

Services of an expert for the engineering and physics design of a high voltage Bushing and assessment of the R&D for the ITER Neutral Beam systems

Technical Specifications

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1 Abstract

The purpose of this contract is to provide expert support to the NB section leader and the IO engineers in the management of the design for the ITER neutral beam system

The engineering and physics design of the ITER neutral beam injectors are on-going activities which will grow rapidly in the coming years

This work to be carried out in this contract is primarily concerned with the design of the HVB for the HNB and MITICA which should reach FDR at the end of 2012.

2 Background and Objectives

The expert hired under this contract will be closely involved with the following areas of work, with the objectives indicated. The contract duration is up to 24 months, based at ITER Organization, Route de Vinon sur Verdon, 13115 St Paul-lez-Durance, France, on full time basis. Missions are foreseen under the contract (see 5. Work description).

3 Scope of Work

This contract is foreseen to perform:

- (1) evaluations and validations of the design of the HV bushing toward FDR for the HNB ;
- (2) assessments of the design work of the beam source for MITICA
- (3) evaluations of the importance of the results from all the R&D tasks on the ITER injectors and the procurement of the injector components.

The contractor will write monthly technical reports on the work done and store them on IDM.

HV Bushing for MITICA and HNB in ITER

The HV bushing, that is 1MV potential feedthrough between vacuum and SF₆ insulation gas, is used in both MITICA and HNB in ITER. They have the same structure except the seal methods of ceramic rings and FRP rings are different for MITICA to that of the HNB. MITICA allows the use of viton seals which is not allowed in the ITER design. The PA of the HV bushing for MITICA was signed with JADA in Dec. 2011, and a part of the PA (Stage-1 for non-metallic components of ceramic and FRP rings that need a long duration time for the fabrication) has commenced for the manufacturing phase. The rest of the HV bushing components, mainly metallic parts, are being designed under an ITER Task. The R&Ds including vibration test and voltage holding test for a component of the HV bushing is on-going in parallel with the design and those results are critically evaluated the suitability of the Stage-2 design of the HV bushing. The Annex B of the HV bushing for HNB in ITER is also required to be completed by the beginning of 2013, through completing the design and R&Ds for the ceramic and FRP rings seal structure.

Objectives: The contractor will assist the NB section in carefully assessing the design work for MITICA and the HV bushings for both MITICA and HNB in ITER, both as the work progresses and the final product, in order to ensure, as far as is possible, that the primary objectives of MITICA can be fulfilled, and that the component design for ITER meets the ITER standards and requirements. The contractor will initially carry out a design of the stage-2

components of the HV bushing for MITICA and assess the status of the work completion. He will at the same time follow the progress of the design work of the HV bushing for the HNB. He will also oversee the ITAs ongoing on the bushing design.

This will be the principal work of the contractor.

PRIMA facility

The PRIMA facility (to be built at Padua, Italy) will consist of SPIDER (previously called the ion source test facility) and MITICA, which is essentially a full size heating neutral beam injector. The design of PRIMA will be finalised under ITER tasks for ≈ 100 PPY in coming one year. That work will produce the build to print designs of the components for the HNB as well as PRIMA.

The diagnostics to be used on PRIMA, which are crucial to the mission of the facility, are also being designed under an ITER task.

Objectives: The contractor will assist the NB section in carefully assessing the design work for PRIMA, in particular beam source including RF driven negative ion source and 1MeV accelerator, both as the work progresses and the final product, in order to ensure, as far as is possible, that the primary objectives of PRIMA can be fulfilled, and that the component design for ITER meets the ITER standards and requirements. The contractor will initially carry out a review of the foreseen work and assess the status of the work completion. He will then investigate possible issues and identify solutions of the design work via the progress meetings foreseen in the relevant ITER task.

R&D for ITER HNB system

ITER tasks have been launched for R&D in the following areas:

- Effectiveness of new magnetic filter configurations for the ion source.

- Development of the 1 MV bushing for the HNB

- R&Ds of vibration test and voltage holding for the screen shield in the HV bushing

- Detailed physics design of the MAMuG 1 MV accelerator for ITER HNB.

- Tolerance of electrodes with ITER HNB relevant separation distances to the energy released during high voltage breakdowns.

Objectives: The contractor will assist the NB section in assessing the importance of the results from all the R&D tasks to the ITER injectors and the procurement of the injector components. The contractor will also assess the need for further R&D that would ensure, or help ensure, that the systems meet the required level of performance and reliability/availability.

4 Estimated Duration

The duration is expected to be up to 24 months, with two periods of 220 working days (each 220 days period over 12 months).

5 Work Description

- **Subtask-1: Prepare an assessment of the status of the design work of the HVB for MITICA and the HNB.**

Attend and participate in the progress meetings held under the ITER task for the HV bushing design.

Take responsibility for the design of the HVB and the liaison between IO and JAEA

Help the NB section staff assess the work performed.

Help the engineering staff of the NB section understand the impact of design modifications on the injector performance

Prepare for the design reviews of the HVB.

Carry out oversight of the ITA on the HVB which are underway.

This subtask will be the priority work of the expert.

- **Subtask 2: Prepare an assessment of the status of the design work.**

Attend and participate in the progress meetings held under the ITER task for the design of PRIMA.

Help the NB section staff assess the work performed.

Help the engineering staff of the NB section understand the impact of design modifications on the injector performance

- **Subtask-3: Evaluate the importance of the results from all the NB R&D tasks.**

Assess whether the results from the R&D tasks lead to necessary changes of the injector components or if they could lead to an improvement in the injector reliability or performance.

Keep abreast of results from other relevant systems and inform the NB section of those results.

Under sub-tasks 1, 2 and 3, up to one mission off site within Europe (Munich or Padua) and two to Japan (Naka) should be foreseen.

All reports are to be written and stored in the ITER IDM after approval by the NB section leader.

Profile of the Expert proposed:

Qualifications and skills:

- Degree at least equivalent to 8 years of study after the High School Diploma in Physics or Engineering (e.g. PhD).
- Technical experience:
 - Extensive knowledge of NB injector physics and engineering
 - Thorough knowledge of negative ion sources used for neutral beam injection
 - Thorough understanding of the electrostatic acceleration of H^- and D^- at current densities and energies relevant to neutral beam injectors ($200A/m^2$ and 0.5 MeV to 1 MeV respectively).

General Experience:

- Fluency in English, both written and spoken.
- Direct experience of project management

Specific Professional Experience:

- Proven experience in the construction and commissioning of high power neutral beam systems
- At least 15 years of experience in the operation of high power neutral beam systems on a large Tokamak

6 Responsibilities

ITER:

ITER will provide the needed information and access to the adequate ITER files for executing this work when needed following the implementation plan.

In particular ITER will make available any technical information, for example copies of ITER task agreements, documents from previous ITER task agreements, drawings and references needed for the contractor to perform the work. The documents containing this information must be returned to ITER on completion of the contract.

Contractor:

The Contractor appoints a responsible person, the Contractor's Responsible, who shall represent the Contractor for all matters related to the implementation of this Contract.

The contractor will provide results according to the scope of the work outlined above and will fulfil the conditions of present contract.

The contractor shall obtain a valid entry VISA and work permit in order to allow the expert to work in France within ITER's site.

7 List of deliverables and due dates (proposed or required by ITER)

The Contractor shall submit monthly reports to the ITER Organization as per the progress on each subtasks mentioned in paragraph 5 work description.

All reports are to be written and stored in the ITER IDM after approval by the NB section leader.

8 Acceptance Criteria (including rules and criteria)

The selection will be done taking into account the following criteria:

- | | |
|----------------------------|-----|
| 1) Expert CV and Interview | 70% |
| 2) Price | 30% |

9 Specific requirements and conditions

In response to this call for tender the Contractor will provide:

- Cost breakdown (as indicated in the Template for Financial Offer)
- Payments will be made monthly in arrears after approval of the monthly report or alternative report(s).
- Profile(and/or CV) of the proposed expert and the key personnel involved in execution of the work activity
- Implementation plan for execution of the contract to demonstrate how the work will comply with the requirements of this specification. The implementation plan shall include list of points which need ITER check and/or approval for continuation of the work.

The official language of the ITER project is English. Therefore all input and output documentation relevant for this Contract shall be in English. The Contractor shall ensure that all the professionals in charge of the Contract have an adequate knowledge of English, to allow easy communication and adequate drafting of technical documentation. This requirement also applies to the Contractor's staff working at the ITER site or participating to meetings with the ITER Organization.

Documentation developed shall be retained by the contractor for a minimum of 5 years and then may be discarded at the direction of the IO. The use of computer software to perform a safety basis task activity such as analysis and/or modelling, etc shall be reviewed and approved by the IO prior to its use, it should fulfil IO document on calculation code for safety analysis.

The work shall require the presence of the Contractor's personnel at the site of the ITER Organization, Route de Vinon sur Verdon, 13115 St Paul-lez-Durance, France, on full time basis. Missions are foreseen under the contract. For all deliverables submitted in electronic format the Contractor shall ensure that the release of the software used to produce the deliverable shall be the same as that adopted by the ITER Organization.

10 Work Monitoring / Meeting Schedule

A report on the activity of the contractor shall be submitted by the contractor at the end of each month. When other report(s) covering the majority of the activities are produced is due on the same month only a brief log of the activities carried out shall be submitted.

The Contractor shall also propose a list of meetings with ITER for progress monitoring in agreement with schedule proposed. At least the following meetings should be foreseen.

Scope of meeting	Point of check/Deliverable	Place of meeting
Kick-off contract	Work program	ITER site
Progress meetings	Report(s)	ITER site
Final draft deliverable review meeting	Final report(s)	ITER site
Closing meeting for contract completion	Checking the final report	ITER site

11 Payment schedule / Cost and delivery time breakdown

Payments will be made monthly in arrears after approval of the monthly report or alternative report(s). When other report(s) covering the majority of the activities are produced is due on the same month only a brief log of the activities carried out shall be submitted.

12 Quality Assurance (QA) requirement

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

The general requirements are detailed in ITER document [ITER Procurement Quality Requirements \(22MFG4\)](#)

Prior to commencement of the task, a Quality Plan [Quality Plan \(22MFMW\)](#) must be submitted for IO approval giving evidence of the above and describing the organisation for 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 [Manufacturing and Inspection Plan \(22MDZD\)](#) must be approved by ITER who will mark up any planned interventions.

Deviations and Non-conformities will follow the procedure detailed in IO document [MQP Deviations and Non Conformities \(22F53X\)](#)

Prior to delivery of any manufactured items to the IO Site, a Release Note must be signed [MQP Contractors Release Note \(22F52F\)](#).

Documentation developed as the result of this task shall be retained by the performer of the task or the DA organization for a minimum of 5 years and then may be discarded at the direction of the IO. The use of computer software to perform a safety basis task activity such as analysis and/or modelling, etc shall be reviewed and approved by the IO prior to its use, it should fulfil IO document on Quality Assurance for ITER Safety Codes [Quality Assurance for ITER Safety Codes \(258LKL\)](#).

13 References / Terminology and Acronyms

In the following table denominations and definitions are given of all the actors, entities and documents referred to in this specification, together with the acronyms used in this document.

<u>Denomination</u>	<u>Definition</u>	<u>Acronym</u>
ITER Organization	For this Contract the ITER Organization	IO-
ITER Organization Responsible Officer	Person appointed by the ITER Organization with responsibility to manage all the technical aspects of this contract	IO-RO
Contractor	Firm or group of firms organized in a legal entity to provide the scope of supply.	C-
Contractor's Team	The Contractor plus all the sub-contractors/consultants working under its responsibility and coordination for the performance of the contract	C-Team
Contractor Responsible	The person appointed (in writing) by the legally authorised representative of the Contractor, empowered to act on behalf of the Contractor for all technical, administrative legal and financial matters relative to the performance of this contract	C-R
ITER Organization Task Responsible Officer	Person delegated by the IO-RO for all technical matters, but limited to one specific task order	IO-TRO
Contractor Task Responsible Officer	Equivalent to the IO-TRO in the Contractors team.	C-TRO