Summary Technical Specification

Neutronics analysis support framework contract
1 Abstract

The scope of the framework contract shall cover Neutronics Analysis activities for the ITER facility. This will include creation of computer models for radiation transport simulations, radiation transport calculations, determination of nuclear response (nuclear heating, damage, gas production, dose estimates etc.), activation calculations and full reporting of analyses including the provision of input and output results in formats specified with each Task Order.

It is expected that most of the work will be carried out at the home location of the Contractor but some travel to ITER in the South of France is expected for either the gathering of information, the presentation of results or consultation meetings.

2 Background

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 - the ITER Parties - are the European Union (represented by EURATOM), Japan, the People's Republic of China, India, the Republic of Korea, the Russian Federation and the USA. ITER is being constructed in Europe, at Cadarache in the South of France.

It is envisaged that ITER should produce as much as 700 MW of fusion power. This equates to the production of $2.48 \times 10^{20}$ $14$MeV neutrons/s which will give an uncollided flux at the first wall of approximately $4 \times 10^{13}$ n/cm$^2$/s and a total with the addition of the collided to some $10^{14}$ n/cm$^2$/s. ITER is therefore a significant nuclear facility and extensive nuclear analyses are required.

The principle needs of ITER with regard to nuclear analysis can be divided into the broad categories of safety and licensing, plant operation, and decommissioning although there is much overlap and interdependence within these categories.

The requirements for nuclear analysis related to safety are mainly related to:

- decay heat (input to demonstrate heat removal capabilities after operation or accidents – confirmation and refinement of previous results)
- activated material (for dose rate calculation, decay heat estimate, waste estimate, activated dust and Activated Corrosion Products (ACP) estimate)
- integrated dose and dose rate for Safety Important Components in view of qualification (maintain capability to operate, radiation damage)
- dose rate for human exposure (dose rate map in all areas accessible by workers)
- sky-shine assessment in normal operation and in maintenance scenario

A continuing programme of analysis is required because of changes in the design of the components, for shielding sensitivity analysis and as the site requirements are clarified.
During operation the nuclear issues in addition to those related to safety are concerned with ensuring the operability and integrity of the plant; this also includes work during maintenance periods.

Of primary concern is the heating of the superconducting coils which generate the magnetic field but the nuclear heating of all components must be known for the specification of the water cooling to be made. Helium production, damage and activation of components must be known to determine the life-time of components and the radiation environment during maintenance and change over. This data will be used to set the specifications for remote handling and storage and in the case of electronics and other sensitive components the radiation environment must be known to ensure that they remain operable or that the radiation does not induce spurious signal or induce calibration drifts.

When considering the radio-active waste issues the ITER Organization is concerned with impurity specifications of in-vessel materials, decay heat in the radioactive waste and tritium production at the end of ITER life in order to minimize the quantity of waste required for disposal. This implies the need for material specification (e.g. ITER grade steel with low cobalt and niobium contents) plus a consideration of shielding, and the use of remote handling techniques which in turn need activation and dose rate estimates.

There are constraints on the quality of the neutronics analysis which is performed. The regulators (i.e. the French Nuclear Safety Authorities (Autorité de Sûreté Nucléaire) must be satisfied that both the ITER will operate safely and that the justification for this claim is based on sound analysis.

The physical size of ITER and the complexity of the design mean that some of the analyses require large computational problems.

### 3 Objectives

The purpose of this Call for Nomination is to identify potential companies or consortia wishing to tender for the Neutronics Analysis Support Framework contract.

The companies or consortia of companies selected shall be recognised for their knowledge and expertise in:

- Radiation Transport Analysis
- Activation Analysis
- The nuclear issues for the ITER device
- Nuclear Engineering

### 4 Estimated duration

The duration of the Framework Contract will be two (2) years, with options to extend for up to three (3) further years. Task Orders will be issued for specific scopes of work, the duration of each dependent upon the scope of the task.

It is anticipated that an initial set of Task Orders will be issued in spring 2013.
5 Scope of work description

5.1 Scope of work

The Contractor shall provide neutronics analysis support to the ITER Nuclear Shielding Analysis Co-ordinator at the Contractor’s premises, or on the ITER site at Cadarache, with the location and type of support being detailed in the specific Task Order. The Contractor will assist the ITER Nuclear Shielding Analysis Co-ordinator with the planning, preparation, documentation, management and execution of the activity as defined in the applicable Task Order.

The scope of the specific support will include, but will not necessarily be limited to:

- Creation of computer models
  - Selection and simplification of CAD models (various formats including CATIA, step etc.)
  - Conversion of CAD models to input to transport codes (various formats including e.g. MCNP, Attila)
  - Incorporation of models into ITER reference models or combining of models
  - Specification of materials
  - Variance reduction optimisation (e.g. weight windows)
  - Tally specification
  - Documentation of models

- Radiation transport calculations
  - Estimates of neutron flux with energy resolution when required
  - Estimates of gamma flux with energy resolution when required
  - Assessment of uncertainties and quality or results
  - Production of mesh tally results
  - Documentation of results

- Determination of nuclear responses
  - Nuclear heating
  - Damage
  - Gas production
  - Material dose estimates
  - Biological dose estimates

- Activation calculations
  - Specification of materials including impurities
  - Activation and inventory calculations
  - Pathway analyses
  - Mapping of isotopic content

- Definition of Sources
  - Production of neutron source models for
    - Deuterium (DD) and Deuterium-Tritium (DT) plasmas
• Activated water
  • Production of gamma source models for activated components

• Full reporting of analyses
  • Provision of input and output results
  • Provision of reports on all work undertaken

• The contractor is expected to have access to the following computer resources
  • ITER approved radiation transport codes (MCNP, Attila)
  • CAD to MCNP conversion programs
  • CAD software
  • Provision of appropriate computer platforms for computations within the timescales of the tasks orders.

• Supervision and planning
  • Provision of oversight and coordination for nuclear analysis activities performed by the Contractor
  • Provision of information on task durations, resources etc. to develop analysis schedules
  • Provision of various reports to record progress against the project plan, identifying issues and recommending solutions

5.2 Profiles and skills

The Contractor’s team shall cover all disciplines that may reasonably be required to carry out the scope of work.

As guidance the following personnel profiles are expected to be required for work at the ITER site and in support of factory acceptance tasks:

• Nuclear Analyst(s):
  • proven experience in the nuclear physics or engineering and nuclear analysis
  • ability to process CAD packages
  • familiarity with MCNP and/or Attila
  • familiarity with activation codes (e.g. FISPACT)

5.3 Anticipated level of requirements

The anticipated level of support corresponding to each of the profiles described in section 5.2 is given below as guidance. The numbers quoted correspond to the estimated workforce needed to support nuclear analysis tasks. However, this level of support will not necessarily be achieved during the life of the contract.

• 2013 2 man-years
• 2014 1 man year
6 Responsibilities

Access and regulation:
Contractor will be responsible for all work visas and other required documentation and their respective costs associated with working at the ITER site.

IT equipment and licences:
Where the task order includes the supply of IT equipment, the contractor shall have and maintain the necessary IT equipment and licenced software tools required. All deliverables shall be supplied in a format acceptable to IO.

Where licensing or Export Control issues exist, the Contractor will be responsible for supplying the code and licenced users and abiding to all the relevant legal obligations and any costs associated with them.

The IO uses Microsoft Office Suite for general purpose document preparation, Catia/Enovia V5 for design work and Primavera for Scheduling. AutoCAD software is also available (used primarily for integrating third party Installations into the ITER CATIA models).

7 Quality Assurance (QA) requirements

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

8 Candidature

Candidates are allowed to form consortia or subcontract other companies. In this case, ITER Organization shall only have one single executive contact. All members of a consortium (i.e. the leader and all other members) are jointly and severally liable to the ITER Organization for the implementation of the contract. The Candidate’s composition (i.e. an individual legal entity or a consortium) shall be presented at the pre-qualification stage, following this Call For Nomination. The candidate’s/tenderer’s composition cannot be modified without a prior approval of the ITER Organization after the pre-qualification.

No more than one application can be submitted by a legal person whatever the form of participation (as an individual legal entity or as a member of a consortium submitting an application). In the event that a legal person participates in more than one application, all applications in which that person has participated may be excluded.

Legal entities belonging to the same legal grouping are allowed to participate separately if they are able to demonstrate independent technical and financial capacities. IO reserves the right to disregard duplicated references and may exclude such legal entities form the tender procedure.

Any subcontractor(s) shall not be considered to be members of a consortium and the experience and capacity of subcontractors will not be taken into account during the pre-qualification procedure.
9 Selection criteria

At prequalification stage, the candidate’s capacity will be assessed on the following:
- The candidate’s staffing profile shall cover all disciplines that could reasonably be required to complete the work described in the summary technical specification i.e. CAD processing, nuclear physics, nuclear engineering, neutronics, technical reporting.
- Accredited Quality System in accordance with ISO 9001 or equivalent for this type of work;
- Ability to work in the English language and interact as necessary to fulfil the requirements described in the summary technical specification: The Candidate shall have worked in at least 2 international projects carried out in English

10 Tentative Schedule

The tentative schedule is as follows:

- Prequalification submission: January 2013
- Tender submission: March 2013
- Contracts signature: May 2013