

Heater solution for current lead terminal instrumentation of the ITER coils

Call for Nomination

Purpose

This Contract concerns the supply of several types of electrical heaters to heat the current leads (CL) used for powering the superconducting magnets of the ITER machine and to avoid heavy condensation or ice formation.

The current leads for the ITER machine are optimized for operation at nominal current. The optimal cross-section/length of the current leads and the enhanced heat transfer to the cooling helium gas (GHe) by the integrated heat exchanger (HEX) ensure that the GHe at the exit and warm terminals of the current leads is automatically maintained at ambient temperature conditions.

Background

Because of their design for the nominal electric current level, the CLs will be overcooled in standby conditions without this nominal current. Although the cold end temperature can be increased to compensate the excessive cooling in standby, it is often desirable to keep the standby condition close to nominal so that the CLs can be operated without significant delays. Therefore electrical heating at the warm terminals are provisioned to compensate the overcooling at standby condition. For the TF coil CL at 68kA, a heating power of 2-3 kW is estimated for each warm terminal (300 W in case of the CC coil CL). The warm terminals are designed to allow insertion of rod type cartridge heaters into the terminal body. In such conditions the heaters will stay at the room temperature.

Scope of work

The Figure 1 gives a functional picture of the heater chain. This chain is made of following components:

The heating function is implemented by heating cartridges (1). Heating cartridges are introduced into the CL terminal (9) and locked mechanically in that position. There may be several heating cartridges in one CL terminal. The heating cartridge is designed to provide thermal power by conduction to the CL terminal.

The heating cartridge (1) is electrically connected by a cable (2) to an interface block (4). The function of this interface block is to connect all the cartridge cables of a same CL terminal to a power supply cable (11). The heating cartridge is delivered with its cable already connected to and equipped with a connector/plug (3) for being easily replaced for maintenance. The interface block (4) is delivered with a power cable plug (5). There will be one interface block (4) to one and only one CL terminal (9). All the components referenced 1, 2, 3 and 4 are installed into a Dry-box (10). The interface block (4) is designed to sustain the HV coming from the CL terminals.

The power cable (11) is connected to a heating cartridge power supply (6) installed into a cubicle (12). There will be one power supply (6) connected to one and only one CL terminal (9). There may be several power supplies (6) within a cubicle (12). The power supplies (6) are supplied by a main supply power line (8) and are interfaced to the magnet control system (7).

The contract scope of supply for hardware components is made of items 1, 2, 3, 4, 5 and 6. The items 7, 8, 9, 10, 11 and 12 are NOT in the scope of this contract.

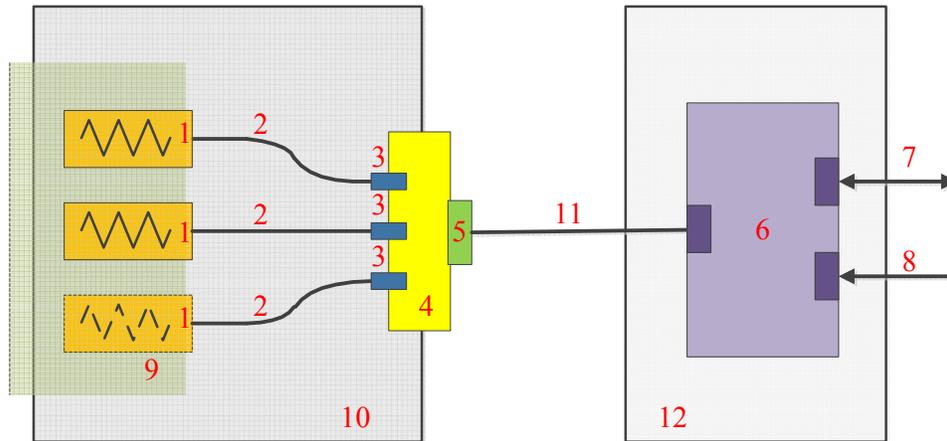


Figure 1 Whole heater loop from Heater to Power Supply

Heater

The Table 1 shows the required heaters for each usage. The heaters will supplied with extend wire and connector.

Type of Cartridge Heater	Dimension (*) [mm]		Max Power [W]	Insulation Strength (DC)	Quantity		Comments
	Ø	Length			Installation	spare	
Type 1	14	500	500	19kV	108	54	TF
Type 2	14	500	500	30kV	48	24	CS/PF
Type 3	14	250	500	4kV	48	24	CC

Table 1: Quantities for the different types of heaters

Interface block & Connectors

The interface blocks will be installed on the wall of the Drybox. One interface block shall be supplied for each CL terminal. Three different types of interface blocks will be needed. Each interface block will be supplied with panel type connectors. The Table 2 shows the required interface block for each usage.

Type of Cartridge Heater	Dimension (*) [mm]		Number of inside Connectors	Insulation Strength (DC)	Quantity		Comments
	H	L			Installation	spare	
Type 1	250	200	6	19kV	18	4	TF
Type 2	250	200	4	30kV	24	6	CS/PF
Type 3	200	100	2	4kV	12	3	CC

Table 2: Quantities for the different types of interface blocks

Power Supply or DC Rectifier with Protection unit

In order to supply the power to the electric heaters 4kW-230V DC electric power supply shall be included in the contract. In order to make it simple, all units have same technical specification to satisfy the highest power (for TF terminals). The required units are following

9(CL)× 2(terminals)	= 18 units for TF
12(CL)× 2(terminals)	= 24 units for CS/PF
12(CL)× 1(terminals sharing)	= 12 units for CC
Spare units	= 3 units

In order to get the isolation strength, the isolated transformer shall be installed with the PS units and together with the PS circuit itself shall be isolated from Ground with 30kV DC level. For reducing the space of power supply, the high frequency modulated carrier current can be applied to the transformer.

Qualification

For all qualification, all device shall pass the 56kV DC high voltage test.

Outline of Contract Implementation

The outline of contract implementation can be simplified with the main contractual milestones only. Alternatively the Contract may be divided in phases as for example below.

The overall procurement cycle is divided into 2 main phases:

-

Phase-I: Proto-type development

Preliminary Design

Preliminary Design test

Manufacturing Design

Proto-type manufacturing

Qualification Test

Phase-II: Series production

Manufacture

Factory Acceptance Testing (FAT)

Delivery to the ITER Site

Provisional Acceptance at the ITER Site

Testing at the ITER Site

Support to Testing

Final Acceptance at the ITER Site

The contents and requirements of each phase are detailed in the following sections.

Experience

The contractor and its personnel shall have adequate experience in CL terminal heater development and manufacturing.

Cartridge type Heaters and its Control

R&D in High Voltage insulation technology over 30kV DC

Design and Manufacture of High Voltage insulation over 30kV DC.

High Voltage test facility (Hipot Surge etc).

Design and Manufacture of Power supply.

Experience in HV insulations under vacuum would be an advantage.

Timetable

The tentative timetable is as follows:

Tender submission	July	2015
Tender Evaluation	August	2015
Contract placement	November	2015
Completion of Contract	November	2018

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 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 groupings shall be presented at the pre-qualification stage. The tenderer's composition cannot be modified without the approval of the ITER Organization after the pre-qualification.

Legal entities belonging to the same legal grouping are allowed to participate separately if they are able to demonstrate independent technical and financial capacities. Candidates (individual or consortium) must comply with the selection criteria. The IO reserves the right to disregard duplicated reference projects and may exclude such legal entities from the pre-qualification procedure.