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**Report**

# Technical Specification - Engineering Support on VV components

The objective of this Task Order is to provide the ITER Organization (IO) with four engineers to provide services in support of the engineering work for some Vacuum Vessel systems.

| *Approval Process* | | | |
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| Technical Specification - Engineering Support on VV components (LX557H_v1_1) | v1.1 | Signed | 16 Dec 2013 | chap 12 conflict of interest |
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| Technical Specification - Engineering Support on VV components (LX557H_v0_0) | v0.0 | In Work | 28 Nov 2013 | |

# Provision for Services in Support of Engineering for ITER Vacuum Vessel Components:

## Table of Contents

# 1 Background and Objectives

The ITER tokamak is a complex system designed to produce 500 MW of power through nuclear fusion reactions. The major components of the tokamak are the superconducting toroidal and poloidal field coils which magnetically confine, shape and control the plasma inside a toroidal vacuum vessel. The magnet system comprises toroidal field (TF) coils, a central solenoid (CS), external poloidal field (PF) coils, and correction coils (CC). The vacuum vessel is a double-walled steel structure. Inside the vacuum vessel, the internal, replaceable components, including blanket modules, divertor cassettes, and port plugs such as the heating antennae, test blanket modules, and diagnostics modules, absorb the radiated heat as well as most of the neutrons from the plasma and protect the vessel and magnet coils from excessive nuclear radiation. The heat deposited in the internal components and in the vessel is rejected to the environment by means of the tokamak cooling water system. The entire tokamak is enclosed in a cryostat, with 80K cooled thermal shields between the hot components and the 4.5K cryogenically cooled magnets.

The objective of this Task Order is to provide the ITER Organization (IO) with four engineers to provide services in support of the engineering work for some Vacuum Vessel systems.

# 2 Scope of Work

The scope of work for **Engineer 1** is presented below:

The ITER Vacuum Vessel (VV) is procured in kind by ITER Domestic Agencies. Domestic Agencies have selected suppliers supervised by both the IO and Domestic Agencies. The design of the main VV sectors sub-assemblies is “built to print”. Suppliers use the design as provided by IO to develop fabrication/shop drawings. Suppliers will account on technical specification requirements and may request changes to the detailed design subject to IO approval. The IO remains the Manufacturer (under the meaning of ESP) of the completed VV (double shell structure and ports) and is responsible for design, manufacture and conformity assessment.

This task consists in supporting IO with the supervision of the manufacturing of the VV by
1) Reviewing supplier deliverables, such as manufacturing drawings and procedures,
2) Inspecting the suppliers

The deliverables to be reviewed will be focused on the one issued as part of the procurement of the 7 EU sectors by the AMW consortium and the deliverables of the 18 upper ports by MDT. In addition, the expert may be asked to review deliverables from other DAs (HHI for KO DA sectors and equatorial and lower ports and ENSA for VV assembly welding contract) and documentation for other components of the Division (thermal shields, in-vessel coils andcryostat).

Inspections will be in the premises of AMW consortium and MDT and their sub-suppliers in Europe, HHI and its sub-suppliers in Korea and in Japan.

The scope of work for **Engineer 2** is presented below:

The Vacuum Vessel (VV) system is equipped with instrumentation. The main vessel sectors PAs, signed by the KODA and the EUDA make provision for the procurement of these

instruments/sensors. The VV instrumentation together with other tokamak systems instrumentation, in particular the one of the vacuum system and the cooling water system, monitor the vacuum vessel state. The measurements will be recorded and integrated by the CODAC. The CODAC will make these measurements available to operators in the control room to verify that the VV operates within its defined operating limits. The VV instrumentation is classified Safety-Relevant, because it contributes to compensation measures for the lack of inspectability of the VV. The VV instrumentation measures discrete temperatures, thermal fluxes and other mechanical parameters. It implies 995 temperature sensors, 145 resistive strain gages, 91 optical strain gages, 120 displacement sensors and 150 accelerometers. Sensors are spread on VV sectors, both in-vessel and ex-vessel, VV ports and VV gravity supports. The design is now being finalized and will be reviewed in August 2014 before being handed over to DAs for procurement. Therefore, a support in finalizing the design is needed.

The scope of work for **Engineer 3 and 4** is presented below:

The Final Design Review of the In-vessel Coils (IVC) will be held in March 2014. During the FDR preparation phase, additional design work will be carried out in the following areas:

- Brazing/welding of conductor joints.
- Possibility of replacing the CuCrZr conductor and Inconel 625 jacket of the ELM coils with different or less expensive materials.
- Alternatives study on ELM coil enclosure in a fully welded case within the same space envelope presently available.
- Field joints of VS coils

Following the FDR, a direct call for tender from the ITER Organization will be launched with a planned contract signature in early 2015. The preparation for this CFT has already started and includes:

- Market survey and pre-selection of potential contractors
- Accurate cost estimation of the procurement
- Development of detailed engineering design
- The preparation of technical specification based on FDR conclusions, including qualification programme and activities, quality assurance/quality control requirements
- Review of manufacturing and quality control procedures

The expert shall provide support to these near term activities.

## 3 Estimated Duration

| | Estimated Start | Duration of the contract | Working onsite ( per | Missions | Working offsite (per |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| | | | year) | (per year) | year) |
| Engineer 1 | April 2014 | Minimum 12 months, up to 24 months ( second year optional) | 100 days | 20 days | 80 days |
| Engineer 2 | April 2014 | One year maximum | 50 days | | |
| Engineer 3 | April 2014 | up to 24 months (second year optional) | 30 days | 5 days | 90 days |
| Engineer 4 | April 2014 | Minimum 12 months, Maximum 2 years | 60 days | 10 days | 180 days |

# 4 Work Description

The work description of the engineering support to be provided by the Contractor is, but not limited to, the following:

**Engineer 1:**

The reviewed deliverables may include:
- CAD models checking,
- Manufacturing design documentation (drawings, welding maps/lists),
- Material supplier documentation,
- Manufacturing procedures,
- Welding data packages,
- Qualification documentation (WPQRs, Ultrasonic Testing),
- Manufacturing and Inspection Plans,
- Deviation Requests,
- Non Conformity.

In-process inspection will be performed throughout the manufacturing operations by the expert. As required by the code and PA Annex B, Manufacturing and Inspection Plans (Control Plans) are prepared prior to the commencement of actual manufacturing. These plans establish the sequence of activities and identify appropriate manufacturing inspection. IO has specified intervention points on the CP. The expert will be acting on behalf of IO for the intervention points.
Scope of intervention includes material production, manufacturing activities (marking/cutting/forming/cleaning/NDT/Welding/Dimensional Inspection/Testing).

Receipt and inspection by the expert will focus on ensuring that PA requirements (including regulatory, RCC-MR 2007 Code and functional requirements) and related approved documentation are properly implemented by personal having the required certifications.

**Engineer 2:**

1. Support in finalization of the design of the VV instrumentation
2. Contribute to 2 revisions of the design description document
3. Contributes to the specification of qualification of sensors under EM and/or radiation
4. Contributes to the implementation of the radiation mitigation policy
5. Contributes to the preparation of cabling diagrams and drawings:
   a. Supervision of designer
   b. Control of SSD diagrams
   c. Integration
6. Writing of technical specifications for:
   a. Various instrumentation cables
   b. Various connectors
   c. Various data acquisition electronics
7. Contributes to the RAMI analysis
   a. Preparation of inputs
   b. Follow up and review of results
8. Write a maintenance and periodic inspection plan for electronics
9. Contributes to the on-site assembly plan
10. Assist and present results at the final design review

**Engineer 3:**

The expert support will consist in:

1. Reviewing IVC design and manufacturing procedures and writing recommendations for improvements of the manufacturing procedures
2. Helping in preparing a detailed technical specification for the IVC Call for Tender
3. Prepare the information about the scope of the supply
4. Prepare the information about the integration and installation
5. Prepare the document about technical requirements
6. Prepare the document about material requirements
7. Prepare the document about manufacturing requirements
8. Prepare the document about manufacturing procedures
9. Prepare the document about reliability and maintainability
10. Prepare the document about delivery and commissioning
11. Prepare the document about testing, inspection, examinations
12. Prepare the document about quality assurance.

**Engineer 4:**

The expert support will consist in:

1. Help in closure of the final design
2. Review and supervision of design work
3. Helping in preparing a detailed technical specification for the IVC Call for Tender

4. Prepare the information about the scope of the supply
5. Prepare the information about the integration and installation
6. Prepare the document about technical requirements
7. Prepare the document about material requirements
8. Prepare the document about manufacturing requirements
9. Prepare the document about manufacturing procedures
10. Prepare the document about reliability and maintainability
11. Prepare the document about delivery and commissioning
12. Prepare the document about testing, inspection, examinations
13. Prepare the document about quality assurance.
14. Supervision of the IVC contract

# 5 Responsibilities

## 5.1 Contractor's Obligations

The Contractor will provide personnel as required who is fully dedicated to performing the Services.

Maximum four Contractors are expected to be hired with this Service contract.

The Contractor agrees not to remove or reassign the personnel for the duration of the task, without the prior approval of the IO. Notwithstanding the foregoing, the Contractor shall not be held responsible for any individual decision to leave or to seek reassignment.

Contractor's personnel will be bound by the rules and regulations governing IO safety and security.

In case of non EU personnel, it is required for the employees to obtain their French working visa prior their arrival in France.

## 5.2 Obligations of IO

IO shall make available to Contractor's Personnel dedicated and located on IO site at Cadarache:

- Procedures, information and data and any other information for the Contractor to perform its functions under this Scope of Work;

- User facilities on equipment (including communication lines and computers) with adequate capacity necessary for a proper execution of the Services by the Contractor; computers, software and all data produced during the contract shall remain property of the ITER Organisation.

- A safe work area which meets the requirements which are generally made for such an area for the satisfactory execution of the Services.

## 6 Deliverables and Due Dates

Deliverables for Expert 1:

The expert will review deliverables in ITER IDM, the document database ITER. He will record his recommendation or comments in ITER IDM.

The expert shall report any inspection in form of an inspection report. The report will be made available for review in IDM no later than 3 days after the inspection for review.

Deliverables for Expert 2:

- Draft revision of Design Description Document
- Delivers final versions of the technical specifications at least 1 month before the FDR
- Delivers final versions of maintenance and periodic inspection plan at least 1 month before the FDR

Deliverable for expert 3 and 4:

- Technical specification for the IVC Call for Tender
- The expert will review deliverables in ITER IDM, the document database ITER. He will record his recommendation or comments in ITER IDM.
- Memos related to his/her findings and observations for the work supervision

## 7 Specific Requirements and Conditions

The Contractor agrees that it shall require the person assigned to perform the services hereunder to abide by the following nondisclosure conditions:

- To not disclose, deliver, or use for the benefit of any person other than the IO, or its authorized agents, any restricted or confidential information or material he or she receives from the IO, other than material or information previously in the records of the Contractor or obtainable prior to such disclosure, delivery, or use, from third parties or from the public domain, or required to be disclosed by law or court order;

- To adhere to any reasonable policies or instructions provided by the IO as to the classification, use or disposition of any restricted or confidential information or materials;

- To not use any restricted or confidential information or material for personal gain.

The Contractor further agrees to take such reasonable steps as may be needed to ensure that the terms of the nondisclosure statements are observed during and after the termination of the Services.

## 8 Acceptance Criteria (including rules and criteria)

Monthly reports shall contain a description of the work carried out in the corresponding Task.
All communications between the Contractor and the IO shall be in English language and all measures shall be given in the metric system SI. This includes all reports, documentation, correspondence and labelling. All the reports shall be properly bound.
Text and tables of the Final Report in MS-Word shall also be delivered electronically to the IO.

## 9 Technical Requirements

Engineer 1 should have the following competences:

Minimum requirements :

- Mechanical engineer or technician
- At least 10-15 years of industrial experience of manufacturing design and manufacturing supervision of pressure vessels.
- At least 3 years of experience of use of RCC-MR French Code on Nuclear components.
- At least 3 years of experience of work on a Nuclear Pressure Equipment following French Decree on Nuclear Pressure Equipment (December 2005).
- At least 3 years of experience in stainless steel welding development including narrow-gap TIG technology.
- Basic knowledge in CATIA-V5.
- At least 3 years of experience of technical management of a mechanical component with international customers.

Engineer 2 should have the following competences:

Minimum requirements:

- Electrical Engineer/Technician
- At least 10 years of experience in either fission or fusion nuclear facility
- Min. 5 years of experience in instrumentation and control of a nuclear facility
- Small/large project management experience
- Experience in the procurement of Data Acquisition Systems
- Technical documentation tools (SSD diagrams, CAD, MS Office)
- Proficiency in English and experience in writing technical documentation in English

Bonus experiences:

- Experience in hazard and risk analysis for nuclear applications
- Experience in the maintenance of electrical systems in a nuclear facility
- Experience in electrical and/or electronic systems assembly

Engineer 3 should have the following competences:

- Masters or higher degree in Engineering
- Some fusion experience is desirable
- At least 10-15 year’s practical experience in superconducting and or resistive magnets
- At least 10 years of industrial experience in managing complex and highly integrated magnet system

- Experience in working with international customers
- Ability to work effectively in a multi-cultural environment in English language
- Ability to work in a team
- Ability to organize and monitor activities
- Good planning and organisational skills

Engineer 4 should have the following competences:

- Minimum B.Sc. honours degree in Engineering
- Minimum 5 years fusion experience is desirable
- At least 10-15 year's practical experience in design and development of precision electro-mechanical components
- At least 10 years of industrial experience in managing complex and highly integrated engineering system
- Experience in working with international customers
- Experience with SolidWorks & CATIA v5 Mechanical Design Software
- Ability to work effectively in a multi-cultural environment in English language
- Ability to work in a team
- Ability to organize and monitor activities
- Good planning and organisational skills

## 10 Travel Expenses

The ITER Organization may request Contractor's staff to travel and work at places other than ITER site. Travel mission expenses are claimed by the Contractor according to the following:

a) Only economy class flights are reimbursed by ITER Organization
b) Subsistence expenses reimbursement rate for Contractor's employee shall not exceed the respective per diem rates
c) Travel by train (first class) when agreed by ITER Organization
d) Travel by car reimbursement rate is 0.50 € / km when flight or train are not available

All claims for mission travel will be reimbursed only when supported by original invoices and flight tickets.

## 11 Payment schedule / Cost and delivery time breakdown

Invoices will be paid monthly, based on working days worked and according to the resources allocated to the Contract in the month, supported by accepted deliverables.

Time for acceptance of the deliverables and written reports by the IO Responsible Officer shall be 15 calendar days.

## 12 Conflict of interest

The company that is awarded this contract and the experts provided in this contract shall not be eligible to participate to the future tenders for the supply of the respective systems/components they will be preparing within this contract, namely:

1. In-vessel coils
2. VV instrumentation

3. Manufacturing of VV sectors