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Technical and Financial Quotation Documents

Technical Summary for CFN for SF6 Gas Handling System

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Change Log

Technical Summary for CFN for SF6 Gas Handling System (3SPEYH)

<i>Version</i>	<i>Latest Status</i>	<i>Issue Date</i>	<i>Description of Change</i>
v1.0	Signed	23 Mar 2023	
v1.1	Approved	24 Mar 2023	Reference to CFT added and planning modified



SUMMARY

Call For Tender IO/23/CFT/10025842/ERA

SF₆ Gas Handling System for filling/evacuation of insulating medium in Heating Neutral Beam Power Supply High Voltage compartments

Background

The ITER project aims to build a fusion device with the goal of demonstrating the scientific and technical feasibility of fusion power. The ITER Organization (IO) is bringing together people from all over the world to be part of this unique project and to contribute to building the ITER device which requires the best people from many disciplines.

In ITER, the plasma burning conditions will be obtained and controlled by additional Heating and Current Drive systems, including Ion Cyclotron (IC), Electron Cyclotron (EC) and Neutral Beam (NB) systems. The ITER device will be equipped with **two Heating Neutral Beam (HNB) Injectors for heating with a provision for adding a third Neutral Beam Injector (NBI) at a later date**. Each NBI will provide 16.5 MW of power to the ITER Tokamak.

To penetrate deep into the ITER plasma, the Neutral Beam has to be accelerated to very high potentials and then neutralizing it by means of an interaction with neutral gas of the same type. The beam acceleration voltage that has been chosen is 1 MV and all power supplies and transmission lines will therefore be insulated using pressurized SF₆ gas. This requires a SF₆ gas handling system that is initially capable of handling ~70 tonnes of SF₆. **This would be about 100T of SF₆ gas inventory when a third NBI is added.**

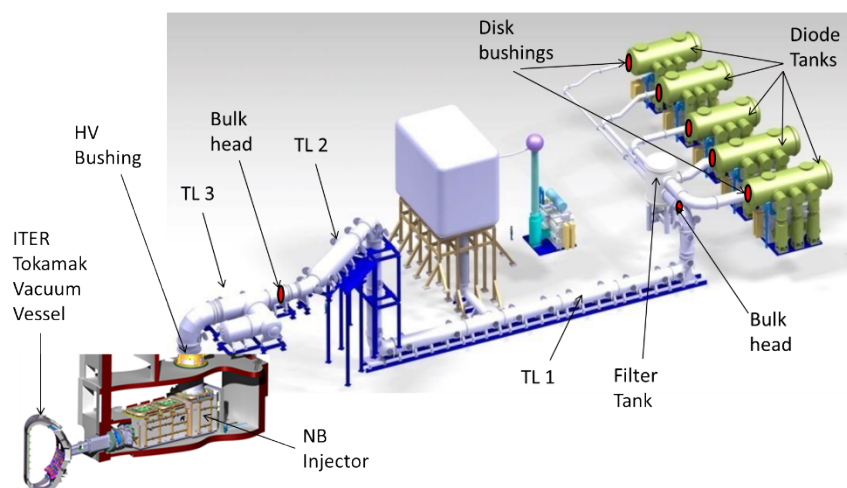


Figure 1: One HNB Line with HV compartments overview

Scope of work

The Scope of this work is design, manufacture, supply of the SF₆ Gas, Gas Storage and Handling Plant along with associated distribution piping, quantity and quality monitoring devices and leak detection system to be delivered, installed tested and commissioned at the ITER site.

The Gas Handling System shall perform the following operations:

- a) Evacuating SF₆ from HV compartments
 - Evacuate the SF₆ gas from all the/single HVPS compartments;
 - Flood the compartments with fresh air with filters;
 - Store the SF₆ in tanks during intervention in the compartments;
- b) Transferring gas from storage tanks to HV compartments
 - Evacuate the air from the compartment after the intervention;
 - Flood the compartments with SF₆;
 - Increase the SF₆ pressure to the nominal value
- c) Filter the SF₆ to remove impurities and moisture during gas handling
- d) Monitor the quality and quantity of the SF₆ in different compartments
- e) Continuous Leak Detection in all areas to monitor any leaks

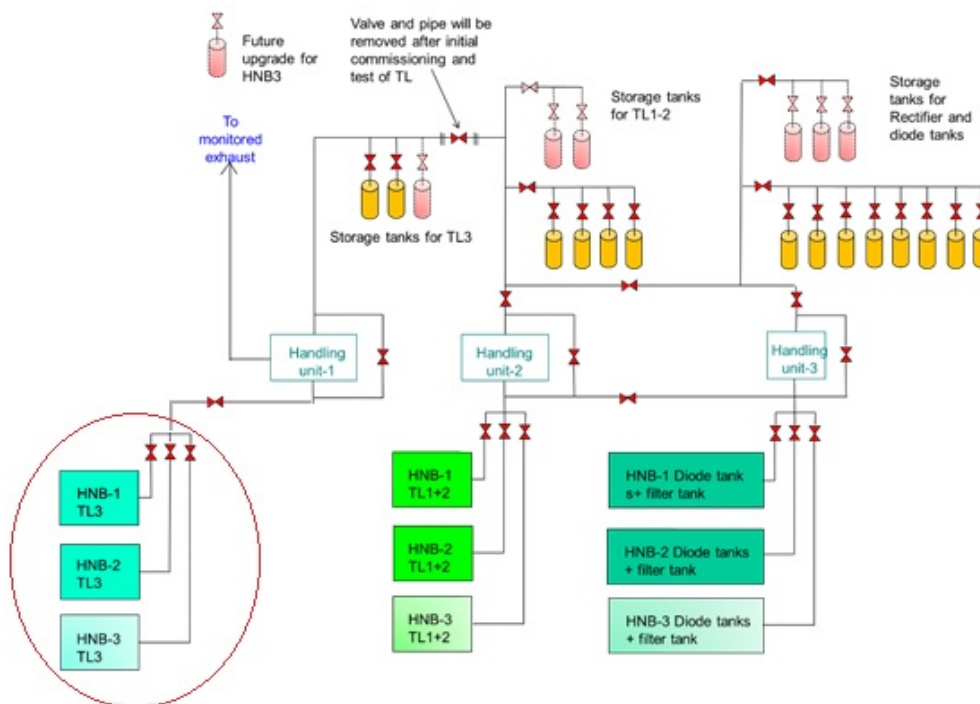


Figure 2: Proposed scheme (PFD) with three Handling Units

Storage of SF₆ gas in tanks is envisaged in liquid form at 50 bars and the working pressure for the gas in HV compartments of power supply is maintained at 6 bars. All pressures are in absolute. The compressors/evaporators necessary for this liquid/gas phase conversion, suction/vacuum pumps to evacuate one medium before filling other (air and SF₆) with all other necessary components like heaters, filters, etc. assembled on a suitable structure together with an enclosure to provide human comfort HVAC within, forms the Gas Handling Unit (GHU).

Major components of the system therefore, can be outlined as follows:

- a) Gas Storage Tanks
- b) Gas Handling Units (GHU) - assembly of Compressor, Suction pumps, Vacuum Pumps, filters, heaters, etc. on a structure in a suitable size fabricated enclosure.
- c) Piping – interconnecting between tanks and GHU and distribution from GHU to HV compartments
- d) Instrumentation and controls
- e) Electric power distribution and earthing

Relative layout of these gas system components with respect to the distributed High Voltage compartments to be filled with this gas at site can be visualised in Figure 3

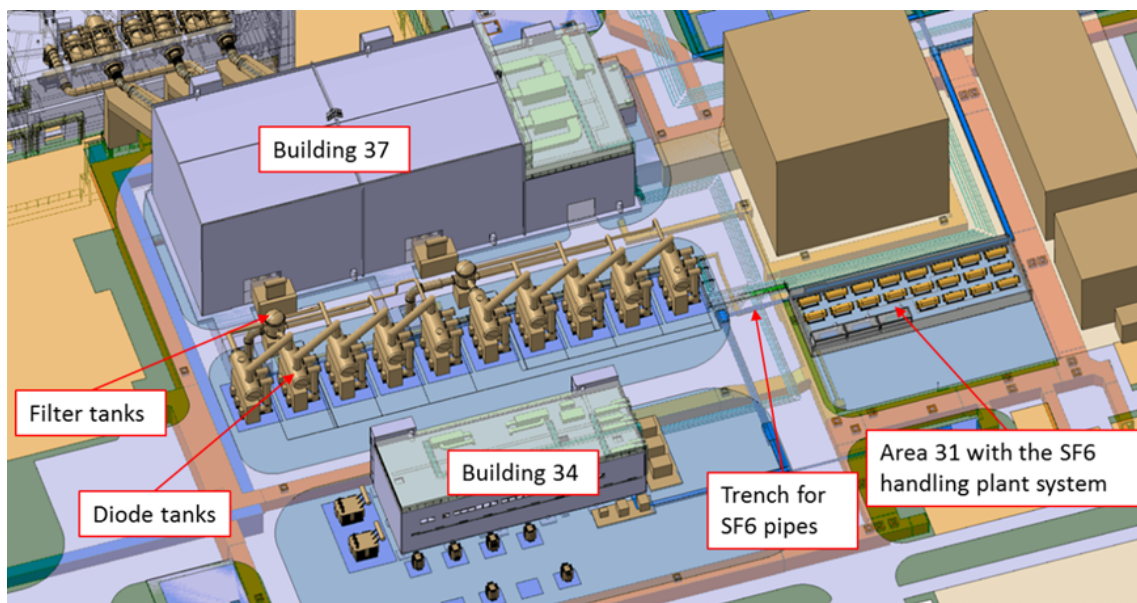


Figure 3: Site Layout of gas handling plant and distribution

Components a, b and part c (interconnecting piping) are to be installed on concrete foundation (known as Area 31) which is qualified to withstand loads corresponding to seismic level SL-2. The design of supports, foundations and the components supplied for SF₆ handling system shall also qualify to withstand same loading. While there are embedded plates for fixing tank foundations, piping/cable tray supports have to be post drilled and anchored.

System component (d) essentially envisages measuring devices and instruments essential for gas analysis (Quality), high accuracy P/T/Density measurements for gas phase and weight sensors on tanks for liquid phase for quantity and indoor/outdoor leak detection with high sensitivity detectors. Integration of controls of all units in one control cubicle within GHU enclosure for providing a network and hardware exchange of information with overall central control centre of the ITER project (CODAC).

Component (e) refers to provision of electrical distribution boards. Bulk power as one feeder cable will be provided by ITER. This is to be received and multiplied into different outlet feeds for all the electrical equipment of SF₆ system including cabling. Similarly, individual equipment earthing is to be extended to the overall earthing grid provided around Area 31.

The breakdown of scope of work in several Phases is as follows:

- **Phase 1:** corresponds to Engineering, system design, production and integration plan, structural and seismic analyses, risk analysis and FMECA reports, developing 3D CAD models and 2D drawing using CATIA. Preliminary and final design each followed by design review as per ITER review procedures will form part of this Phase.
- **Phase 2:** corresponds to manufacturing, factory testing, transport and delivery.
- **Phase 3:** corresponds to the assembly, installation, testing and commissioning at IO site up to first filling of gas from tanks to HV components of Power Supply
- **Phase 4:** corresponds to Training of ITER staff for O&M of gas handling system.

The scope of work also includes the design methods and testing capabilities listed in the following fields:

- Manufacturing design, comprising drawing production and tolerance evaluation (3D CAD model and 2D drawings following ISO standards) using CATIA V5
- Raw material procurement
- Material qualification and tests (filler material for welding/brazing, base material...)
- Testing of components (such outgassing tests, hydrostatic tests...)
- Producing the technical documentation required such as manufacturing sequences, WPS, WPQR... in accordance with the nuclear code.
- Non-destructive tests (NDT) and examination such as vacuum leak tests (hot/cold leak rate in the range of $10^{-9} Pa.m^3.s^{-1}$), volumetric examination, dye penetrant testing...
- Supply of requisite quantity of SF₆ gas
- Management of technical and contractual data

Duration of services

The Contract is scheduled to come into force in the 1st quarter of 2024 for an estimated duration of:

- 18 months for phase 1
- 12 months for phase 2
- 12 months for phase 3 & 4

Procurement Time table

A tentative timetable is outlined as follows:

Call for Nomination release	31 March 2023
Receipt of nominations	21 April 2023
Issuance of Pre-qualification Application	12 May 2023
Submission of Prequalification Application	12 June 2023
Notification of Prequalification results	8 July 2023
Launch of Call for Tender	5 August 2023
Clarification questions related to this Call for Tender	8 September 2023
Response to Questions from ITER Organization	15 September 2023
Tender Submission Date:	3 October 2023
Estimated Contract Award Date:	March 2024
Estimated Contract Start Date:	April 2024

Experience

The acceptance criteria for the selection process of the tenderer are listed below:

- Past experience in design of High pressure and high vacuum components requiring various engineering expertise
- Past experience in SF₆ gas and gas handling systems
- Past experience in structural, risk, failure analyses
- Expertise in Non-Destructive Examination of welded assembly
- Expertise in manufacturing, control and management of component for High Pressure and High vacuum application
- 3D CAD modelling with CATIA
- Access to test equipment and facility (hydrostatic test, outgassing test...)
- Experience in the management of component for Nuclear application
- Quality Management

Candidature

Participation is open to all legal persons participating either individually or in a grouping (consortium). All legal persons including all consortium members should be established in an ITER Member State. A legal person cannot participate individually or as a consortium partner in more than one application or tender. A consortium may be a permanent, legally-established grouping 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. The consortium cannot be modified later without the approval of the ITER Organization.

Legal entities belonging to the same legal grouping are allowed to participate separately if they are able to demonstrate independent technical and financial capacities. Bidders' (individual or consortium) must comply with the selection criteria. IO reserves the right to disregard duplicated references and may exclude such legal entities from the tender procedure.

Reference

Further information on the ITER organisation procurement can be found at:

<http://www.iter.org/org/team/adm/proc/generalinfo>