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1 Purpose

This specification describes the consultancy work to support ITER staff regarding composites and electrical insulation of magnets, feeders and ancillary components.

2 Scope

The ITER magnet system consists of 48 superconducting coils and 26 coil feeders, all of which are designed for use at high voltage up to 30 kV. These high voltages are isolated by high voltage insulation in order to avoid electrical arcing which would damage these components and render them inoperable. The high voltage insulation must encapsulate the magnet winding packs and extend along the feeder busbars in a seamless manner.

The high voltage insulation on the magnets will be applied using a vacuum pressure impregnation process. This process is subject to rigorous QA and QC procedures. The scope of the consultancy work is to assist the magnet ROs with the manufacturing follow-up of these components.

The pre-compression rings for ITER will be fabricated with a glass-fibre/epoxy composite and will be the largest composite structure ever fabricated. Their robustness is critical for the 20 year period of machine operation. The scope of the consultancy work is to assist the magnet ROs with the manufacturing follow-up of these components.

The process used to apply the high voltage insulation on the coil feeders is currently under investigation, with an R&D programme underway at the feeder manufacturer. The scope of the consultancy work is to assist the feeder RO with the monitoring of this activity and to help troubleshoot any problems which might arise. The Consultant will also assist the feeder RO with insulation issues arising from the feeder manufacturer.

The insulation breaks for the ITER coils and feeders are made by a wet winding process using a fiberglass/epoxy configuration. Over the past several years the IO, with the help of National Institutes, has developed and validated 30 kV and 4 kV designs. These designs are now undergoing pre-series manufacturing and preparation for the final series production. The scope of the consultancy work is to assist the instrumentation RO with the manufacturing follow-up of these components.

The magnets and feeders also contain components made of composite material which are not necessarily operating in a high voltage environment. For example, composite pieces are used in the magnet structures to suppress the circulation of induced currents. The scope of the consultancy work is to assist the ROs with technical enquiries concerning these components.

3 Definitions

IO - ITER Organization

RO - Responsible Officer

DA – Domestic Agency

QA – Quality Assurance
QC – Quality Control
PA – Procurement Arrangement

4 References

TF Coil PA Annex B – IDM 2F9VWQ
Pre Compressions Rings PA Annex B – 33MG5H
PF Coil PA Annex B – 2NMU6M
CS Coil PA Annex B – 3344WP
CC Coil PA Annex B – 3PW67C
Feeder Annex B – 3PW67C

5 Estimated Duration

The duration shall be 36 months from the starting date of the contract. The contract will be divided into equal 3 phases each of duration 1 year, with Phase II and Phase III being optional. The IO will take a decision on the take-up of an option no later than 2 months before the end of the previous phase.

6 Work Description

The objective of this contract is the supply of specialised services to perform the following activities:

- Assess industrial solutions for TF coil electrical insulation.
- Assess industrial solutions for PF coil electrical insulation.
- Assess industrial solutions for CC coil electrical insulation.
- Assess industrial solutions for feeder electrical insulation.
- Assess industrial solutions for the CS coil electrical insulation.
- Assess industrial solutions for the pre-compression rings.
- Assess industrial solutions for the Insulation breaks
- Support the IO ROs in the follow-up of the Procurements Arrangements. This activity may imply occasional missions in China, Japan, Russia, the US and Europe.
- Follow-up pre-series and series contracts for insulating breaks at ASIPP (China) and Efremov (Russian Federation).

7 Responsibilities

The ITER ROs are responsible for the components which employ high voltage insulation or composite materials. The Consultant will assist the ROs as described in Section 2 of this Technical Specification.

8 List of deliverables and due dates

The work will be performed in close contact with the relevant IO RO. Regular visits to the IO site are expected as well as monthly progress meetings which can be carried out without physical presence on site.

A report on the work performed regarding the expected activities is required on a two-monthly basis from the signature of the contract.

Trip reports must be submitted to the relevant RO after any mission to visit a manufacturing site. In particular it is very important that critical information be transmitted swiftly to the IO RO so that Contracts can run smoothly, and that any unexpected holding points can be quickly resolved.

9 Acceptance Criteria

The acceptance of the work is based on the acceptance of each of the bi-monthly progress reports.

10 Specific requirements and conditions

The Contractor must have excellent detailed knowledge and experience of the activities listed below. This experience will have been acquired over at least 20 years working in Universities, National Laboratories and Industry.

- Properties and selection of composite materials, including resin systems.
- Knowledge and contacts within the suppliers of these materials
- Processes for applying insulation: vacuum pressure impregnation, pre-impregnated materials and wet-winding.
- Standards and test methods used to qualify insulation, and interpretation of results. This includes high voltage testing.
- Industrialization of insulation processes to series manufacture of components, including QA and QC procedures.
- Able to communicate effectively with personnel at all levels involved in the qualification and manufacture of the insulation.

The contractor must have familiarity with the ITER magnets and in particular with the electrical and nuclear operating conditions.

The contractor must be prepared to travel at short notice to locations in China, Russia, Japan and the US. It will be the responsibility of the contractor to obtain the necessary visas based on invitation letters arranged through the IO.

11 Work Monitoring / Meeting Schedule

Monthly meetings are foreseen to monitor the work performed, which may not require on-site presence. In addition, it is expected that the Contractor will participate in meetings involving DAs and industry related to the scope of the work.

12 Payment schedule / Cost and delivery time breakdown

The payments shall be granted for each Phase according to the following approximate schedule and upon approval of the 6 progress reports for each Phase. Payment will be subject to weekly timesheets.

- 15% upon IO's approval of 1st report
- 15% upon IO's approval of 2nd report
- 15% upon IO's approval of 3rd report
- 15% upon IO's approval of 4th report
- 15% upon IO's approval of 5th report
- 25% upon IO's approval of 6th report.