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Technical Specifications (In-Cash Procurement)

HV cubicle and conditioners technical specification summary for the ITER Magnet system

Summary of specs for the CFN process for the in-cash procurement of the HV cubicle and conditioners required for the Magnet system

Magnet HV Cubicles and signal conditioners production and delivery

Summary of specifications for Call for Nomination

1 Purpose

This call for nomination is associated with the design, manufacturing and delivery to the ITER site of the High Voltage cubicles of the ITER Magnet system and the HV conditioners required for the Magnet quench detection system and the monitoring of the Current Lead temperatures.

2 Introduction

ITER is a joint international research and development project that aims to demonstrate the scientific and technical feasibility of fusion power. The partners in the project are the People´s Republic of China, the European Union, India, Japan, the Republic of Korea, the Russian Federation and the USA. ITER is being constructed at Cadarache in the South of France (for details see **www.iter.org**).

The ITER Magnets of are cooled by a forced flow of super-critical helium at a temperature of approximately 4 K. This helium is supplied to the magnets via cryolines grouped into 29 separate feeders. The feeders contain all the necessary valves and instrumentation to control and monitor the various helium gas flows, pressures and temperatures and the quench detection signals involved in the Magnet protection functions.

HV conditioners are required to interface the HV measurements signals coming from the Magnet system to the Magnet control system. These signals are voltage and temperature signals set to HV (30 kV DC) to the ground; the HV voltage conditioners are delivered as equipment fully integrated in ready to install cubicles so called HV cubicles; the HV temperature conditioners are delivered as separate components.

As part of the Magnet quench detection system, the HV voltage conditioners are critical components of the Magnet primary protection. A particular care shall be paid to the quality of the design, the quality control at manufacture and the factory acceptance tests.

The HV cubicle contract scope includes the design, qualification, manufacture and testing of the HV voltage conditioners; the design, qualification, manufacture and testing of the HV temperature conditioners and the design, qualification and testing of the HV cubicles. The ITER on site assembly and commissioning of these components are out of scope of this contract.

All these HV cubicles are installed in protected area and therefore are not exposed to any specific environmental constraints. Standard industrial environmental requirements apply only.

A total of 45 HV cubicles, 800 HV voltage conditioners and 280 HV temperature conditioners shall be produced and supplied from this contract

Figure 1: Illustration of a HV cubicle

2.1 Introduction to the HV voltage conditioners

A functional diagram of the primary Quench Detection System (QDS) of the Magnet systems is shown in the Figure 2-2. The purpose of the HV voltage conditioner is to collect the HV voltage measurements and transmit them as voltage data to the QDS.

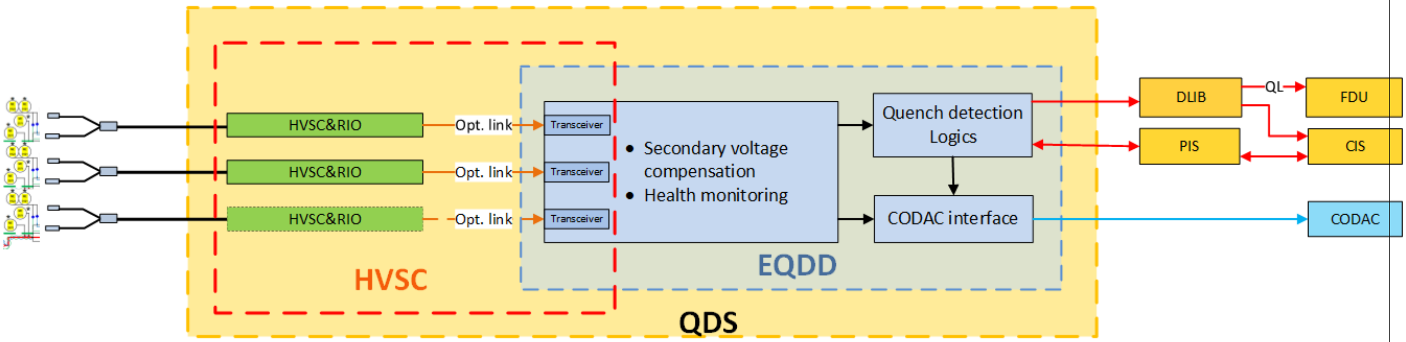

Figure 2-2: Functional diagram of the primary Quench Detection System

A functional diagram of the HV conditioners is shown in the Figure 2-3. The HVSC&RIO is made of a linear chain of analogue front end, digitizer and optical transmitter components.

- ✓ The analogue front end purpose is to connect physically the HV cables, to get the signal range suited to what is acceptable by the digitizer, to filter the signal high frequency noise and to monitor the signal loop continuity.
- ✓ The digitizer (ADC) purpose is to sample and digitize the analogue voltage signals as provided by the analogue front end.
- ✓ The optical transmitter transmits optically the digitizer data to a data receiver interfaced to the QDS controller (EQDD).

The HV conditioner is operated at high voltage and then shall be powered by a power supply voltage insulated to the ground at the proper voltage level. This power supply is protected against over current in case of loss of voltage insulation at its level.

The HV signal loop shall be protected at the level of the HV voltage conditioner input against any over current coming from any HV signal conditioner internal fault.

In addition to these functionalities the HV voltage conditioner implements some health monitoring on the HV signals, on its own internal functions and provides the QDS controller with the appropriate health monitoring data.

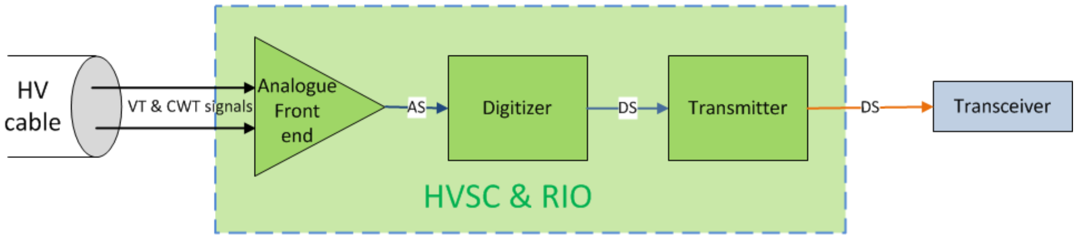

Figure 2-3: Functional diagram of the HV conditioner

A total a 10 different types of HV voltage conditioners shall be designed and manufactured in scope of this contract. A HV conditioner type is defined regarding the number of signal channels connected (up to 6 channels) and the voltage measurement configuration and range (up to +-1300 V in differential mode). The voltage measurement resolution is 24 bits allowing a signal accuracy better than 2 mV with a sampling rate above 500 Hz.

The transceiver shown on the Figure 2-3 is part of the design and delivery. The optical cable between the transmitter and transceiver is out of this contract scope. The transceiver provides the voltage and status data to a National Instrument cRIO chassis through an RS422 electrical link; the cRIO chassis is not part of the contract delivery but the qualification tests of this RS422 link is part of the contract.

HV cables are connected to the HV conditioner signal front end through a HV cable splicing box installed in the HV cubicles. The design, manufacture and cubicle installation of the HV cable splicing boxes is part of the contract scope. The HV cables are not part of this contract but the technical specifications of these cables shall drive the design of the HV cable splicing boxes.

The HV voltage conditioners and HV cable splicing boxes shall be designed to handle signals set to 30 kV DC nominal to the ground.

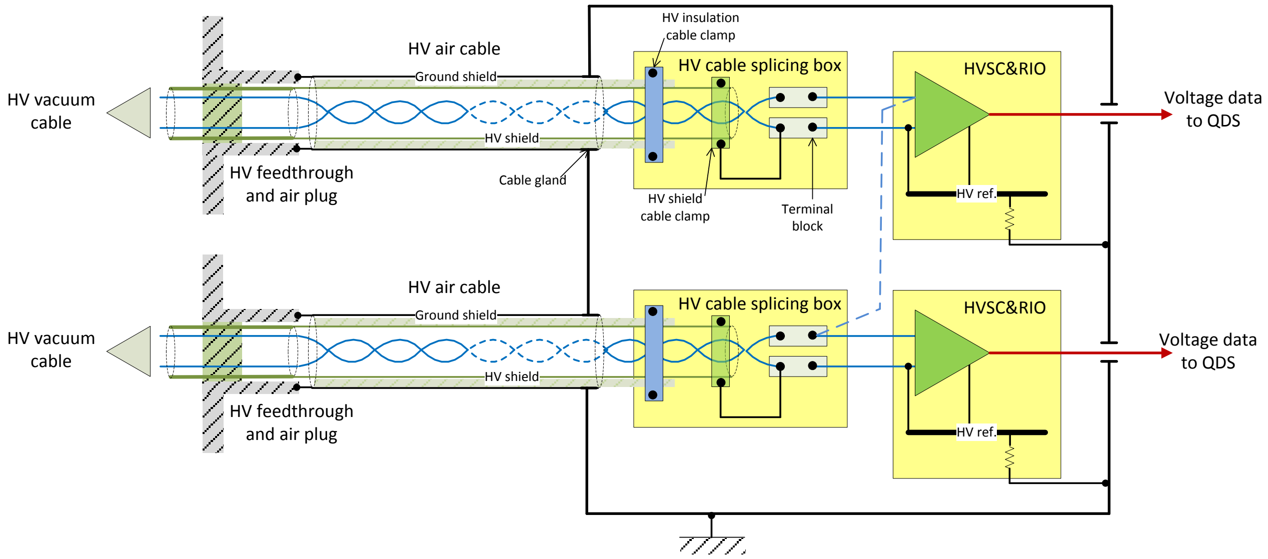

Figure 2-4: HV cable splice at HV conditioner signal input

2.2 Introduction to the HV temperature conditioners

The HV T conditioner device is made of an analogue signal conditioner designed to handle PT100 temperature signals. The HV T conditioner is set to the HV (30 kV DC); an optical data transmitter and receiver is part of the HV temperature conditioner to publish the temperature signal as 4-20 mA signals to an industrial controller.

The HV T conditioner is operated at high voltage and then shall be supplied through a ground insulated power supply channel. The optical transmission of the electrical power is the option to be selected by the contractor.

In addition to the functionalities mentioned above the HV temperature conditioner implements some health monitoring on the temperature sensor signals and its own internal functions

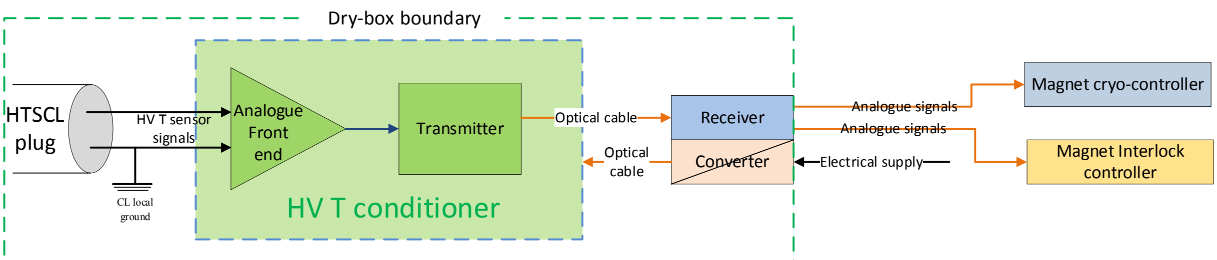

Figure 2-5: Functional diagrams of the HV temperature conditioner.

2.3 Design background

Already fully qualified prototypes of the HV voltage conditioners and HV temperature conditioners have been designed, manufactured and fully qualified through R&D contracts placed by IO. The contract technical specifications will reflect the outputs of the R&D already performed on these components reducing in the meantime the risk to the contractor.

3 Scope of work

The contract scope of work is made of the following steps:

3.1 HV voltage and temperature conditioner and HV cable splicing box design

From the HV conditioner specifications, the contractor shall produce a design of the HV voltage conditioners for each type of conditioners (10); a design of the HV temperature conditioners (one type only) and a design of the HV cable splicing box. The design materials of each shall be approved by IO before moving to the next step.

3.2 HV voltage and temperature conditioner and HV cable splicing box prototyping

From the HV conditioner and HV cable splicing box design material, the contractor shall manufacture and qualify a prototype of one type of the HV voltage conditioners out of the 10 types, a prototype of the HV temperature conditioner and a prototype of the HV cable splicing box. The qualification tests of each shall be successful for moving to the next step.

3.3 HV voltage and temperature conditioner and HV cable splicing box First of Series

From the HV conditioners and HV cable splicing box design material and the outcomes of the prototyping phase, the contractor shall produce the manufacture design materials including a Manufacture and Inspection Plan (MIP) and proceed to the First of Series production for each of the HV voltage conditioner types, the HV temperature conditioner and the HV cable splicing box. The first of series production samples shall be qualified successfully before moving to the series production.

3.4 HV voltage and temperature conditioner and HV cable splicing box Series

Each of the HV conditioners and HV cable splicing box is tested individually at Series production. The MIP reports and test reports are issued and delivered to IO for each of the manufactured items.

3.5 HV cubicle design

From the HV conditioner and HV cable splicing box design materials and the HV cubicle specifications, the contractor shall produce the HV cubicle design materials including a layout for each of the cubicles delivered from this contract and a MIP. IO shall approve the cubicle layouts and MIP before moving to the cubicle series production.

3.6 HV cubicle series production

The cubicle series production is the integration and internal cabling of the HV voltage conditioners and HV cable splicing boxes in a cubicle enclosure. The cubicle enclosure product is selected by IO from IO standards. Each cubicle is tested to HV. The HV voltage conditioners are individually tested again at this step for functionalities and noise rejection while operated to HV. The MIP reports and test reports are issued and delivered to IO for each of the manufactured cubicles.

3.7 HV Cubicle and HV temperature conditioner deliveries

After successful testing of the cubicles and HV temperature conditioners the cubicles shall be shipped by the supplier to IO with the proper packing.

4 Tentative time table

A tentative timetable is as follows:

Call for nomination	November 2020
Pre-qualification	January 2021
Call for tender	March 2021
Tender submissions	May-June 2021
Contract awarding	July-August 2021

5 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 which are:

- European Union including Switzerland (EURATOM Members),
- Republic of India,
- Japan,
- People's Republic of China,
- Republic of Korea,
- Russian Federation, or
- United States of America.

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.

In the event of a consortium, a draft of the Consortium Agreement, or letter of intent and Power of Attorney signed by all the consortium members shall be submitted together with the tender.

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 form the tender procedure.

On 31 January 2020, the UK left the EU and Euratom with a transition period from 1st February to 31 December 2020 to be used to determine the conditions of their future relationship. Euratom is the ITER Member and the withdrawal of the UK from Euratom leads to the fact that UK is not anymore party to the ITER project.

Until the 31 December 2020, current end date of the transition period, UK entities retain the right to participate in IO procurement procedures.

More information on ITER Organization Procurement process can be found at: https://www.iter.org/proc/generalinfo

6 Experience and key competencies

The Candidates will need to demonstrate that they have the capabilities to successfully perform the entire scope of work mentioned above and in particular:

- ✓ Strong experience HV insulated electronics for signal handling.
- ✓ Strong experience in instrumentation signal handling and EMC.
- ✓ Strong experience in optical data transmission.
- ✓ Strong experience in control cubicle design, manufacture and tests.
- ✓ Experience in electronics design and manufacture exposed to Magnetic field.
- ✓ Experience in investment protection systems based on voltage measurements and inductive voltage compensation.
- ✓ Capability to produce electrical and electronic equipment compliant to EU Directives.

7 QA requirements

The organization conducting these activities should have an ITER approved QA Program or an ISO 9001 accredited quality system.

Prior to the commencement of the task, a Quality Plan must be submitted for IO approval giving evidence of the accredited quality system and describing the organization of 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.

Prior to commencement of any manufacturing, a Manufacturing Inspection Plan (MIP) must be approved by ITER who will mark up any planned interventions.

8 Safety

There is no Safety component in the scope of this contract.

9 Applicable document and references

Applicable Documents

[1] Electrical Design Handbook (EDH Part 1: Introduction (ITER_D_2F7HD2))

[2] Requirements for Preparing and Implementing a Manufacturing and Inspection Plan (ITER_D_22MDZD)

[3] Procedure on procurement documentation exchange between IO, DAs and contractors (35BVQR)

[4] ITER Procurement Quality Requirements (ITER_D_22MFG4)

Reference Documents

[5] DDD11-9: Instrumentation (2F2B53)

[6] DDD11-10: Magnet Controls (JF2N9W)

10 Definitions

BOM	Bill of Material
CAD	Computer Aided Design
CMM	Configuration Management Model
DDD	Design Description Document
EQDD	Electronic Quench Detection Device
FO	Fibre Optic
HP	Hold Point
HV	High Voltage
HW	Hardware
IDM	ITER Document Management
IO	ITER Organization
ISO	International Organization for Standardization
I&C	Instrumentation and Control
KOM	Kick Off Meeting
MIP	Manufacturing and Inspection Plan
MQP	Management and Quality Program
NA	Non Applicable
NCR	Non Conformity Report
NI	National Instrument
NP	Notification Point
PBS	Plant Breakdown Structure
PRM	Contract Progress Meeting
QA	Quality Assurance
QCR	Quality Control Review
QP	Quality Plan
RO	Responsible Officer
R&D	Research and Development