



IDM UID  
**TK32M9**

VERSION CREATED ON / VERSION / STATUS  
**17 Jan 2017 / 1.2 / Approved**

EXTERNAL REFERENCE / VERSION

## **Technical Specifications (In-Cash Procurement)**

# **Technical Specification for Analysis Section On-site Structural Analysis Services**

This document specifies the requirements for the provision of on-site structural analysis support to the ITER Analysis Section/Division (AS).



## **Technical Specification for In-Cash Analysis Section On-site Structural Analysis Services**

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## 1 Purpose

This document specifies the requirements for the provision of on-site structural analysis support to the ITER Analysis Section/Division (AS).

## 2 Scope

### 2.1 The ITER Project

The ITER project aims to demonstrate the scientific and technological feasibility of fusion power for peaceful purposes and to gain the knowledge necessary for the design of the next stage device.

The ITER project is organized as an international research and development project jointly funded by its seven Members; 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 southern France, which is also the location of the headquarters of the ITER Organization (IO).

During ITER construction, most of its components will be supplied "in-kind" by the ITER Members. These in-kind contributions are being managed through a Domestic Agency (one per ITER Member) located within the Member's own territory.

The working language of the ITER Project is English.

More details about the Project Organization, The Domestic Agencies, the IO location and other different aspects of the Organization are available on the website: [www.iter.org](http://www.iter.org).

### 2.2 Scope of the Task

The purpose of this contract is to provide general structural analysis support to the Analysis Section (AS) of ITER. This is broken down into the review of analysis reports, and the performing of analyses. In certain cases, the Contractor may have to gather the detailed requirements for an analysis prior to starting the analysis itself.

Structural analysis in ITER covers a wide range of different types of components and codes and standards. Thus, for a Contractor to be able to effectively support AS, the analysts supplied by the Contractor must be able to quickly adapt themselves to different types of tasks.

To ensure the best possible transfer of information, the Contractor shall supply two analysts to work on the ITER site in Cadarache, France.

To ensure that the contract imposes a minimum overhead on ITER management resources, the analysts supplied by the Contract shall be able to work effectively with a minimum amount of input from the IO RO.

### 3 Definitions

BC	Boundary Conditions
QA	Quality Assurance
RO	Responsible Officer
SQEP	Suitably Qualified and Experienced Personnel
SSC	System, Structure and Component

### 4 References

- [1] Analyses and Calculations. ITER\_D\_22MAL7.
- [2] Instructions for Structural Analyses. ITER\_D\_35BVV3.
- [3] Instructions for the Storage of Analysis Models. ITER\_D\_U34WF3.

### 5 Duration

The task shall start only after the signature of the contract. The total duration starting from the kick-off meeting is one year, with two possible options for one year each.

### 6 Work Description

This task will be implemented through Work-units. Each Work-unit consists of a well-defined task or set of tasks. Estimated Work-Units volumes are only indicative. The Work-units will be launched by the ITER RO, see paragraph 7.1.

The Contractor shall perform the tasks assigned and described in this section, in order for IO to perform quality check(s) and accept the deliverable(s).

Structural analyses have to be performed with ANSYS (or other software agreed with the IO Responsible Officer) or hand calculations based on the received input data.

Analysis reports have to contain an exhaustive description of the input data, the used assumptions, the analysis methodology, the FE model, the design loads and load combinations, and the results. Analysis reports shall be written following references [1] and [2]. Document reviews and checks shall also be performed in accordance with these references. FE models shall be stored on the IO Analysis Database following [3].

All tasks performed by the contractor will be assigned a category depending on the complexity of the task.

#### **6.1.1 Review or Technical Checking of Analysis Reports**

Contractors will be required to perform reviews or technical checks of structural analysis reports. Reviews will be documented using checklists, with completed checklists being attached to the relevant analysis report. The checks performed will depend on the type of

analysis in question. However, the non-exhaustive list below gives an indication of the types of checks that the contractors will be required to perform:

- Design philosophy and analysis methodology are well-documented and sound.
- The system, materials, requirements, acceptance criteria and other pertinent factors are considered, appropriate and used correctly.
- Inputs are reasonable, applicable and properly referenced.
- The safety, quality and seismic classes of the analysed structure are documented and correct.
- Assumptions are reasonably substantiated and justified.
- Calculations, analyses and models are well-documented, and the models are appropriate for the purpose of the analysis.
- The used software and its version is properly indicated and it is validated for the scope and purpose of the analysis.
- Outputs are reasonable for the given inputs and assumptions.
- Conclusions are reasonable and representative of the outputs.
- The analysis QA requirements are met.
- The references are traceable and valid.
- The document and the conclusions properly meet (or cover) the scope and purpose.
- The BCs and loads applied to the computational model are valid. This review shall be performed by the responsible for the system Load Specification.
- The geometry, materials and interfaces described in the report reflect the object under investigation. This review shall be performed by the RO of the system.
- The calculations are correct, and the analysis results are reasonable.
- The analysis model is stored in the analysis database.
- The geometry, mesh, element types, and material and element properties of the model in the database match the description.
- The BCs and loads of the model in the database match the description.

#### Categorisation of Review Tasks

The review tasks performed by the Contractor will be assigned a category depending on the complexity of the task. The table below lists the defined categories of tasks of the contract, along with an estimate of the number of each category of tasks.

<b>Category</b>	<b>No. days required per task</b>	<b>Estimated volume per year</b>	<b>Estimated total number of working days per year</b>
Category 1 review	0.125	80	10
Category 2 review	0.25	100	25
Category 3 review	0.5	80	40
Category 4 review	1	60	60
Category 5 review	2	40	80
Category 6 review	5	20	100
		<b>Total</b>	<b>315</b>

Category 1 review tasks would typically be a relatively simple review of a single short document. Higher category tasks would typically represent tasks that are more complex due to either the length of document to be reviewed or the level of detail of review.

A single review task may involve the review of several documents. For example, a task may be to review all analysis documents prepared for the design review of a particular system.

### **6.1.2 Performing Analyses**

Contractors will be required to perform analyses based on project priorities. The exact analyses required are not yet known. However, the following list gives an indication of the type of analysis work that may be required:

- Assessments of Systems, Structures and Components (SSCs) to calculate margins against the structural design criteria. Commonly used codes are RCC-MR, ASME VIII, ITER SDC-IC, Eurocode 2 and Eurocode 3.
- Calculation of interface loads between SSCs and the supporting civil structure.
- Preparation of models for use by analysts elsewhere in the ITER project.

The primary analysis software environment of ITER is ANSYS. It is expected that all Finite Element analysis tasks performed by the Contractor will be performed using ANSYS. The use of alternative Finite Element software packages shall be agreed in advance by the IO RO.

In some cases the contractor may be required gather details of the input data before starting the analysis itself.

#### **Categorisation of Analysis Tasks**

The analysis tasks performed by the Contractor will be assigned a category depending on the complexity of the task. The table below lists the defined categories of tasks of the contract, along with an estimate of the number of each category of tasks.

<b>Category</b>	<b>No. days required per task</b>	<b>Estimated volume per year</b>	<b>Estimated total number of working days per year</b>
Category 1 analysis	1	5	5
Category 2 analysis	2	5	10
Category 3 analysis	5	4	20
Category 4 analysis	10	3	30
Category 5 analysis	20	3	60
		<b>Total</b>	<b>125</b>

Several analysis tasks can be allocated to a single analysis project. For example, if the input data is too uncertain to allow an accurate estimate to be made of the time required to perform the analysis, a Category 2 analysis task could be launched to allow Contractor to gather the

data. Once the uncertainty has been reduced a second analysis task could be launched to perform and report the analysis.

## **7 Responsibilities**

### **7.1 ITER Organization Responsibilities**

IO shall assign a Responsible Officer to work as the sole Contractor interface. The IO RO is the Analysis Section/Division Leader or a person delegated by him.

The IO RO shall assign task descriptions by e-mail, specification documents or minutes of meetings.

The IO RO shall be responsible for ensuring that deliverables are checked against requirements, including quality and schedule.

IO shall make available to the Contractor all technical data and documents which the Contractor requires to carry out its obligations pursuant to this specification in a timely manner. Note however that the Contractor may have to gather this data from various individuals or documents identified by the IO RO.

For each on-site analyst provided by the Contractor IO shall provide a workstation that is suitable for the requested analysis tasks, one ANSYS license and network access rights.

### **7.2 Contractor's Responsibilities**

The Contractor shall ensure that he complies with the provisions of the contract. In particular:

- The Contractor shall provide two structural analysts to perform the tasks listed in this contract. Both of these analysts shall work on the ITER site.
- The Contractor shall ensure that the analysts assigned to create the deliverables of this contract are Suitably Qualified and Experienced Personnel (SQEP).
- The Contractor shall guarantee that all input information provided to perform the task remain property of IO and shall not be used for any other activity than the ones specified by this contract and the IO RO.
- All output created by the Contractor under this contract becomes the sole property of IO. This includes any macros and software used to run analyses, including pre- and post-processing.
- The Contractor shall be in charge of the training & coaching of all its resources.
- The contractor shall work in accordance with the QA plan approved by IO.
- The contractor shall perform the activities accordingly to this specification taking into account all relevant additional documents and IO processes into account (hand books, export control, intellectual properties, etc.).
- If assigned tasks are not clear, the Contractor shall request clarification as soon as possible from the IO RO.
- The Contractor shall inform the IO RO as soon as possible of any event which leads to deviation in content or due date of the delivery of a task.



Prior to the start of work of any analysis, the Contractor shall gather and review the input technical information provided to it by IO for completeness and consistency, and shall advise the IO representative of any deficiencies it may find. The contractor shall not be responsible for errors in the input technical information which could not be reasonably detected during such review.

## **8 List of Deliverables and Due Dates**

The Contractor shall issue completed checklists and analysis reports as defined by the IO RO. The language used for all document shall be English.

An indicative list of activities, including an estimate of the number of each type of task, is given in section 6. These quantities are estimates only and may vary depending on IO needs. However the maximum price of the Contract shall not be exceeded.

## **9 Acceptance Criteria (Including Rules and Criteria)**

All deliverables shall be uploaded to the IO IDM system where they will be reviewed as arranged by the IO RO. Analysis reports will be reviewed by IO. Completed checklists may be subjected to spot checks arranged by the IO RO to ensure the quality of reviews.

The process of acceptance is driven by the IO internal process of approval. Until this process is completed, modifications can be requested. The IO approval process involves all the interfacing system concerned.

The form of deliverables is according to the formalized request by the IO TRO. Any deviations, if not previously agreed, may lead to the deliverable being refused.

Deliverables will be reviewed by IO within 20 working days of being stored on IDM. They will be accepted if compliant with the requirements advised by the IO TRO at the start of the task.

In case of non-compliance / conformity of a deliverable or a set of deliverables, the contractor shall correct them and re-submit them for review and acceptance. Resubmission shall be at contractor's cost.

Note that reviewing deliverables imposes an overhead on ITER. To keep this overhead to a minimum, the deliverables shall be of high quality. This includes good use of English in any documentation produced. If deliverables are of unacceptably low quality, or there are delays in the submission of deliverables, IO reserves the right to terminate the contract.

## **10 Specific Requirements and Conditions**

The Contractor warrants that the group responsible for the deliverables of this contract has the necessary qualifications and experience to carry out their work. Minimum requirements for the group are as follows:

Skill	Minimum requirement
Thermal and mechanical analysis of structures using Finite Element Analysis.	All members of the group must be highly skilled structural analysts. This cannot be measured by experience alone, but a minimum requirement is 5 years of experience, of which a minimum of 2 must be with ANSYS Mechanical APDL. At least one individual must have at least 2 years of experience with ANSYS Workbench.
Codes and standards	All members of the group must have at least 3 years of experience with the finite element requirements of at least one of the following: RCC-MR, ASME III, ASME VIII, ITER SDC-IC.  This experience shall cover all of the main methods of assessments: <ul style="list-style-type: none"> <li>• Plastic collapse (linear, limit and elasto-plastic analysis. Use of stress classification lines).</li> <li>• Buckling (Euler and elasto-plastic analysis).</li> <li>• Ratcheting.</li> <li>• Fatigue (including weld assessments and use of sub-modelling and stress concentration factors).</li> </ul>
English language	Demonstrated ability to communicate effectively, both orally and in writing. Ability to write clear and concise documentation.
Seismic	At least one individual must have at least 2 years of seismic experience, including response spectrum analysis.

The table above represents the minimum requirements. The bullets below represent skillsets that would be useful.

- Extensive seismic experience such as use of Power Spectrum Density and mode-superposition transient analysis or use of transfer functions.
- Knowledge of other codes and standards (EC2, EC3, EN 13155, EN 1570-1, ASME B31.3).
- Experience of piping analyses in nuclear environments, and use of CAESAR II.
- Experience of complex thermal analyses including conduction, convection (by means of heat transfer coefficients) and radiation (using view factors).
- Knowledge of ITER systems.

## 11 Work Monitoring / Meeting Schedule

A kick-off meeting shall be arranged on the IO site at the beginning of the task. Progress meetings on the IO site will be arranged as necessary.

The Contractor shall provide a weekly report of its activities highlighting in particular:

- Consumption of Work-units
- Average, shorter and longer time of implementation per type of Work-units

- Possible issues
- Possible proposals for improvements

Schedule is defined according to the requirements stated in section 10 and the individual requests of Work-units.

The Contractor has to maintain a detailed schedule of the Work-units launched and planned. This schedule should be permanently available and will be the basis for the TRO to define possible priorities

## 12 Quality Assurance (QA) Requirements

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.

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 Safety Requirements

ITER is a Nuclear Facility identified in France by the number-INB-174 (“Installation Nucléaire de Base”).

For Protection Important Components and in particular Safety Important Class components (SIC), the French Nuclear Regulation must be observed, in application of the Article 14 of the ITER Agreement.

In such case the Suppliers and Subcontractors must be informed that:

- The Order 7th February 2012 applies to all the components important for the protection (PIC) and the activities important for the protection (PIA).
- The compliance with the INB-order must be demonstrated in the chain of external contractors.
- In application of article II.2.5.4 of the Order 7th February 2012, contracted activities for supervision purposes are also subject to a supervision done by the Nuclear Operator.

For the Protection Important Components, structures and systems of the nuclear facility, and Protection Important Activities the contractor shall ensure that a specific management system is implemented for his own activities and for the activities done by any Supplier and Subcontractor following the requirements of the Order 7th February 2012 [2].