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Technical Specifications (In-Cash Procurement)

CFN - Technical Summary for FWC on manufacturing of components for diagnostic systems

technical summary for Call for Nomination

TECHNICAL SUMMARY

IO/26/CFT/70001404/LLJ

Framework Service Contract for Manufacturing of Components for Diagnostic Systems

1. Purpose

The main purpose of this framework contract is to provide the ITER Diagnostics Program with mechanical components and associated acceptance and qualification tests to support its manufacturing and construction.

Due to the diversity of the required components, the ITER Organization reserves the right to award this contract to more than one contractor.

2. Background

The ITER Project is an international effort aimed at demonstrating the scientific and technological feasibility of fusion energy. ITER is specified as a Nuclear Facility INB-174. It has to be highly reliable, efficient and safe device built to produce a predefined output quantity and quality of scientific data.

Monitoring and controlling the ITER device using diagnostics is crucial for successful operation. Design, construction and planning for operation of these diagnostics are now well underway. There are about fifty diagnostics systems in ITER which are needed to cover the reliable routine operation, advanced operation and physics exploitation. These diagnostics are divided into several categories, including magnetics, neutrons, bolometer, infrared, optical, ultraviolet, X-ray, microwave and operational systems. with manufacturing and testing resources where there is an overlap regarding the requested experience. The diagnostic systems concerned by this framework contract correspond to about 15 systems and are mostly optical systems.

The diagnostic system components will be located within the ITER Vacuum vessel, in specialized diagnostic ports and within the tokamak building complex. They will be subject to high neutron and gamma radiation, temperatures and magnetic field. Environmental and Integration constraints require complex manufacturing and assembly techniques to comply with all requirements including those from diagnostic systems. In some cases, this will require qualification testing in support of manufacturing.

3. Nuclear Safety

As mentioned above, ITER is a Nuclear Facility (INB-174) and work within the scope of this framework contract could potentially involve Protection Important Components (and in particular Safety Important Class components (SIC)) or other activities defined as Protection Important Activities (PIA). For those the French Nuclear Regulation must be observed, in application of the Article 14 of the ITER Agreement.

In such case, the Suppliers and Subcontractors must be informed that:

- The Order 7th February 2012 applies to all the components important for the protection (PIC) and the activities important for the protection (PIA).
- The compliance with the INB-order must be demonstrated in the chain of external contractors.
- In application of article II.2.5.4 of the Order 7th February 2012, contracted activities for supervision purposes are also subject to a supervision done by the Nuclear Operator.

For the Protection Important Components, structures and systems of the nuclear facility, and Protection Important Activities the contractor shall ensure that a specific management system is implemented for his own activities and for the activities done by any Supplier and Subcontractor following the requirements of the Order 7th February 2012 (PRELIMINARY ANALYSIS OF THE IMPACT OF THE INB ORDER - 7TH FEBRUARY 2012 (AW6JSB v1.0)).

4. Scope of Work

ITER Organization Diagnostics Program shall coordinate the manufacture and assembly of mechanical components and the achievement of both prototype and final component manufacture, qualification and acceptance tests through Task Orders. Each Task Order shall have a dedicated technical specification providing detailed requirements on the expected supply. Task Orders are in principle expected to be limited to work for a single diagnostic subsystem, but exceptions might occur whereby the work covers supply to multiple diagnostic subsystems to improve procurement efficiency. In general Task Orders would fall into following categories:

- Preparation of Manufacturing Readiness Reviews (MRR) plan and scheduling. This would include (but is not necessary limited to) evaluation of final design specifications and drawings with respect to the anticipated manufacturing methods and tooling, update of design (including engineering verification) to ensure compatibility with manufacturing methods and tooling, and reducing manufacturing risks, pre-qualification of manufacturing methods and tooling This would also include verification of: welding requirements, weld designs and planning of non-destructive testing (NDT) of welds, coatings or other special techniques,.
- Conduct MRRs according to ITER guidelines [ITER_44SZYP].
- Assembly tests and 1:1 scale mock-up, and associated tests if required.
- Procurement of ITER grade material, including material certification and potential material composition tests..
- Manufacturing and assembly, including Factory Acceptance Testing (FAT) of Diagnostic components and/or subassemblies. FAT includes but not limited to: vacuum, baking, outgassing and vibration tests.
- Manufacturing may allow outsourcing the production of very specialized subcomponents to specialized suppliers.
- The manufacturing and assembly of the components would also include all stages up to the Delivery Readiness Review and organise delivery to the IO site.

The scope of the work requested in this call covers the services of experienced manufacturers in Ultra High Vacuum components, Optical components (including optical coatings) and Mechanical components (including motion in vacuum). The scope of the work includes:

- Supplying of ITER grade materials with certification, incl. possibility for testing Co, Ta and Nb content of materials if they cannot be procured with certification of Co< 0.05%, Ta<0.01% and Nb<0.01% content.
- Reading 3D and 2D Computer Aided Design model from CATIA files and models provided by ITER Organization;
- Design and execution of Welding / Brazing on multiple materials, incl. tests to qualify weld/braze/diffusion bonds;
- Machining (Milling, Cutting, Drilling, Spark erosion, additive manufacturing, etc.) of Austenitic Stainless Steel (304 or 316), Nickel Based Alloys, Titanium, Copper, etc., incl. high precision machining (<10 micron);
- Permanent or temporary assembly of mechanical components in subassemblies;
- Electrical wiring and installation of electrical connectors (incl. electrical testing for connectivity, resistance, grounding and electromagnetic compatibility as per applicable norms and standards) both for Ultra High Vacuum (UHV) use (mineral insulated cables junction boxes, setup and weld cable end joints, fabricate braze joints, sealing cables into vacuum test rig) and use outside vacuum;
- Manufacturing of UHV compatible ceramic Printed Circuit Boards (PCBs) for the radio frequency signals (~10-100 MHz) (potentially outsourced);
- Vacuum outgassing tests, residual gas analysis and Helium Leak Testing (leak rate < $1x10^{-10}$ $Pa.m^3.s^{-1}$) on welded joints or particular assemblies;
- Assembly and testing of mechanical components in clean room facilities;
- Cleaning of components to level of vacuum and optical cleanliness;
- Manufacturing, assembly and testing of pressurized circuits (e.g. for water cooling or pneumatic actuators, mirrors, mechanical assemblies);
- Thermal cycling and heat flux tests;
- Mechanical testing, incl. vibration table tests (resonance, sine or random), motion in vacuum tests, pulling / pushing tests;
- Radiography, Ultrasonic testing and dye penetration testing of welded joints;
- Metrology and optical alignment (e.g. with laser tracking, FARO arm, etc.);
- Manufacturing of custom optical surfaces (e.g. by diamond turning) and optical precision polishing;
- Uniform coating (e.g. by Physical Vapour Deposition) of multiple materials (e.g Copper, Rhodium, Platinum, Aluminium, Zirconium- and Silicon-Oxide, Boron Carbide, Titanium Oxide, Dielectric coatings etc.) with coating thicknesses up to 10µm, on several substrate materials (e.g. Ceramic, Stainless Steel, Copper, Aluminium, Alumina, Aluminium Nitride, etc.) of sizes up to 300x300mm^2.

- Optical testing (transmission, specular/diffuse reflectivity and BRDF[1], contrast, wavefront error, stray light characterization …) in the infrared and visible.
- Manufacturing Preparation and Follow-Up;
- Organise, perform and thoroughly document Site Acceptance Tests;

ITER may require the contractor to perform the work either at remote locations such as the contractor's usual place of business, or at the ITER site, or at a location to be established and maintained by the contractor within easy reach of the ITER site.

5. Duration of Services

The Contract is expected to come into force by second half of 2026 for a firm duration of four (4) years, with an option to extend for a further period of 2 years.

The indicative Call for Tender milestones are:

Call for Nomination	End of February 2026
Issuing of Prequalification invitations	End of March 2026
Issuing of Call for Tender	Beginning of May 2026
Deadline for submission of Tenders	Beginning of August 2026

6. Experience

The selection process will be based on the following past experiences and facilities:

- Experience in procuring special grade steels ITER grade materials (E.g. Stainless Steel SS316LN-IG) with certification;
- Supplying of Ultra-high vacuum-compatible mechanical components or systems;
- Machining of UHV-compatible mechanical components;
- Supplying and machining of non-UHV mechanical components;
- Supplying and manufacturing of optical components (mirrors, lenses, coatings, polishing) both UHV compatible and non-vacuum;
- Assembly and alignment of optical systems and optical boards including detectors (cameras, photomultipliers, etc.);
- Manufacture and assembly of scientific instruments, diagnostics and detectors for fusion, fission and general use nuclear applications;
- Metallic assemblies using welding and brazing;
- UHV and non-UHV electrical (Low Voltage and Radio Frequency) circuit manufacturing and assembly;
- Computer Aided Design;
- Machining facilities;

[1] Bidirectional reflectance distribution function

- Integration of complex systems and their subassemblies (examples: Shielded cabinet with optomechanical interfaces, in-vessel water cooled mirror boxes, and ex-vessel optical relay unit, motorized mirror unit assembly, ...)
- Experience in manufacturing specification and follow up for complex, high precision components
- Test facilities including UHV testing, electrical testing, optical testing, alignment and metrology testing;

7. Examples

The document ITER_D_ EZ972D shows a global overview of ITER Diagnostics. Some of the components are shown below for information.

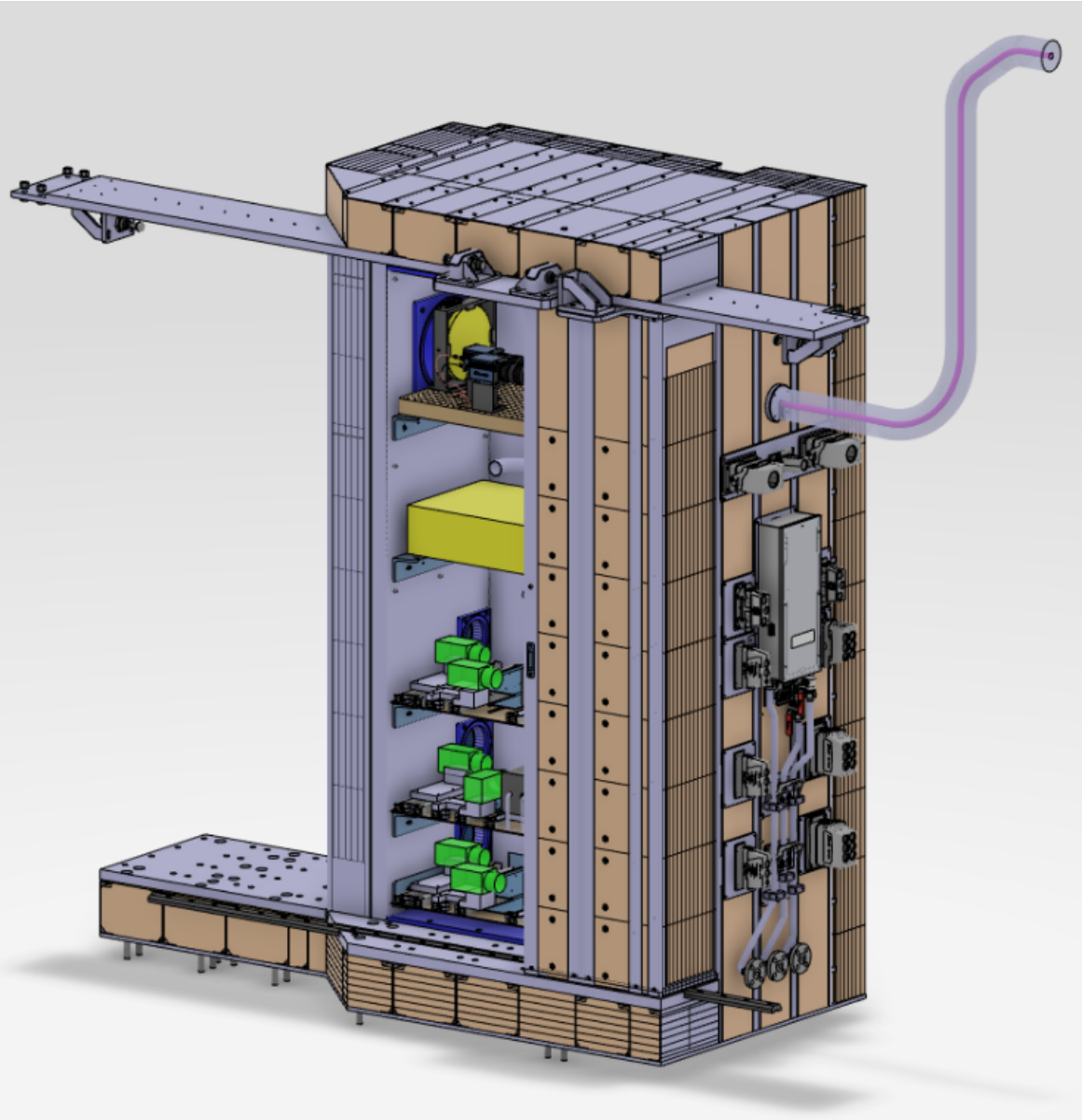

Figure 1: Example of Shielded Cabinets containing electronics (rough dimensions L 2m by W 0.8m by H 2.5m and weighs >10t)

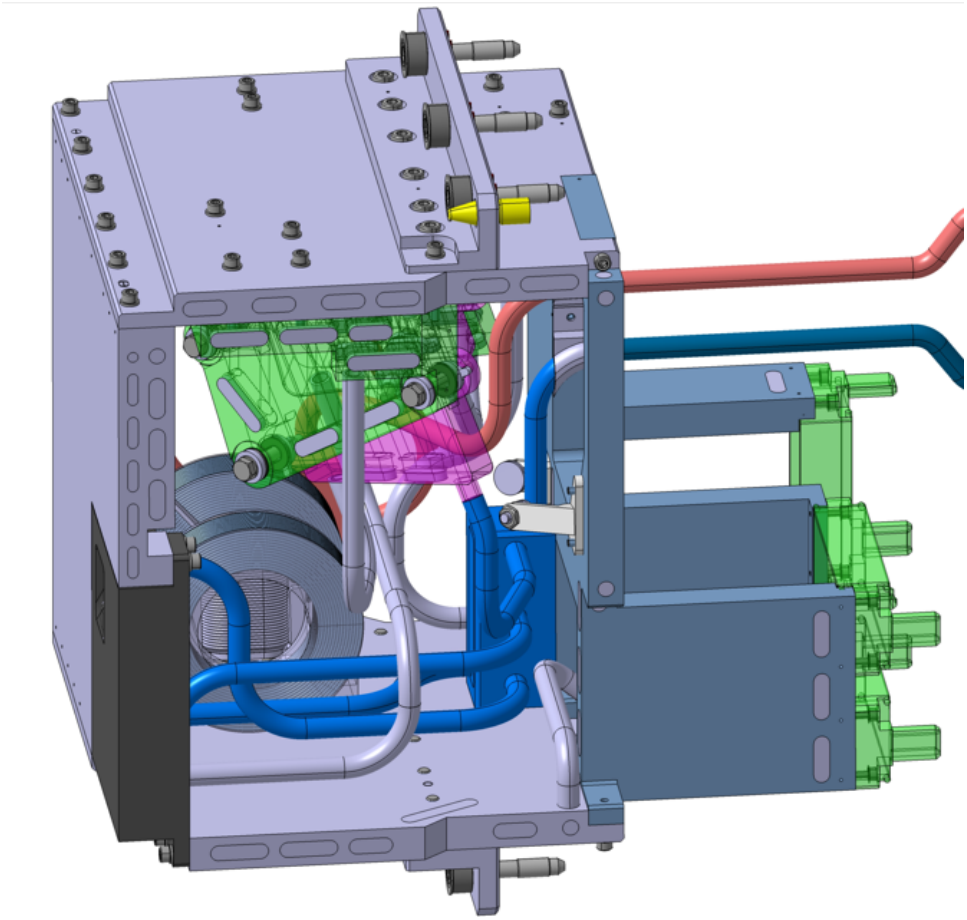

Figure 2: In-vessel First Mirror Unit with Water cooling (Rough dimensions L690mm by W 333mm by H 484mm)

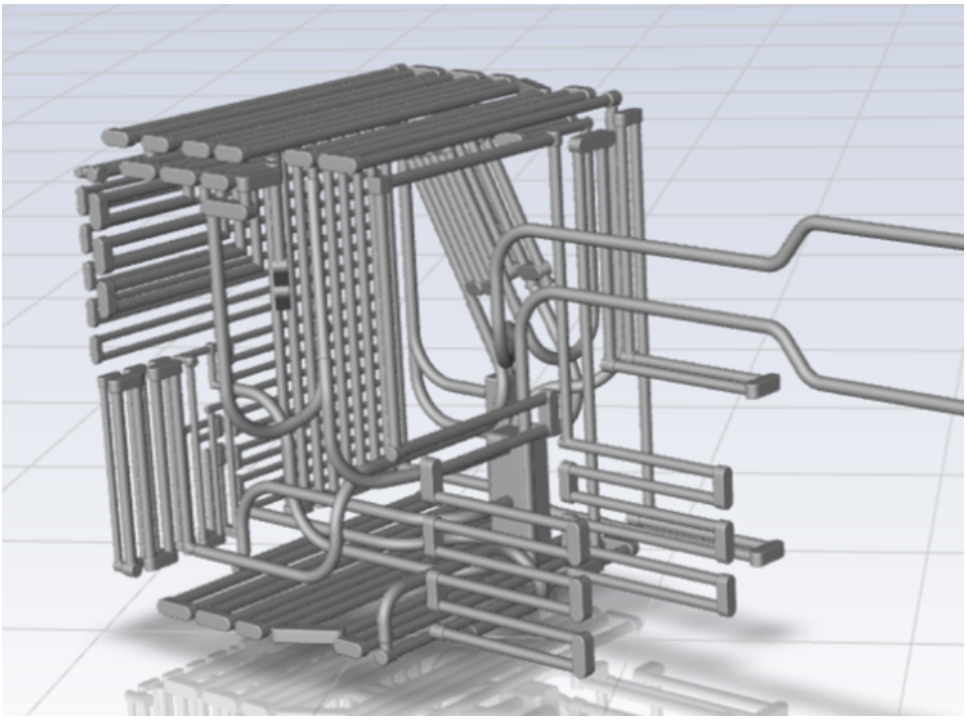

Figure 3: Cooling circuit of the in-vessel First Mirror Unit (Rough dimensions L690mm by W 333mm by H 484mm)

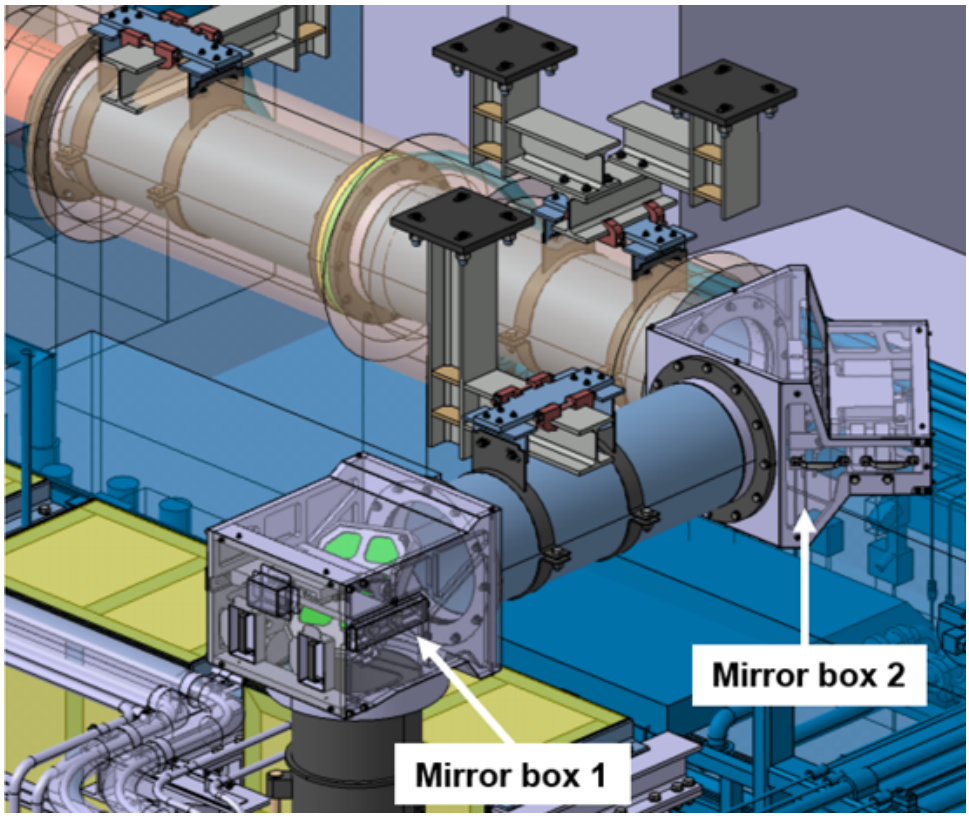

Figure 4: Example of Ex Vessel Optical relay unit (Rough Dimensions Mirror box 1 457 by 457 by 557 mm and Mirror box 2 449 by 698 by 688 mm)

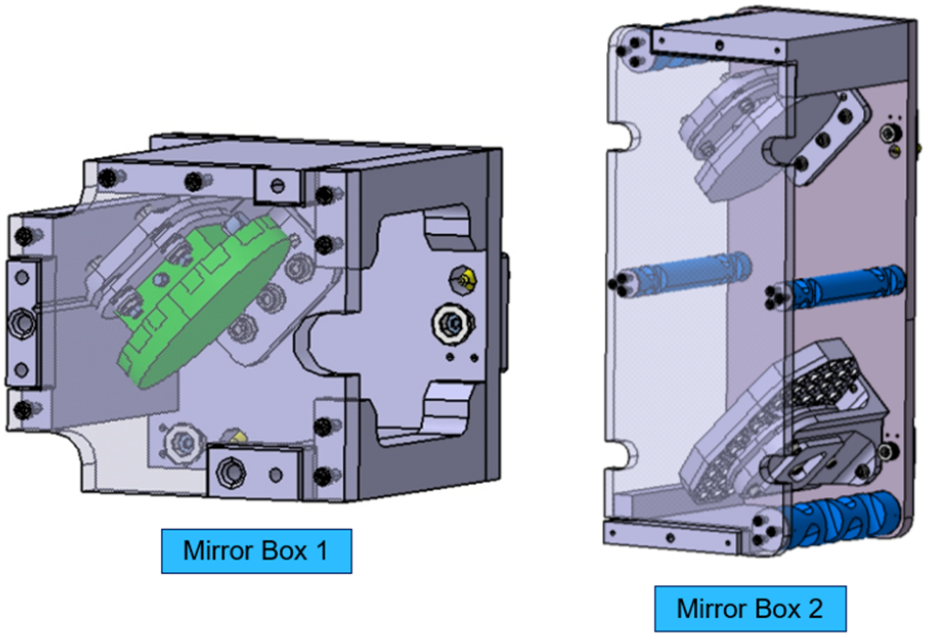

Figure 5: Mirror Boxes (Rough dimensions Mirror Box 1 220 by 225 by 200 mm and Mirror Box 2 306 by 705 by 294mm)

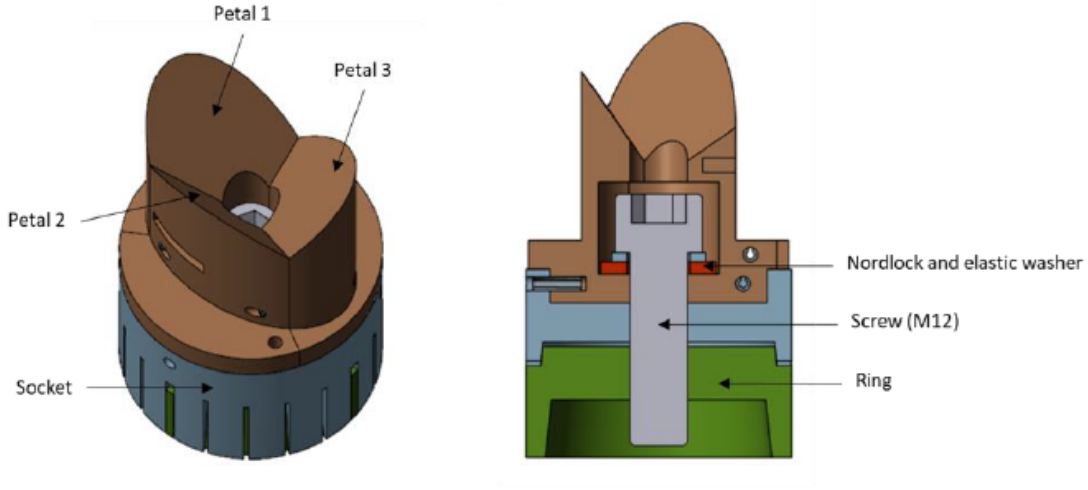

Figure 6 Corner Cube Retroreflector (CCR) assembly (rough dimensions 90mm length and radius 27.25 mm)

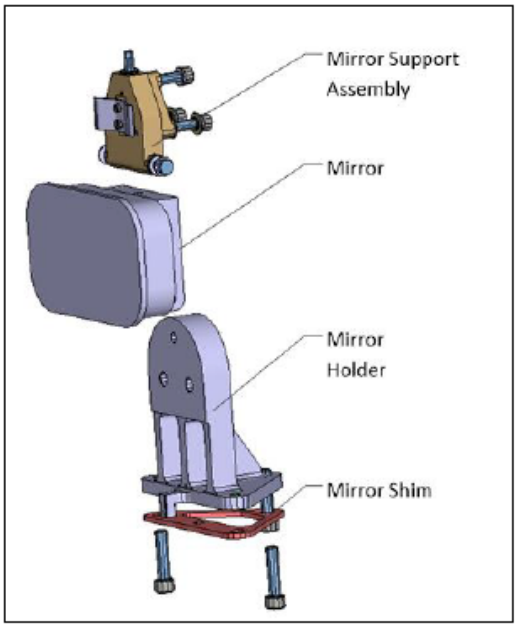

Figure 8-29: Exploded view of a mirror assembly

Each mirror assembly is composed of

- The mirror itself
- The mirror support assembly
- The mirror holder
- The mirror shim

The latter is to be adjusted during optical alignment of the FMU in the laboratory.

Figure 7 : First In-vessel Mirror Unit (not water cooled). Rough Dimensions L 492 mm by W 267mm and H 218mm

8. Candidature

Participation is open to all legal persons participating either individually or in a grouping (consortium) which is established in an ITER Member State. A legal person cannot participate individually or as a consortium partner in more than one application or tender. A consortium may be a permanent, legally-established grouping or a grouping, which has been constituted informally for a specific tender procedure. All members of a consortium (i.e. the leader and all other members) are jointly and severally liable to the ITER Organization.

The consortium groupings shall be presented at the pre-qualification stage. The consortium cannot be modified later without the approval of the ITER Organization after the pre-qualification.
Legal entities belonging to the same legal grouping are allowed to participate separately if they are able to demonstrate independent technical and financial capacities. Bidders' (individual or consortium) must comply with the selection criteria. IO reserves the right to disregard duplicated references and may exclude such legal entities form the tender procedure.