

Contract for Conceptual Design of the Analytical System

SUMMARY

Purpose

The purpose of this contract is to provide to provide Conceptual Design of the Analytical System.

Background

The Analytical System (ANS) shall be installed as an integral part of the ITER Tritium Plant with the functions of:

(i) Determination of the composition of various gas mixtures

ANS shall provide the analysis of chemical compositions of the gases handled in the storage and delivery system (SDS), the tokamak exhaust processing system (TEP) and the isotope separation system (ISS).

(ii) Verification of the correct functioning of various processes

If unexpected concentrations are observed by the analytical techniques used in the ANS, it is clear that the process of a system is not functioning as planned or expected. Thus the ANS can verify the correct functioning of various processes or of the integrity of components. For instance the observation of gases other than hydrogen isotopes in the permeate gas of a permeator would indicate the occurrence of a leak.

(iii) Determination of tritium concentrations in various gas mixtures and liquid samples for tritium accountancy and tracking

In case tritium accountancy and tracking is to be performed in a system by $PVT\epsilon$ measurements, this system should provide the necessary tools for PVT acquisition whereas only tritium concentration, ϵ is determined by the analytical techniques of the ANS. In addition, tritium concentrations in liquid samples shall be determined by the ANS.

(iv) Monitoring and calibration of local instrumentation, e.g. pressure gauges

Pressure gauges in systems used for $PVT\epsilon$ measurements, for instance, shall be regularly calibrated by standard pressure gauges in the ANS in order to reduce the systematic errors for tritium accountancy and tracking. Calibration shall be also carried out for flow meters and process ion chambers.

Although the analytical requirements were summarized in 2001 DDD 32H for the SDS, TEP (three streams of permeators: feed gases, permeate gases and bleed gases) and ISS, they shall be reviewed against the current design of the SDS, TEP and ISS. In addition, tritium concentrations in liquid samples shall be determined by the ANS from the viewpoint of tritium

accountancy and tracking. In hydrogen discharge phase, it is required to determine hydrogen balance. Furthermore deuterium accountancy and tracking is a compulsory task in deuterium discharge phase because deuterium is a nuclear material in France. On the other hand, the ANS should be also capable of analysing concentrations of hydrogen isotopes in solid samples and oil samples for the purpose of tritium accountancy and tracking.

Three micro gas chromatographs were proposed in 2001 DDD 32H for the analysis of hydrogen isotopes, because conventional gas chromatography suffers from the disadvantage of long retention times of around 30 min for the heavier hydrogen species whereas micro gas chromatography has recently achieved important improvements with respect to the retention times of non-radioactive hydrogen isotopes (H_2 , HD and D_2). Although micro gas chromatography can be considered as a demonstrated analytical technique for the determination of non-radioactive hydrogen and impurity gas mixtures, its suitability in ITER Tritium Plant shall be further demonstrated in the nearest future by R&D with six hydrogen isotopes mixture (H_2 , HD, D_2 , HT, DT and T_2) after replacing non-tritium compatible components in commercial micro GCs. On the other hand, laser Raman spectroscopy has been employed to analyse the composition of the six hydrogen molecules in pure hydrogen gas mixture because the vibrational and rotational energies of the various molecules are so far apart that overlapping does not occur. Further advantages are that the samples can be analysed in-situ, meaning that the sample is not modified during the analysis and can be re-used, and that the time needed for performing an analysis is very short, implying this technique can be used as an on-line analytical technique for the case of fast changing gas composition. In addition, a variety of mass spectrometers can also be employed to determine the composition of hydrogen isotope mixtures and impurities. The general principle of a mass spectrometer is the separation of ions by magnetic and/or electrical field and registered by a detector. The performance of a mass spectrometer is characterized by resolution, sensitivity, maximum operating pressure and smallest detectable partial pressure. Therefore, it is urgent task to determine the analytical technologies for gas analysis and the strategies and procedures for both in-situ gas analysis and sampling/ex-situ gas analysis.

It is also an urgent task to finalise documentations of the individual system requirement document (I-SRD), system interface control document (S-ICD), process flow diagram (PFD) and conceptual design description (CDD) for the ANS. In addition, it is required to provide electrical Diagrams for Functional Specification Design. Subsequently it is necessary to prepare piping and instrumentation diagram (P&I Diagram), drawings of major analytical tools, list of components, list of instruments, list of pipes, list of valves, and the layout of the ANS system in gloveboxes.

Scope of work

This contract is foreseen to perform:

- (1) To Identify analytical requirements to the ANS;
- (2) To Propose the strategies and procedures for gas analysis;
- (3) To provide inputs to I-SRD, S-ICD, PFD and CDD for the ANS.

Export control

The technical specifications are not sensitive, but the outcomes of this contract may be sensitive and there may be Export Control considerations.

Estimated Duration and Timetable

The duration of the Contract will be 12 months from the date of the signature.

The tentative timetable of the applicable Call for Tender procedure is as follows:

Call for Pre-qualification	September 2010
Call for Tender	October 2010
Tender submission	November 2010
Contract placement	December 2010
Completion of contract	January 2012

Experience

The potential tenderers should have proven experience in the following areas:

- Recognized competence in the analysis of hydrogen isotopes;
- Handling of large amount of tritium (greater than a few grams);
- Employing micro gas chromatography or conventional gas chromatography for the analysis of hydrogen isotopes;
- Employing laser Raman spectroscopy or mass spectrometer for the analysis of hydrogen isotopes;
- Measurements of tritium in solid samples and oil samples.

The potential tenderers should expect to spend a significant amount of time at the ITER site to facilitate regular meetings with members of the ITER Organization.

Candidature

Participation is open to all legal persons participating either individually or in a grouping (consortium) which is established in an ITER Member State. A consortium may be a permanent, legally-established group 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.