the ITER Organization at the following address under the responsibility of the Contractor.

ITER Organization, Zone 2, B 89 , Logistic Platform

Route de Vinon-sur-Verdon –

13115 St Paul Lez Durance,

France

7.3 Acceptance of the delivery at IO

Upon receipt of the shipment at the delivery location, the crates shall be opened by IO or its authorised representatives for visual inspection to confirm that:

- the integrity of the crates and internal packages has been preserved, including identifying visible damage;
- the number and type of components contained in the packages is correct;
- the enclosed documentation (materials certificates, test results, etc.) is complete;
- the reading of the accelerometers or other sensors is consistent with handling of fragile items;
- the integrity of the components and cleanliness has been preserved.
- the existence and correctness of the markings on the Items

Acceptance of delivery will be completed by signature of Delivery Report by IO after successful conclusion of the inspection. Following such confirmation, the shipment will be accepted.

7.4 Service Duration

The maximum expected duration for both Firm and Optional Parts of the contract is 18 months. Refer to the Section 9 to the list of deliverables and their due dates.

8 Location for Scope of Work Execution

Contractor can perform the work at their own location with exception of the Task 3.2 (see Section 6.1) that shall be performed at the ITER site.

9 IO Documents & IO Free issue items

9.1 IO Documents

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

Ref	Title	Doc ID	Expected date
1	CAD models of the in-vessel environment and main interfaces	Via DET	By the KoM

9.2 Free issue items

Under this scope of work, IO will deliver the following equipment/parts by the stated date:

Ref	Equipment / Part Description	Quantity	Expected date
1	OFSS bodies in stainless steel	5	T0 + 3
2	OFSS bodies in Inconel 718	5	T0 + 6
3	OFSS sensors in stainless steel	5	T0 + 3
4	OFSS sensors in Inconel 718	5	T0 + 6

10 List of deliverables and due dates

The Supplier shall provide IO with the documents and data required in the application of this technical specification, the GM3S [AD 1] and any other requirement derived from the application of the contract.

A minimum, but not limited to, list of documents is available hereafter with associated due dates:

Deliverable description	Expected date (T0+x) *	Contract Gate
FIXED PART:		
D# 1 Quality Plan	T0 + 2	Kick-off meeting

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D# 2 Schedule of contract execution	T0 + 2	Kick-off meeting
Phase 1. Feasibility study		
D# 3 CAD Model of LWT structural design	T0 + 4	Design review
D# 4 Technical specification of the laser welding equipment	T0 + 4	Design review
D# 5 CAD Model of LWT Prototype	T0 + 4	Design review
D# 6 LWT 2D Drawings	T0 + 4	Design review
D# 7 Test plan of the LWT prototype	T0 + 4	Design review
D# 8 Test report of the LWT prototype	T0 + 5	Design review
OPTIONAL PART:		
Phase 2 Manufacturing, qualification and testing of LWT		
D# 9 CAD Model of LWT manufacturing design	T0 + 6	MRR
D# 10 LWT assembly drawings	T0 + 6	MRR
D# 11 LWT manufacturing design report	T0 + 6	MRR
D# 12 Manufacturing and Inspection Plan	T0 + 6	MRR
D# 13 Draft user manuals	T0 + 6	MRR
D# 14 Design report of qualification mock-ups	T0 + 6	MRR
D# 15 Bill of materials	T0 + 6	MRR
D# 16 Qualification Program	T0 + 8	MRR
D# 17 Qualification Mock-ups Material certificates	T0 + 8	MRR
D# 18 Certificates of conformance for COTS components	T0 + 8	MRR
D# 19 Preliminary Welding Data Package (pWDP)	T0 + 8	MRR
D# 20 Welding Data Package (WDP)	T0 + 10	MRR
D# 21 LWT Qualification report	T0 + 12	MRR
D# 22 FAT report	T0 + 14	FAT
D# 23 Certificate of conformance	T0 + 14	FAT
Phase 3 Delivery to ITER Site		
D# 24 Contractors Release Note	T0 + 16	DRR
D# 25 Packing List	T0 + 16	DRR
D# 26 User manuals	T0 + 16	DRR
D# 27 Equipment handling and storage procedures	T0 + 16	DRR
D# 28 Report on the On-site Commissioning	T0 + 18	SAT

(*) T0 = Commencement Date of the contract ; X in months.

Supplier is requested to prepare their document schedule based on the above and using the template available in the GM3S [AD 1] appendix II (click here to download).

11 Quality Assurance requirements

The Quality class under this contract is QC-2, [AD 1] GM3S section 8 applies in line with the defined Quality Class.

The organisation conducting these activities should have an ITER approved QA Program or an ISO 9001 accredited quality system.

The general requirements are detailed in ITER Procurement Quality Requirements (ITER_D_22MFG4) [AD 4].

Prior to commencement of the task, a Quality Plan must be submitted for IO approval giving evidence of the above and describing the organisation for this task; the skill of workers involved in the study; any anticipated sub-contractors; and giving details of who will be the independent checker of the activities (see Procurement Requirements for Producing a Quality Plan (ITER_D_22MFMW)).

Documentation developed as the result of this task shall be retained by the performer of the task or the DA organization for a minimum of 5 years and then may be discarded at the direction of the IO. The use of computer software to perform a safety basis task activity such as analysis and/or modelling, etc. shall be reviewed and approved by the IO prior to its use, in accordance with Quality Assurance for ITER Safety Codes (ITER_D_258LKL).

12 Specific General Management requirements

Requirement for [AD 1] GM3S section 6 applies in full.

12.1 Contract Gates

The contract gates are defined in [AD 1] section 6.1.5, this scope of service call for the following technical gates:

- Kick-off meeting
- Design review following the feasibility study
- Manufacturing Readiness Review (MRR)
- Factory Acceptance Test (FAT)
- Delivery Readiness Review (DRR)
- Site Acceptance Test (SAT) and Commissioning
- Close-out of the contract

12.2 Data management

The documents generated during the execution of this contract, which the Contractor and its Suppliers shall submit to IO (e.g. technical and QA documents, Minutes of Meetings) will be handled electronically in the ITER Document Management System (IDM).

The Contractor will upload the deliverables in the dedicated IDM folder provided by IO not later than the kick-off meeting.

The Contractor shall hold at the disposal of the IO and make available to it such information and documentation as the IO deems necessary to determine the progress, quality and status of the work. All documentation to be delivered to the IO must be in English.

The Contractor shall ensure that all documents and records are uniquely identified and traceable.

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The Contractor will report as soon as possible to the IO any occurrence, which could delay or jeopardize the proper execution of activities related to this contract.

12.3 Meeting Schedule

The technical meetings shall be organized at least every two weeks and shall be held via videoconference either in person.

12.4 CAD design requirements

The reference requirements for exchange of the CAD data are given in the Section 5.3 of the document [AD 9].

However, considering that the CAD data produced in frame of this contract are not numerous, the Contractor may be exempted from some of them:

- Design plan is not mandatory
- The collaboration scheme can be asynchronous
- The CAD models can be submitted to IO in STEP or CATIA format via Data Exchange Task (DET).

12.5 Access rights

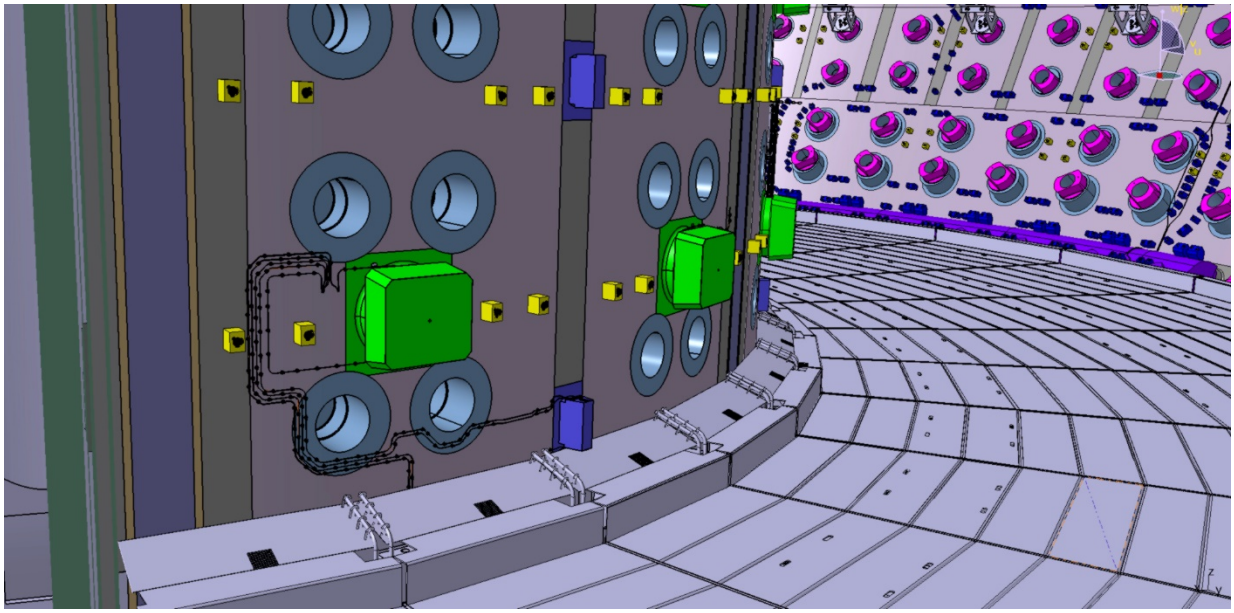
The Contractor shall ensure that access rights are granted to IO personnel at all Contractor's premises where Contract activities is being performed.

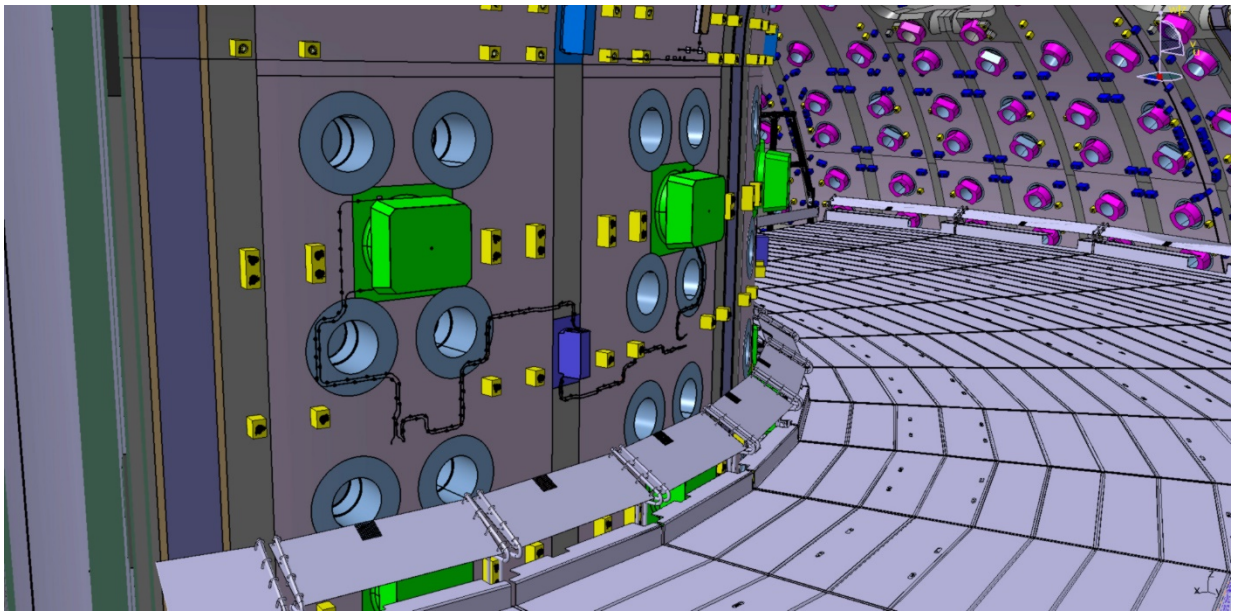
In case of concerns regarding the quality of production, the IO reserves the right to perform unscheduled inspections.

The Contractor shall also ensure that Third Parties (e.g. representatives of OFSS's Supplier) are granted access to the test facility's premises at all reasonable times in order to witness the execution of the tests and to participate to meetings

SUPPLY

13 Appendix: Environment for in-vessel installation activities





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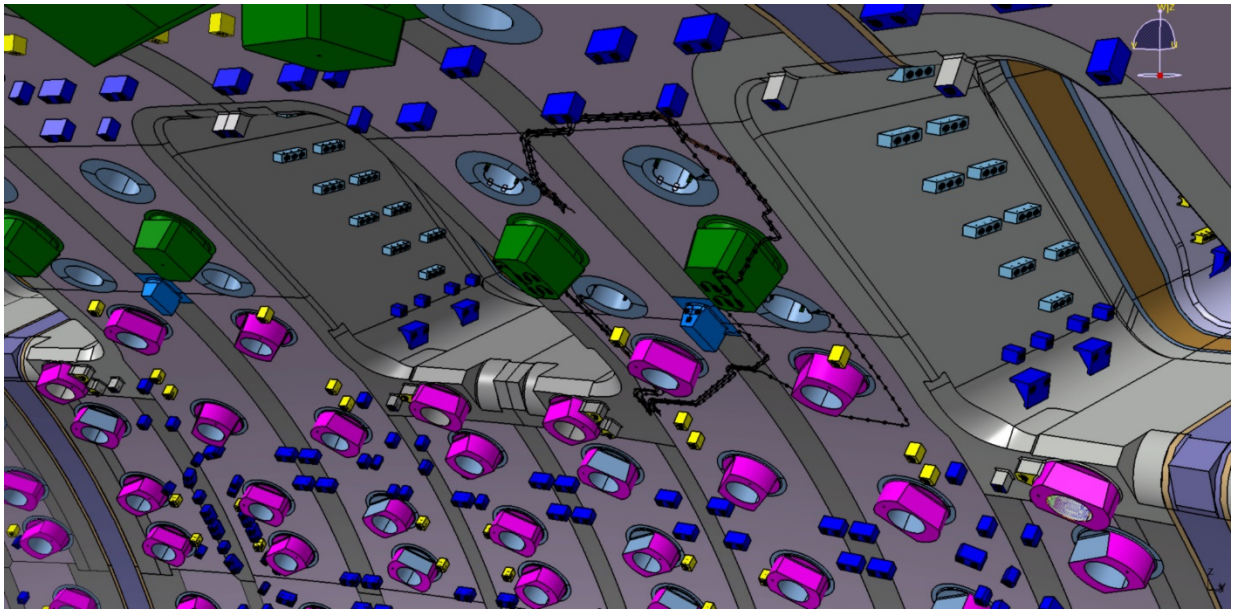

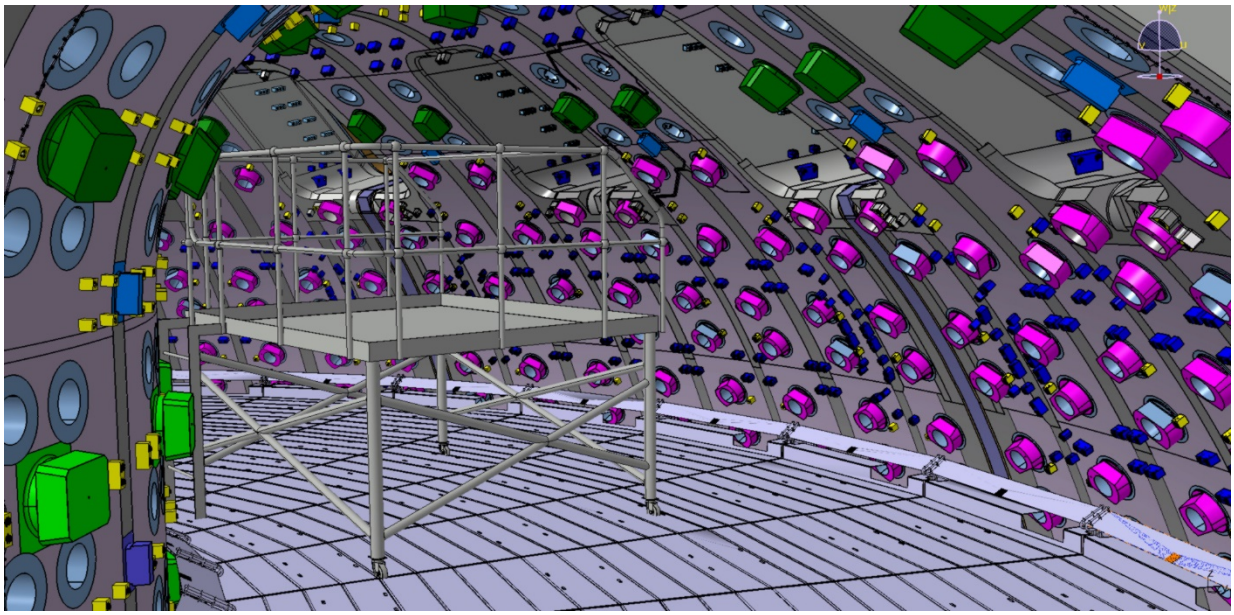

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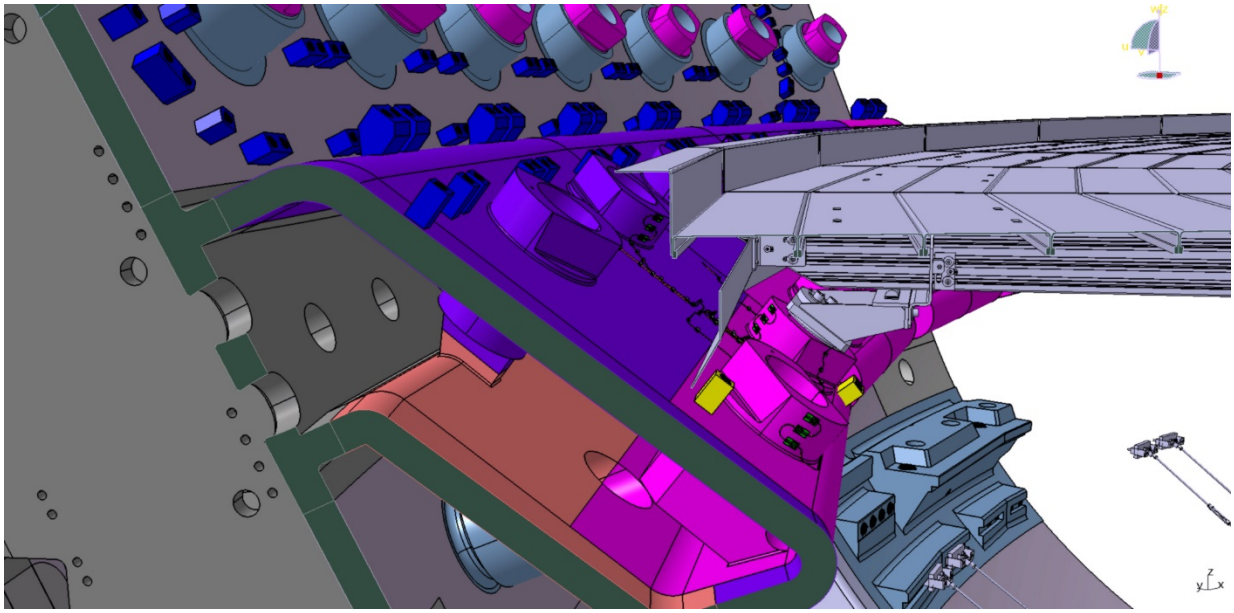

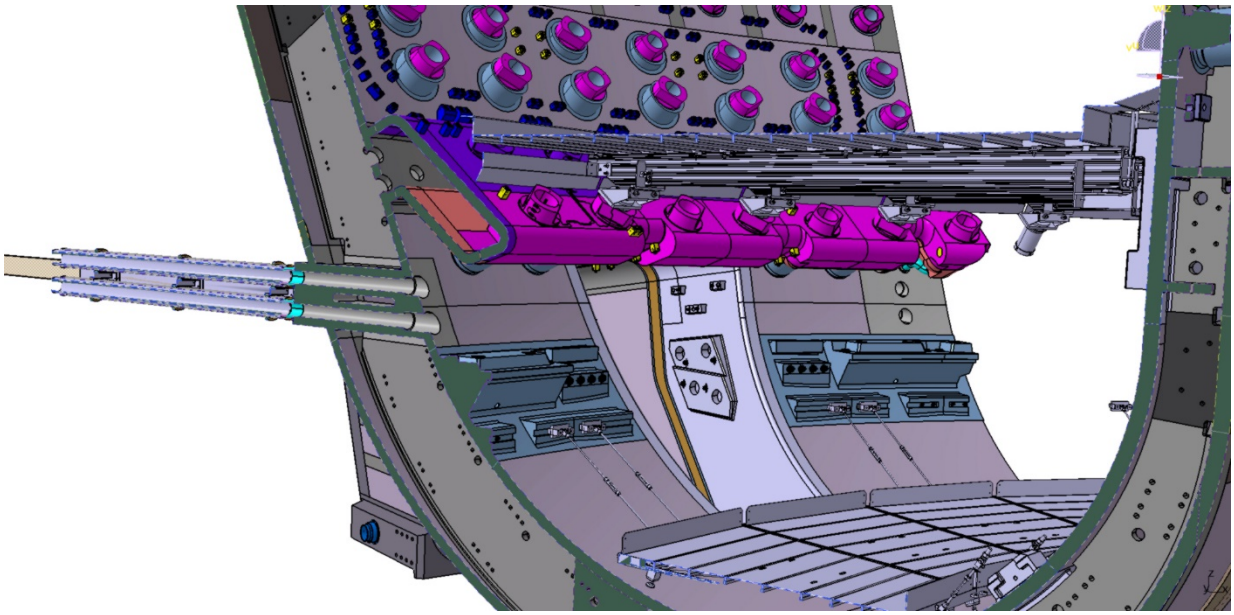

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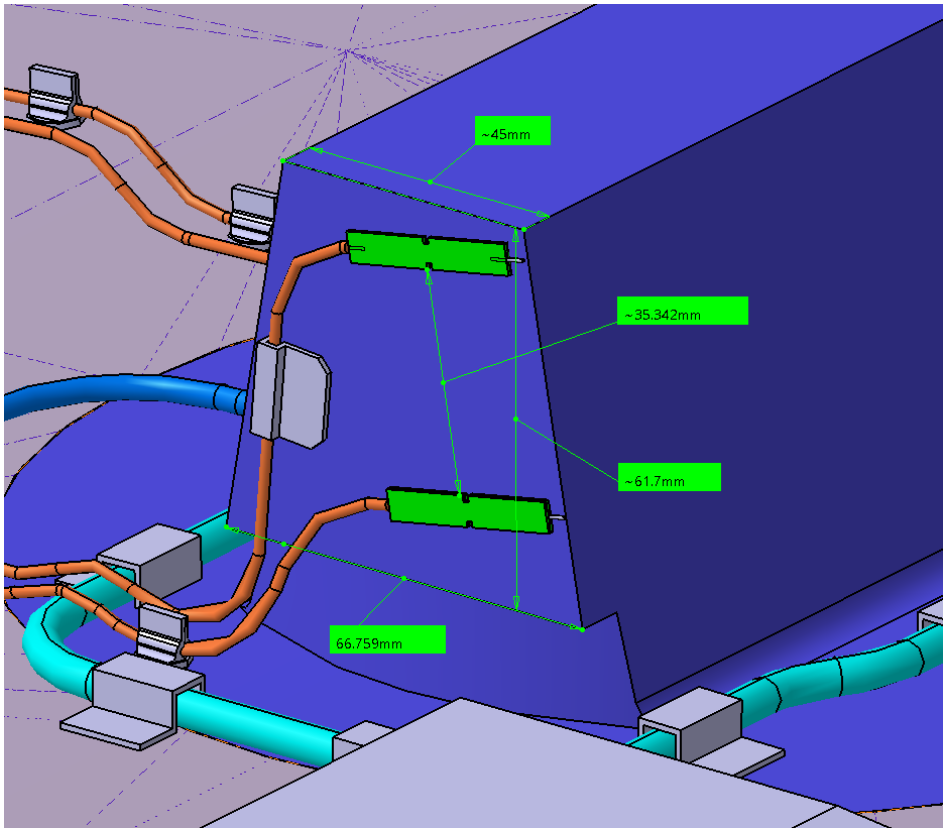
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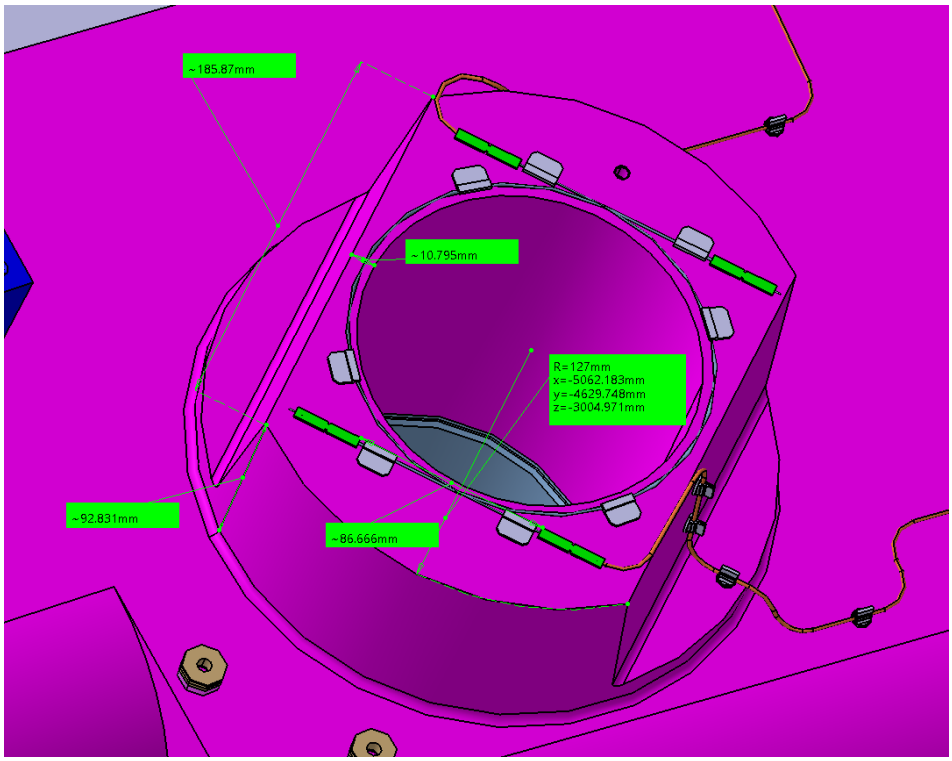
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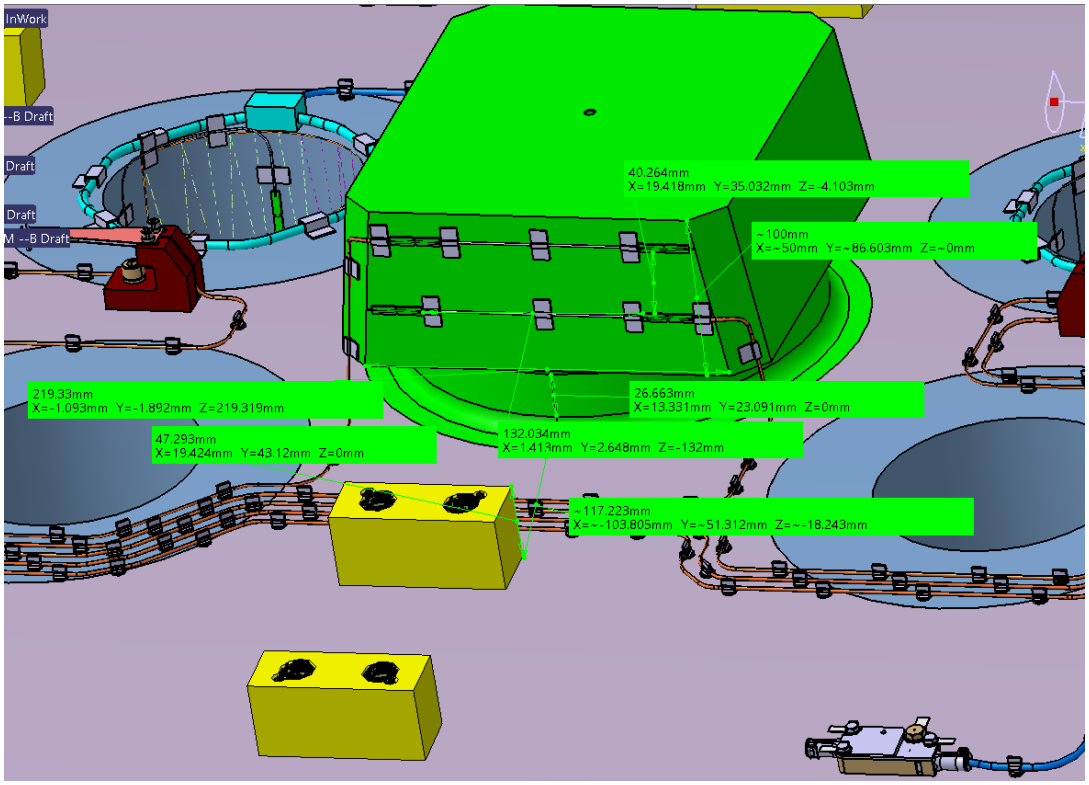
SUPPLY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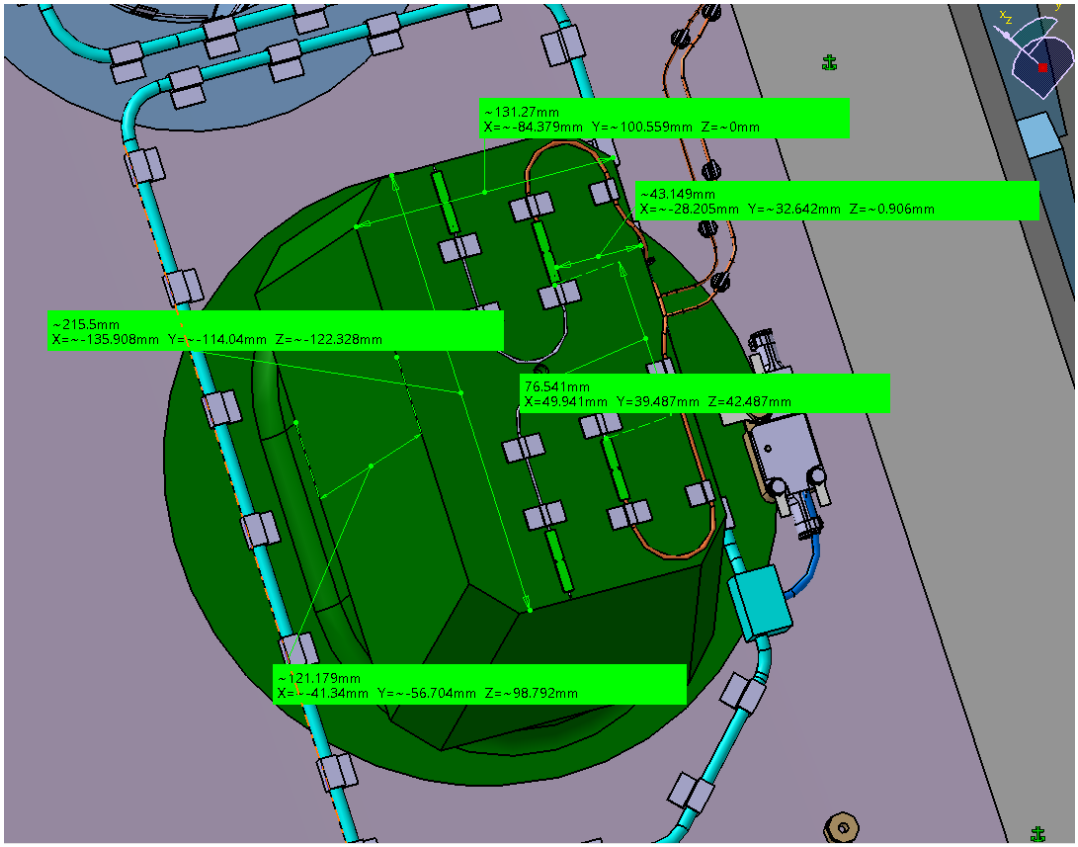
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