iter
china eu india japan korea russia usa

CONTRACT TECHNICAL SPECIFICATION

Engineering Work for the Instrumentation of Coils and Feeders from the ITER Magnet System

Technical Specification

Rev. 1.2

	Version: 1.2	*Date: 2010-11-05*
	Name	*Affiliation*
Author	**F. Rodriguez-Mateos**	**TKM**
Reviewers	**A. Devred**	**TKM**
Approver	**N. Mitchell**	**TKM**

Table of Contents

Revision history

Date	Rev.	Note
15 October 2010	Rev. 1.0	First version
2 November 2010	Rev. 1.1	Corrections to dates for contract end and signature
5 November 2010	Rev. 1.2	Framework contract duration of two years + one year optional

1 Abstract

This technical specification describes Engineering Work for the Instrumentation of Coils and Feeders from the ITER Magnet System.

Instrumentation and quench detection for the Magnet Systems of ITER, including coils and feeders, is an activity for which prototype work is being undertaken at present in many different fronts. From investment protection electronics to monitoring devices for the main process variables, development programmes have been launched with the goal to produce prototypes and validate their qualification under conditions established by the tokamak operation.

The procurement for the Magnets Instrumentation & Controls System is completely In-Fund (and not In-Kind as the major part of the Tokamak systems). Therefore, all sensors, instrumentation cables, conventional control sub-systems, quench detection sub-system, etc will be procured directly by the ITER Organization.

The scope of this contract is fundamentally engineering work in the domain of magnets instrumentation and related electronics, and includes contract follow-up outside of the IO premises in the different Member Countries.

2 Background and Objectives

The instrumentation of the ITER magnets includes the following sensor types:

- Voltage taps for quench detection and their protection resistances, in series with the tap lead at the cold end
- Co-wound tapes around the superconducting cables for quench detection
- Pick-up coils embedded in the ground insulation between CS modules
- Sensors for temperature measurements on superconducting cables, current leads, thermal shields and structures
- Sensors for pressure measurements at the inlet and outlet of the cooling circuits
- Flow meters for mass flow measurements, mainly on the return lines of the cooling circuits
- Strain gages, displacement sensors and possibly contactless optical sensors to monitor the behaviour of the structures

ITER has launched several R&D programmes for the development of all these sub-systems. In particular, specific electromagnetic and thermo-hydraulic calculations are being performed in order to define the functionalities of the quench detection system electronics. Once these calculations conclude, a new phase including prototyping, qualification and industrialisation for series production will start. The choice for the final electronic design and components, as well as the performance in terms of electromagnetic compatibility, is an important aspect which will require attention and studies for which specialized help will be needed.

The objective of this contract is to provide support for development of instrumentation sub-systems and the preparation for the industrialisation and series production.

3 Work Description

The work required in this technical specification includes the following engineering activities:

1) Electronics engineering for quench detection
2) High voltage applications in cryogenic vacuum
3) Transient electro-dynamic effects in the magnets powering chains

3.1 Electronics engineering for quench detection

This task includes:

a) To participate in the design process for quench detectors and high voltage signal conditioners, mainly during the important prototype phase

b) To participate in the design process for the interfaces to external systems, especially to the Central Interlock System

c) To stimulate and coordinate the validation process for the different quench detection solutions across magnet systems

d) To implement a prototype qualification test programme and coordinate its application

e) To help preparing the manufacturing files and the quality assurance plan for the series production as well as finding cost effective solutions, and

f) To improve methods and homogenize strategies across magnets systems in the areas of instrumentation and electronics.

3.2 High voltage applications in cryogenic vacuum

The object of the task is to provide a coordinated approach to the manufacturing and qualification for high voltage equipment, namely instrumentation feedthroughs, insulation breaks, integrated voltage taps and current limiting resistors as well as high voltage cables and co-wound tapes.

The main work areas will be:

a) To participate in the prototype qualification tests (implementation of the programmes, definition of applicable standards and norms, follow-up) and in the test data evaluation process,

b) To write relevant documentation (procurement specifications for the main manufacture, test reports, etc.),

c) To prepare quality assurance plans and participate in their implementation, and

d) To improve and streamline testing methods and homogenize testing strategies for the different components.

3.3 Transient electro-dynamic effects in the magnets powering chains

The magnets of ITER are subject to current/voltage transients as a result of tokamak operation for plasma control. Very fast transients in a large-scale magnet can induce excessive voltage on the first few turns of the winding, as there is a finite time for voltage redistribution from the terminals when insulation capacitance is taken into account.

The objective of this task is to develop a transmission line model of the ITER coils taking into consideration the capacitance of the insulation, ground insulation, etc. The work will be performed in collaboration with the Power supply division. The models are to be used to determine the magnitude of overvoltage during fast transients (different models need to be developed for the different magnet systems, all subject to their own transient scenarios). This electrical transient model for the each coil will form part of the operational interface between coils and power supplies to confirm that applied voltage changes for plasma operation do not exceed the coil voltage limits.

4 Duration and allocation of efforts

The framework contract duration shall be two years. The IO may extend these services for a maximum of one additional period of one year. ITER Organization shall establish the request for services on ad hoc basis and relative to the respective annual work plan;

Allocation of efforts is as shown below:

1) Electronics engineering for quench detection – 40 %
2) High voltage applications in cryogenic vacuum – 40 %
3) Transient electro-dynamic effects in the magnets powering chains – 20 %

5 Deliverables and Time Schedule

- Monthly, yearly and final reports are the deliverables measuring the accomplishment of objectives;
- Regular scientific publications should be prepared.

6 Acceptance Criteria (including rules and criteria)

The acceptance of the work will be based on the examination of the content of each of the specified reports in accordance with the description of the work given in Section 3.

7 Experience

The staff proposed by the bidder to carry out the work described in Section 3 must have proven experience in following areas:

- Proven experience in electromagnetic computations with in-depth understanding of physics related to fast changing magnetic fields, PhD level in the domain is required;
- Proven experience in design of components and manufacture follow-up within cutting edge scientific projects;
- Proven experience in electronics design and particularly in programming microcontrollers, good knowledge in design and construction of printed circuit boards;
- Proven experience in high voltage engineering and insulation materials;
- Capability to work in English language (fluently spoken, read and written);
- Proficient writing of scientific publications;
- Good level of oral French will be an advantage.

Curriculum Vitae showing evidence on the above is required.

8 Work condition

- A work plan shall be established and agreed by IO every two months. Travelling and missions shall be only upon agreement 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 staff working on this contract shall be available full time and deployed to the IO site in St Paul-lez-Durance, France.

9 Timetable

The tentative timetable is as follows:

Call for Expertise	November 2010
The Contract Award	January 2011

10 Candidature

Participation is open to all individuals, companies or institutes which are legally registered in one or more of the ITER Member States. A consortium may be either 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.