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13 Dec 2013 / 1.0 / Signed
EXTERNAL REFERENCE

Technical Specifications (In-Cash Procurement)

Engineering support for the follow up of procurement for the magnet division activities

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Approval Process			
	Name	*Action*	*Affiliation*
Signatory	**Foucher de Brandois C.**	**13 Dec 2013:signed**	**IO/DG/DIP/TKM/MAG**
Co-signatories			
Reviewers	**Foussat A.** **Libeyre P.** **Simon F.**		**IO/DG/DIP/TKM/MAG/TF** **IO/DG/DIP/TKM/MAG/CSCC** **IO/DG/DIP/TKM/MAG/PF**
Approver	**Mitchell N.**		**IO/DG/DIP/TKM/MAG**
Document Security: level 1 (IO unclassified) *RO: Foucher de Brandois Cecile*			
Read Access	**RO, project administrator, LG: Magnet external, LG: PROCUREMENT, LG: Magnet QA RO, LG: Gennaro Romano, AD: Directorate - Tokamak, AD: Division - Magnet, AD: Auditors**		

Engineering Support for the follow-up of Procurements for the Magnet Division Activities

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1 Abstract

This document describes the needs for engineering services concerning the TF section, Magnet division, CSCC and PF section of the Magnet division of the Tokamak Directorate.

- PF Section:

Engineering services for the monitoring of the PF coil PA activities by CNDA, RFDA and EUDA and their suppliers and of the related PA documentation.

- Magnet Division

Engineering services are needed for the follow-up of the architectural design, technical specification and contruction of the workshop and laboratory required for the execution of the ITER Magnet Feeders, PF coils and TF coils Procurement Arrangement (PA) and instrumentation procurement.

- CSCC Section:

Engineering services for the follow-up of the development of the CS modules manufacturing processes and qualification.

- TF section:

Engineering services to cover the work related to the Toroidal Field coils (PA with EUDA and JADA), Precompression rings (PA with EUDA) and Magnet supports (PA with CNDA) of the ITER Magnet System.

2 Background and objectives

- **PF Section – Task 1**

The 6 Poloidal Field Coils (PF coils) are part of the ITER Magnet System. One coil, PF1, will be procured to the ITER Organization by the Russian Federation Domestic Agency (RFDA), on the basis of the Procurement Arrangements (PA), respectively 1.1.P3A.RF.01, with EFREMOV as main manufacturer. The 5 others ones, PF2 to PF6 are procured by the European Domestic Agency (F4E) on the basis of the 1.1.P3A-B.EU.01. The PF2 to PF5 will be manufactured in a facility built on the ITER site with ASG as the main supplier, while F4E has awarded the PF6 coil to the Chinese institute ASIPP.

In the framework of Phase 2 of these PAs, manufacturing drawings and procurement of tools are to be carried out by both DAs. During Phase 3, qualification of the major components shall be performed and Manufacturing and Inspection Plans (MIP) produced. Finally, in the framework of Phase 4, a dummy double pancake is to be built to qualify all processes, tooling and workers before starting the real production (Phase 5). For Phase 2 and 3, The DAs will probably perform some R&D activities that are not described in the PAs. The 3 manufacturers selected by the 2 DAs are at different stages of advancement in regards of the PA and will perform activities related to phase 2 to phase 4 in 2014-2015.

Due to the nature of the one-of-a-kind of the PF coil manufacturing and the impossibility to repair the coils once installed in the Tokamak, particular attention is required during the phases 2 to 4 to ensure the quality of the Phase 5 production. Similarities exist with the production of the Central Solenoid (CS) by US-DA, such as winding practices, impregnation tools and processes.

The PF coil section needs assistance to follow-up thorough fully the development of the tooling, qualification samples and the R&D activities to be performed for these procurements. This includes also the follow-up of the development of the technical specifications of the tooling and of the MIP and procedures.

- **Magnet Division – Task 2**

The ITER Organization Magnets Division requires laboratories and workshop facilities in the near future to cover the following functional usage:

- Handling of components: receipt, staging, storage, assembly and despatch of components
- Workshop, storage, handling areas, HV & LV Instrumentation Laboratory, offices, restrooms and welfare facilities
- Archiving, inspection, control and assembly of components
- Development and testing
- Training and education
- Machining and prototyping.

The Magnet Division needs assistance to prepare the functional specification for the building, to follow-up the development of the design, the construction and commissioning.

- **CSCC Section –Task 3**

The scope of the CS Procurement Arrangement, placed with the US Domestic Agency (DA), is the supply of the Central Solenoid (CS) magnet system of ITER consisting of six (6) modules, one (1) Prototype (spare) module, associated with the pre-compression and support structure, conductor development material for characterisation and winding trials, specialized assembly tooling and a plan for CS assembly. This includes design, R&D, fabrication, acceptance testing and delivery to the ITER site.

The DA has completed the work of the PA **Phase 1** in 2013. The remaining work to be carried out, fully or partly, is presented here after:

In Phase 2

- Perform R&D activities and the design and manufacturing of tooling, including qualification tests and manufacturing processes.
- Procure the elements of the CS coils and structure.

In Phase 3

- Prepare the Manufacturing and Inspection Plans (MIP) and Quality Plan,
- Manufacture and test the qualification samples, precompression structure and the CS Mockup.
- Prepare acceptance criteria and test procedures and provide procedures for assembly.

In Phase 4

- Perform qualification (cold) testing of the CS Mockup and acceptance testing of the subsequent production modules including cold testing;
- Provide specialized tooling for IO use in lifting and handling of the CS Modules and for completing the assembly at the ITER site.

The Magnet Division needs assistance to follow-up thorough fully the development of the tooling, qualification samples and the R&D activities to be performed for these procurements. This includes also the follow-up of the development of the technical specifications of the tooling and of the MIP and procedures.

- **TF Section –Task 4**

The Toroidal field coils are the main magnetic confining magnet system installed on ITER tokamak which support all other magnet system like Poloidal field coils, Central solenoid, correction coils, through a set of supporting structures between the TF of the other magnets and between the whole magnet system and the cryostat ring. The precompression rings (PCR) are applying preload on TF coil structures to allow prestress on inter coil structures connecting components during operation.

The TF coil section needs engineering expertise to guarantee the integration and assembly of the individual components (TF coils, PCR and supports) and of the components within the tokamak. It requires the participation to the follow up of the magnet supports and impregnation of the Toroidal Field coils.

3 Scope of the work

3.1 PF Section – Task 1

The following work packages will be performed:

1) Related to Phase 2, review of the tooling specification and their commissioning.
2) Related to Phase 3, review of the MIPs of the qualification samples, follow-up of the potential R&D work and qualification reports
3) Related to Phase 3, review of the MIPs of the dummy pancake and final manufacturing. Follow-up of the dummy DP winding and impregnation operation.

The work will be reported regularly to the IO staff. The work includes reviewing and commenting, upon IO request, of the documents produced by RFDA and F4E for the tooling and qualification samples, i.e. 3D models, 2D drawings, analyses and mock-ups design, mock-up test results reports and double pancakes manufacturing processes. It also includes attendance to mock-up construction and tests performed on ITER site by F4E. Attendance of tests performed outside (either by RFDA and ASIPP) will be exceptional. The reporting will include reports on each item.

3.2 Magnet Division – Task 2

The following work packages will be performed related to:

1) WP 1, Prepare the functional specification for the workshop and Follow up of the architectural design of the building and safety
2) WP 2, Follow up of the engineering studies and review of all technical specifications developed by the engineering company prior launching the Call for Tenders. From site preparation to facility commissioning
3) WP 3, Follow up of the construction to commissioning.

The work will be reported regularly to the IO staff. The work includes reviewing and commenting, upon IO request, of the documents produced by the Architect and Engineering Company. The reporting will include reports on each item.

3.3 CSCC Section –Task 3

The following work packages will be performed related to:

1) WP1, Phase 2

- Follow up of the R&D and the design, manufacturing and tests of the tooling;
- Follow up of the Procurement of all elements of the CS coils and structures;

2) WP2, Phase 3

- Review and Comment the Manufacturing and Inspection Plans (MIP) and Quality Plan.
- Follow-up the manufacturing of the CS MockUp, pre-compression structures and qualification samples.

- Review and Comment acceptance tests as specified in the MIPs;
- Review and comment the acceptance criteria and test procedures, including the CS Mockup;

3) WP3, Phase 4

- Review and comment the qualification (cold) testing of the CS Mockup and acceptance testing of the subsequent production modules including cold testing;
- Review and Comment specialized tooling for IO use in lifting and handling of the CS Modules and for completing feeder joints during stacking and for tensioning the pre-compression structure after assembly of the CS system at the ITER site.
- Review the procedures for assembly;

The work will be reported regularly to the IO staff. The work includes reviewing and commenting, upon IO request, of the documents produced by the USDA for the tooling and qualification samples, i.e 3D models, 2D drawings, analyses and mock-ups design, mock-up test results reports and pancakes manufacturing processes. It also includes attendance to mock-up construction and tests performed.

3.4 TF Section –Task 4

The scope of the task is divided into 2 work packages as described below.

1) Related to Assembly and integration procedures, Preparation of Technical Specifications, development of assembly and integration procedures, supported by an assessment of the tolerance.

2) Follow up on Suppliers activities, review of Magnet supports manufacture plan, Evaluation of impregnation procedure and operations of the TF coils double pancakes and winding packs.

4 Description of the work items

4.1 PF Section – Task 1

4.1.1 Work Package 1: Review of the tooling specification and their commissioning (PA Phase 2)

The development of the tooling is to be carried out by the RFDA and F4E in Phase 2 of their respective PA. The content of the work is the following:

- Review and assess tooling technical specification and their supporting documents (drawings, analysis reports) by RFDA or F4E. Provide IO with a list of comments and, if appropriate, suggestions for corrections.
- Review of the commissioning reports and attendance to the commissioning of the tooling on-ITER site. One visit to witness a manufacturing stage of the dummy DP produced in ASIPP and EFREMOV is foreseen. Provide comments and make recommendations.
- Write one work package report per manufacturer

4.1.2 Work Package 2: Follow-up of the qualification work (PA Phase 3)

The RFDA and F4E PA include a Phase 3 to carry out the qualification of the main components, for which the DA may develop a R&D plan. The content of the work is the following:

- Comment the R&D plan, if any, prepared by the DAs to support their qualification work.
- Review and comment the MIPs provided by the DAs for the qualification samples, highlighting in particular the critical points accordingly to the experience on the R&D performed on the CS.
- Attend the critical points of the manufacture and tests of the different mock-ups on the ITER site. Produce a Visit Report per visit, which shall include any deviation to the MIP or potential issues identified or witnessed.
- Assess the qualification reports.
- Write one work package report per manufacturer

4.1.3 Work Package 3: Follow-up of the dummy double pancake manufacturing (PA Phase 2).

During the Phase 4 of their PAs, the DA shall manufacture a full double pancake to qualify all critical operations for the final manufacturing and, in the meanwhile, prepare the manufacturing plan. The content of the work is the following:

- Review and assess the MIP of the dummy DP proposed by the manufacturers.
- Attend the critical points of the manufacturing of the dummy DP on the ITER site. One visit to witness a manufacturing stage of the dummy DP produced in ASIPP and RFDA is foreseen.

- Produce a Visit Report per visit, the report shall mention any deviation to the MIP and information about potential issues identified or witnessed, including operations that are not sound enough and bear a risk of failure during the final production.
- In case of dummy DP doesn't pass a test, support IO during the fault analysis and provide IO with suggestion of solution.
- Review and assess the MIP and manufacturing plan for the final production.
- Write one work package report per manufacturer

4.2 Magnet Division – Task 2

4.2.1 Work package 1 - Review of the Architectural design.

The content of the work is the following:

- Participate to the redaction of the functional specification and meetings with the Architect on IO request
- Review and assess the studies
- Write one work package report at the end of the studies

4.2.2 Work package 2 - Follow-up of the Engineering studies

- Participate to the meetings with the Engineering Company on IO request
- Review and assess the studies
- Write one work package report at the end of the studies concerning all tasks to be done from Site preparation to facility commissioning

4.2.3 Work package 3 - Follow-up of the construction till facility commissioning.

During this phase, follow up of the work done on site to verify the correct implementation of the technical specification by the work Controller. This activity will be performed on a regular basis approximately once a week or on IO request

- Write one commissioning report per task (1 page/ task)

4.3 CSCC Section –Task 3

4.3.1 Work Package 1 : Review of the tooling specification and their commissioning.

The development of the tooling is to be carried out by the USDA and General Atomics (GA) in Phase 2 of their PA. The content of the work is the following:

- Review and assess tooling technical specification and their supporting documents (drawings, analysis reports) issued by the USDA or GA. Provide IO with a list of comments and, if appropriate, suggestions for corrections.
- Review of the commissioning reports on ITER site and attendance to the commissioning of the tooling at GA.
- Comment the R&D plan, if any, prepared by the DAs to support their qualification work.
- Write one work package report.

4.3.2 Follow-up of the CS Mock UP Manufacturing and the qualification work

During the Phase 3 of the PA, the USDA shall manufacture a CS Mock Up to qualify all critical operations for the final manufacturing and, in the meanwhile, prepare the manufacturing plan. The content of the work is the following:

- Review and assess the MIP of the CS Mock Up proposed by the manufacturers.
- Attend the critical points of the manufacturing of the CS Mock Up at GA.
- Produce a Visit Report per visit, the report shall mention any deviation to the MIP and information about potential issues identified or witnessed, including operations that are not sound enough and bear a risk of failure during the final production.
- In case of CS mock Up doesn't pass a test, support IO during the fault analysis and provide IO with suggestion of solution.
- Write an intermediate version of a report for the CS-mock UP

The USDA shall also carry out the qualification of the main components and manufacture the pre-compression structure. The content of the work is the following:

- Review and comment the MIPs provided by the DAs for the qualification samples and structures, highlighting in particular the critical points accordingly to the experience on the R&D performed on other magnets.
- Attend the critical points of the manufacture and tests of the different qualification samples and structures at the USDA or GA. Produce a Visit Report per visit, which shall include any deviation to the MIP or potential issues identified or witnessed.
- Assess the qualification reports.
- Review and assess the MIP and manufacturing plan for the final production.
- Write one work package report for qualification samples and for the structures.

4.3.3 Follow-up of the cold tests facility set up and the assembly tooling

During **phase 4** The CS-mock Up report will be completed and issued after reviewing and assessing the the qualification (cold) testing of the CS Mockup and acceptance testing of the subsequent production modules including cold testing;

- Review and comment the manufacturing and qualification of the specialized tooling for IO use will be recalled in the work package report of phase 4.

4.4 TF Section –Task 4

4.4.1 Work package 1 : Assembly and integration procedures

The content of the support for technical integration issues is the following:

a) Preparation of Technical Specifications for the Precompression rings assembly sequences study.

This assembly procedure of PC rings document will be written by the main contractor to describe the scope of the assembly sequence. The part related to the mechanical sequence of

assembly of the bolting and associated tool will be sub contracted and monitored by main contractor in collaboration with IO staff.

The global PCR assembly procedure to be written in collaboration with IO staff shall include all intermediate tests, measurements and define the relevant sequences of rings assembly to be considered.

b) Preparation of the high level assembly procedures that describe how to handle coils, to install the TF pair sectors in assembly hall, in pit.

Continuous activity, monthly reports shall be delivered to describe the progresses made to write the relevant TF assembly related interface sheets with PBS22, to assess technical assembly drawings, to participate in managing their completion, to write technical procedures to define requirements on TF sector preparation

c) To study tolerances of TF coils, analysis of TF assembly scenario procedures in assembly Hall and in Pit

d) To assess tolerances on complete TF with respect to assembly requirements. Monthly reports shall be delivered to describe the progresses made.

4.4.2 Work package 2 : follow up of Suppliers activities

a) Review of Magnet supports manufacture plan

Individual reports shall be prepared assessment of Gravity Support, PF clamps or CC supports manufacture plans.

b) Evaluation of impregnation procedure and layout of Double pancakes, winding packs submitted by DA suppliers. Follow-up of the DP impregnation operation.

Individual reports shall be prepared on the assessment of DA procedures and drawings, on TF Coil impregnation qualification and quality control

5 Special Requirements

The work described in this contract is planned for ONE (1) **professional engineer:**

- The candidate shall demonstrate at least 15 years' experience in management of industrial procurement of large superconducting magnet system components.
- Experience in the design and commissioning of large tooling, winding of large coils, with steel material having a cross section larger than 300mm2 is a mandatory requirement.
- Knowledge in the assembly of large experiments and integration of large magnets for fusion is an asset.
- The candidate shall have experience in the design and follow up of industrial building constructions.
- He should be familiar with engineering drawings, design review procedure, engineering change management procedure, management of interfaces, review of suppliers Manufacturing and Inspection Plans.
- Quality assurance experience
- Fluent English language practice in written and oral is a requirement.

A CV of potential engineer will be attached to the offer.

6 Duration

The total duration of this contract shall be 2 years, according to the present schedule. It could be extended by one year depending on the advancement of the different PAs. This contract shall begin on April 1st, 2014 and be completed on 31 Mars 2016 (to be confirmed at the kick off meeting).

The total duration of the contract will be 400 days, including 80 days of mission. The number of days spent for the different work items will be allocated as follows.

- PF Section – Task 1

The total duration of the work will be 180 days, including 30 days of mission.

The following missions (in days) are considered:

Work item	ASIPP (CN)	EFREMOV (RF)
WP1 - PA Phase 2	5	5
WP3 - PA Phase 4	10	10

- Magnet Division – Task 2

The total duration of the work will be 40 days, including 5 days of mission.

The following missions are considered:

Work item	Europe
WP 1 - Architect/ safety	2
WP 2 - Engineering	3

- CSCC Section –Task 3

The total duration of the work will be 100 days, including 35 days of mission.

The following missions are considered:

Work item	USDA /GA
WP1 - PA Phase 2	10
WP2 - PA Phase 3	10
WP3 - PA Phase 4	15

- TF Section – Task 4

The total duration of the work will be 80 days, including 10 days of mission.

The following missions are considered:

Work item	CNDA/JADA/EUDA
WP 2 – Follow-up	10

7 Deliverables

7.1 PF Section – Task 1

Comments or assessment of each reviewed documents will be summarized in a Review Report. For each mission, a visit report shall be issued. The review or visit reports will contain all comments (it can be as simple as a scan of the document with comment written by hand) and a conclusion and recommendations.

For each work package and each manufacturer, will be provided a Work Package report (WPR) at the end of the work per manufacturer. Each WPR will include a summary list of all the items addressed in the framework of this contract and for each item the reference of the Visit report or Review Report, the issues identified, a detail of the work and a description of the status at the time of the final report. The Visit Reports or Review Reports will be attached in the final report.

The final report of the contract will include references to the 9 WPR of the different work packages. The due dates for the reports are the following:

- 1st work package reports (one per manufacturer): 30 March 2015
- 2nd work package reports (one per manufacturer): 30 September 2015
- 3rd work package reports (one per manufacturer): 1 March 2016
- Final report: 31 March 2016

7.2 Magnet Division – Task 2

Comments or assessment of each reviewed documents will be summarized in a Review Report. The review report will contain all comments (it can be as simple as a scan of the document with comment written by hand) and a conclusion and recommendations.
For each work package, a final report will be provided at the end of the work per task. Each final report will include a summary list of all the items addressed in the framework of this contract and for each item the reference of the Visit report or Review Report, the issues identified, a detail of the work and a description of the status at the time of the final report. The Visit Reports or Review Reports will be attached in the final report.
The final report of the contract will include references to the final reports of the different work packages. The due dates for the reports are the following:

Linked to the T0: Decision to build a Facility. The work performed through the task order 48 placed to Jacobs is proposing an overall schedule to perform the commissioning within one year (to be updated)

1st work package reports (architectural design and safety):	T0 + 3 Months
2nd work package reports (Engineering):	T0 + 6 Months
3rd work package reports (Construction):	T0 + 12 Months
Final report:	At commissioning + 2 Weeks

7.3 CSCC Section –Task 3

Comments or assessment of each reviewed documents will be summarized in a Review Report. The review report will contain all comments (it can be as simple as a scan of the document with comment written by hand) and a conclusion and recommendations.

For each work package, a Work Package report (WPR) report will be provided at the end of the work per manufacturer. Each WPR will include a summary list of all the items addressed in the framework of this contract and for each item the reference of the Visit report or Review Report, the issues identified, a detail of the work and a description of the status at the time of the final report. The Visit Reports or Review Reports will be attached in the final report.

A dedicated report will be issued for the CS mock Up covering the MIP, manufacture and result and assessment of the qualification (cold) tests.

The final report of the contract will include references to the WPR. The due dates for the reports are the following:

- 1st work package reports (Phase 2): 31 December 2014
- 2nd work package reports (Phase 3): 31 October 2015
- Intermediate version of the CS mock Up report: 30 November 215
- Final CS mock up report: 31 January 2016
- 3rd work package reports (Phase 4): 1 March 2016
- Final report: 31 March 2016

7.4 TF Section – Task 4

For work package 1, which is a continuous activity, monthly reports shall be delivered to describe the progresses made. In addition, 3 documents will be written, the global PCR assembly procedure, the technical specification for the contract concerning the sequence of bolting, and a technical specification for the requirement for the TF sector preparation.

For the work package 2, individual reports shall be prepared for each of the 3 Magnet supports (Gravity Supports, PF clamps and CC supports manufacture plans).
Concerning the TFC impregnation, comments or assessment of each reviewed documents (DA impregnation procedures, TFC impregnation qualification) will be summarized in a Review Report. For each mission, a visit report shall be issued. The review or visit report will contain all comments (it can be as simple as a scan of the document with comment written by hand) and a conclusion and recommendations.

At the end of the contract a final report will be provided for each work package. Each final report will include a summary list of all the items addressed in the framework of this task and for each item the reference of the Visit report or Review Report, the issues identified, a detail of the work and a description of the status at the time of the final report. The Visit Reports or Review Reports will be attached in the final report.

The due dates for the reports are the following:

Final report for the integration: 31 March 2016

Final report for the follow up of the suppliers: 31 March 2016

8 Work conditions

A work plan shall be established and agreed by IO every two months. Travelling and missions will be only upon approval with IO.

This contract shall be executed by one sole staff. Splitting it into parts and sharing those between several parties or individuals are not permitted;

The contractor will be given access to the necessary data either in paper or in computer files format.

The staff will be working on IO site. An office will be assigned to the contractor when working on the IO site.

9 Payment schedule

Invoices will be raised and paid monthly, based on working days worked by the resources allocated to the Contract in the period, supported by authorised and approved by IO timesheets and accepted deliverables.

Missions: DSA per Diem + Travels according to IO Regulation. Missions will be done on IO staff request and invoiced separately one after the other. IO will reimburse mission expenses on the basis of the normal ITER staff travel reimbursement.