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Technical Specifications (In-Cash Procurement)

CS Pre-Compression Hydraulic Tooling Specification SUMMARY

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Central Solenoid Pre-Compression Tooling

Summary of specifications for Call for Nomination

1. Purpose

This call for nomination is associated with the design, manufacturing and delivery to the ITER site hydraulic tooling capable of applying a load of 210MN across nine 40-degree sectors of a large magnet as part of the ITER assembly process.

2. Introduction

ITER is a joint international research and development project that aims to demonstrate the scientific and technical feasibility of fusion power. The partners in the project are the People´s Republic of China, the European Union, India, Japan, the Republic of Korea, the Russian Federation and the USA. ITER is being constructed at Cadarache in the South of France (for details see **www.iter.org**).

2.1 Introduction to the Central Solenoid

The CS Assembly consists of a stack of six independently operated circular coils referred to as modules and a related support structure.

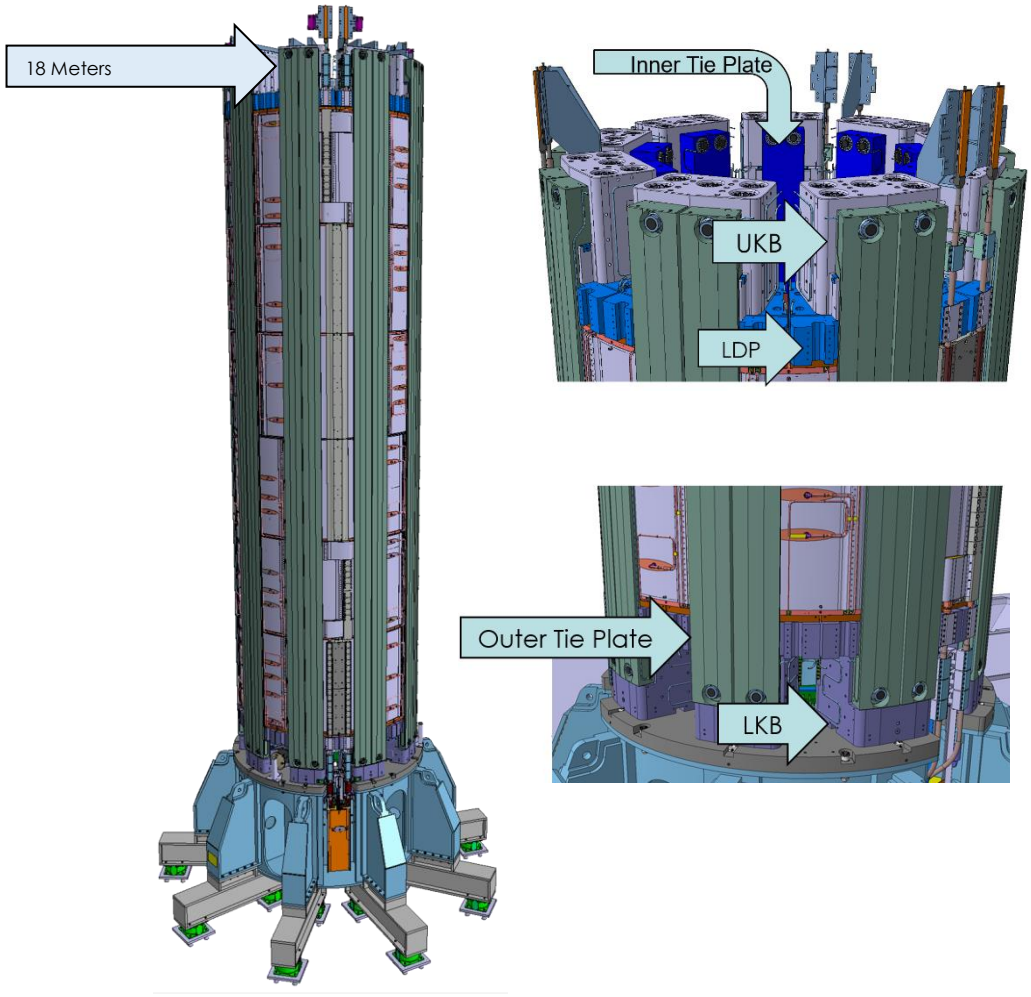

Figure 1: Illustration of CS Upper and Lower Structural Components

The support structure consists of three main assemblies. The first is at the base and consists of nine supports called lower key blocks (LKB). The six CS modules are placed onto these LKB.

The second assembly consists of upper support elements that are placed on top of the sixth module. It consists of nine load distribution plates (LDP), placed directly on the upper most module, and nine upper key blocks (UKB) placed on top of the load distribution plates. The upper key blocks contain compression cylinders used to transfer load to the LDP during the final stage of assembly.

The third major structure consists of twenty-seven tie plates. The tie plates span the entire height of the CS assembly and connect the nine upper key blocks to their corresponding lower key blocks.

The CS once assembled will have a mass of approximately 1000 tonnes and will reach a height of approximately 18 meters prior to installation in the tokomak.

2.2 Introduction to the Central Solenoid Pre-Compression

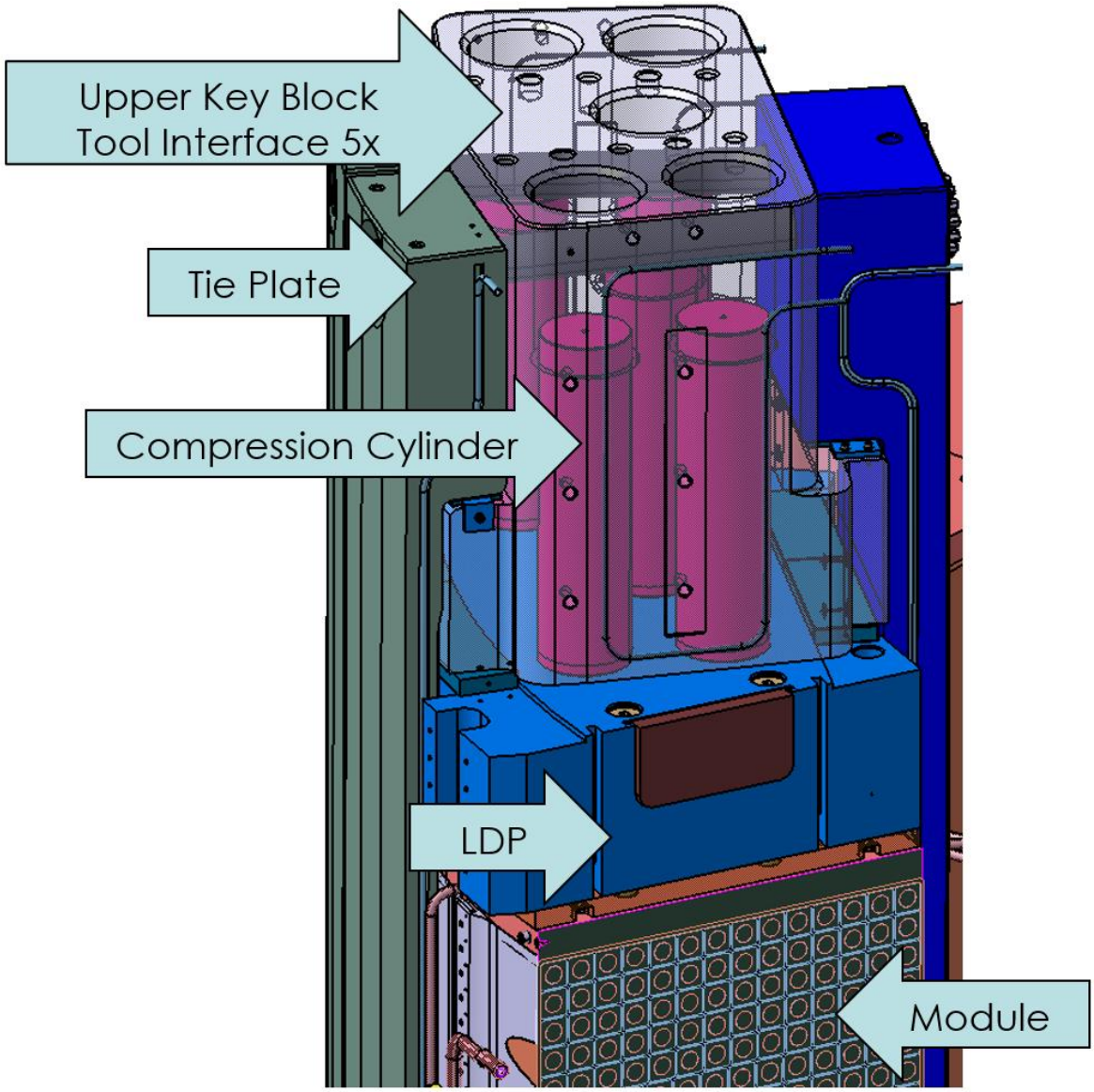

Figure 2: Illustration of CS Pre-compression Components

Pre-compression is required to assure that the CS Modules keep in contact with each other during Tokamak operation. A total of 210 MN of compressive force on the CS Modules is required. The goal is to achieve this compressive force by applying load to the compression cylinders, which in turn will push down on the LDP, this will place the module stack under compression while tensioning the tie plates.

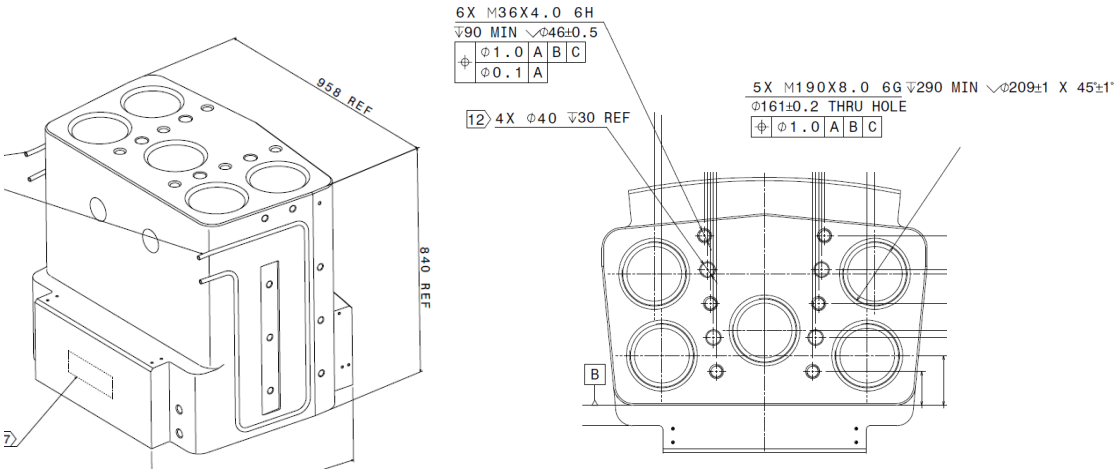

Figure 3: CS UKB Interface Available for Tooling

Pushing on the pre-compression cylinder is to be achieved with custom hydraulic cylinders which will interface with the UKB. The existing M190 threads must be used for this purpose.

3. Scope of work

Design and manufacture of hydraulic cylinders, procurement of ancillary hydraulic equipment and tooling qualification. This tooling will be used for the CS Magnet Pre-compression activity.

3.1 Hydraulic Cylinders

3.1.1 Design Hydraulic Cylinders

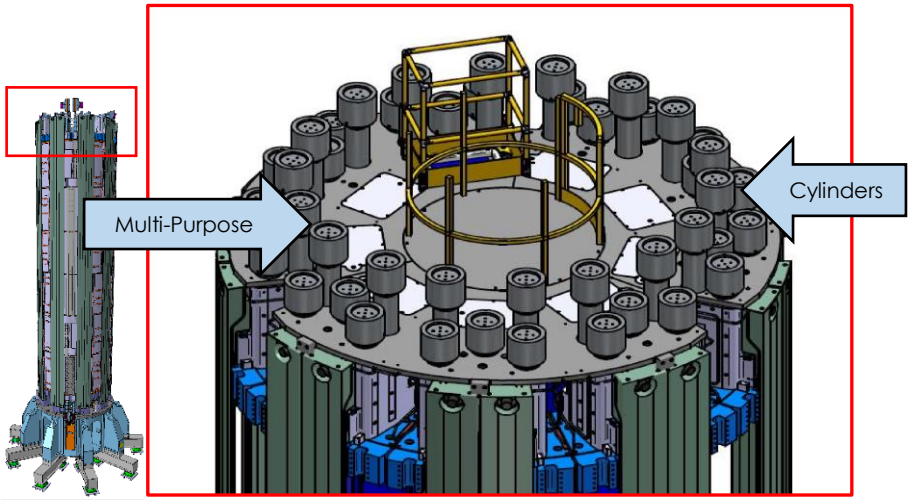

Figure 4: 45 Hydraulic Cylinders Installed on CS Assembly

Cylinders Requirements

Standards

1. The cylinders shall be CE marked and shall therefore comply with the applicable European Directives. The cylinders shall also be compliant with ASME B30.1 or EN reference.

Design

2. 210MN of total load must be applied to the CS. Each cylinder must be capable of Appling 4.7 MN of force.
3. The actual load output from each cylinder based on the applied pressure shall be achieved within a tolerance of +/-5%.
4. Primary design pressure 1500 barg
5. There is a high consequence in the event of oil leakage. Therefore the hydraulic medium shall be a water glycol fluid.
6. The cylinder shall be a double acting
7. The pressure may be held for period of up to 3 days continuously

3.1.2 First of series 5 cylinders manufacturing

1. The contractor shall manufacture the 5 hydraulic cylinders required to load one UKB.

3.1.3 Factory Acceptance First of Series, Five Hydraulic Cylinders

1. A fixture shall be used for FAT testing:
    a. The material and structure of the fixture shall be strong enough to take the load from the cylinder during the proof test case, with the load path going through the M190 thread;
    b. The fixture shall enable a load cell to be incorporated;
2. The FAT shall include a proof test at a minimum of 1.43 x the design pressure in which the load path goes through the piston rod and reacts through the M190 thread. There shall be no leakage.
3. The FAT shall include a functional test of at least 3 cycles to demonstrate smooth operation with no stick-slip behaviour. The cylinder shall be reacted against a load during the stroke.

3.2 Hydraulic System

3.2.1 Design Hydraulic Pressure Unit (HPU)

A conceptual hydraulic system functional layout is shown in Figure 6 and 7.

1. The HPU shall be a self-contained unit capable of operation at the base of the CS.
2. The HPU will supply the 45 hydraulic cylinders using 5 parallel line as illustrated in Figure 6.
3. Each line will contain a pressure gauge, pressure transducer, check valve, and pressure relief valve.
4. The hydraulic system shall have a design pressure at least equal to the design pressure of the cylinders.

5. The HPU shall be CE marked and shall therefore comply with the applicable European Directives. A remote HMI panel shall be provided for automated control

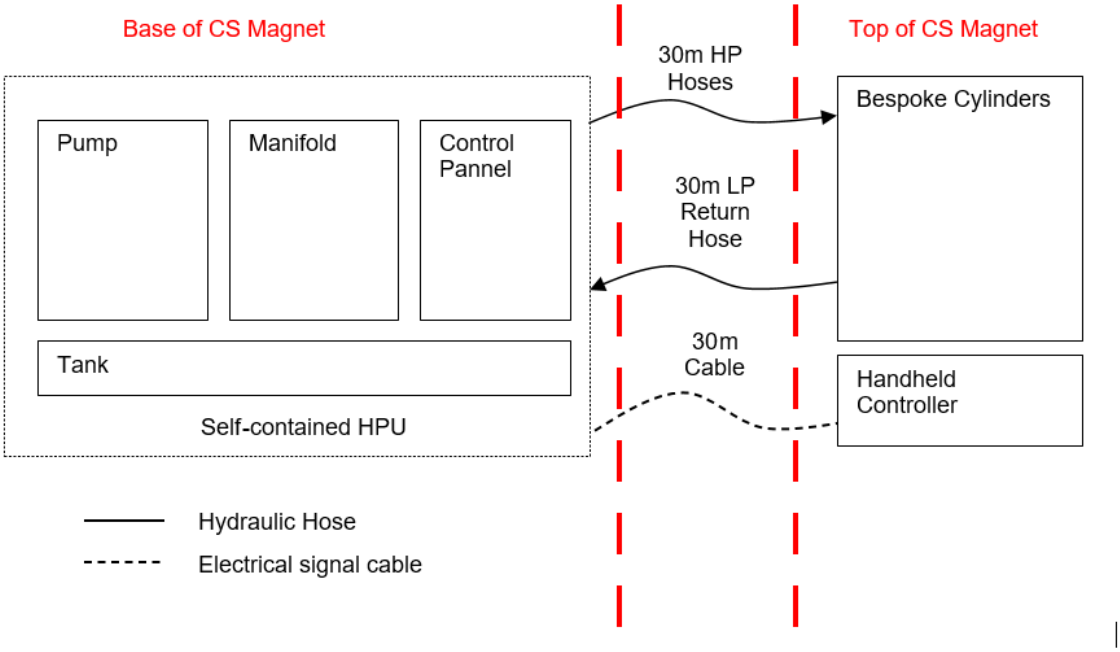

Figure 5: Functional layout of hydraulic system

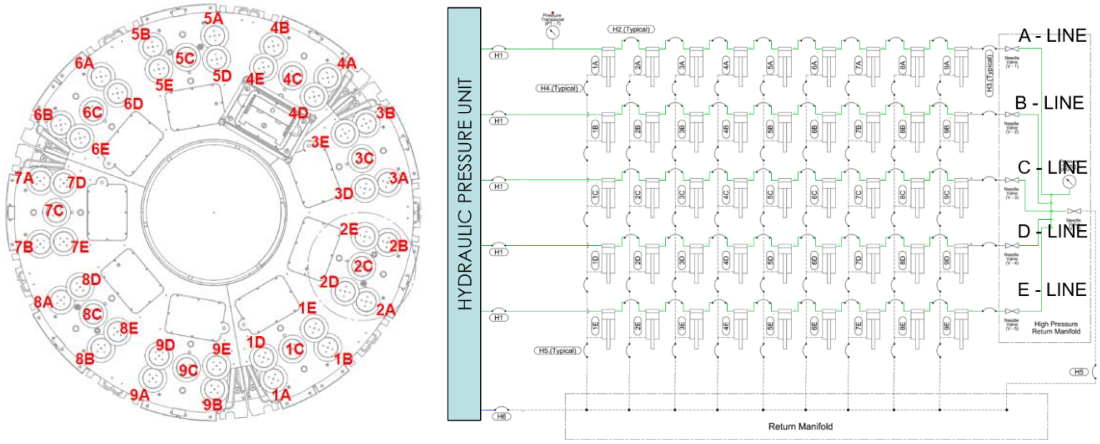

Figure 6: Cylinder Layout and Parallel Line Layout

3.2.2 Factory Acceptance Testing HPU

The HPU rig shall undergo an FAT, which shall include:

1. Demonstrate flushing of the hydraulic lines
2. A pressure test of the circuit at a value greater than the design pressure
3. A functional test demonstrating pressurisation using the HMI and manual controls.

3.3 Series Production of Remaining Cylinders

After a success FAT of the first five cylinders and HPU, series production of the remaining 42 cylinders each subject to the FAT requirements outline in section 3.1.3 shall be realised.

The 42 hydraulic cylinders includes the 40 cylinders required to load 8 UKB plus two spares.

4. Tentative time table

Call for Nomination	*April 2021*
Combined Invitation for Pre-Qualification and Call for Tender	*Early May 2021*
Tender Submission	*July 2021*
Contract Signature	*October 2021*

5. Candidature

Participation is open to any legal entity either an individual or a group (consortium) which is established in an ITER Member State. A legal entity 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 IO.

The consortium groupings shall be presented at the pre-qualification stage. The tenderer's composition cannot be modified 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. Candidates (individual or consortium) must comply with the selection criteria to be disclosed at the Pre-Qualification stage.

More information on ITER Organization Procurement process can be found at: https://www.iter.org/proc/generalinfo

6. Experience and key competencies

The Candidates will need to demonstrate that they have the capabilities to successfully perform the entire scope of work mentioned above and in particular:

- Strong experience in high pressure hydraulic tooling system integration
- Strong experience in producing high pressure equipment compliant to EU directives, norms, and standards
- Strong experience in fabrication and machining of high pressure hydraulic components
- Experience in instrumentation and PLC integration

7. QA requirements

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

Prior to the commencement of the task, a Quality Plan must be submitted for IO approval giving evidence of the accredited quality system and describing the organization of 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.

Prior to commencement of any manufacturing, a Manufacturing Inspection Plan (MIP) must be approved by ITER who will mark up any planned interventions.

8. Safety

The tooling shall be CE Marked in accordance with the applicable legislation. The CE Marking documentation shall be produced in English. IO is the End-User of the tooling. The supplier is considered to be the manufacturer and shall consequently assume the associated duties and responsibilities. The tooling shall be designed to enable its safe handling, assembly, installation, adjustment, operations, maintenance, repairs and storage.

9. Applicable document and references

9.1 Applicable Documents

[1] Procedure on procurement documentation exchange between IO, DAs and contractors (35BVQR)

[2] ITER Procurement Quality Requirements (ITER_D_22MFG4)

[3] ITER Abbreviations ITER_D_2MU6W5

[4] 008426 - Central Solenoid (CS) Structure Upper Components Drawing - Forgings Upper CS Key Block ITER_D_2WNL26

[5] 039360 - Central Solenoid (CS) Assembly Tooling (AT) Multi-Purpose Plate Drawing ITER_D_2WPLQP

[6] ITER Procurement Quality Requirements (ITER_D_22MFG4)

[7] ITER Requirements Regarding Contractors Release Note (ITER_D_22F52F)

[8] Requirements for Producing an Inspection Plan (ITER_D_22MDZD)

[9] Requirements for Producing a Quality Plan (ITER_D_22MFMW)

[10] 010509 CS Upper Components – Precompression Cylinder Drawing ITER_D_2G4921

9.2 Reference Documents

[11] CS Pre-Compression Conceptual Procedure Non-Contractual Supplementary Information (ITER_D_4QX5HW)

[12] CS Pre-Compression Specification Non-Contractual Supplementary Information (ITER_D_52EZZR)

10. Definitions

BOM	Bill of Material
CAD	Computer Aided Design
IDM	ITER Document Management
IO	ITER Organization
ISO	International Organization for Standardization
KOM	Kick Off Meeting
LDP	Load Distribution Plate
LKB	Lower Key Block
MIP	Manufacturing and Inspection Plan
MQP	Management and Quality Program
NA	Non Applicable
NCR	Non Conformity Report
NP	Notification Point
PBS	Plant Breakdown Structure
PRM	Contract Progress Meeting
QA	Quality Assurance
QCR	Quality Control Review
QP	Quality Plan
RO	Responsible Officer
R&D	Research and Development
UKB	Upper Key Block