Scope of Supply & Works, Technical Specifications for IC HVPS

GeM Bid No.	**GEM/2025/B/6267679**
Title	**Part A(II-2): Scope of Supply & Works, Technical Specifications for IC HVPS**

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Acronyms & Abbreviations

AC	: Alternating Current
CCWS	: Component Cooling Water System
DC	: Direct Current
IC	: Ion Cyclotron
FDR	: Final Design Review
H&CD	: Heating and Current Drive
HVAC	: Heating, Ventilation and Air Conditioning
HVPS	: High Voltage Power Supply
II Lab	: ITER-India Lab
IEC	: International Electro-technical Commission
IO	: ITER Organization
IPR	: Institute for Plasma Research
PPEN	: Power Pulsed Electrical Network
PS	: Power Supply
PSM	: Pulse Step Modulation
QA	: Quality Assurance
RF	: Radio Frequency
SSEN	: Steady State Electrical Network

1 Introduction

The Ion Cyclotron Heating and Current Drive system (IC H & CD) shall provide radio-frequency (RF) power to ITER plasma for Heating and Current Drive. A total of 20 MW of RF power shall be injected into the plasma. The IC H&CD system is composed of the antenna port plugs, the matching systems, the transmission lines, the RF power sources, the high voltage power supply (HVPS), plus auxiliary sub-systems and services such as decoupling units, control systems and test facilities.

The full HVPS system supplies electrical power to the 9 IC RF Sources, requires 18 Nos. of HVPS referred to as IC HVPS. The IC HVPS system draws the required power from the ITER 22kV pulsed power electrical network (PPEN). High voltage power supply is used to bias vacuum tubes (i.e. Diacrode/Tetrode), shall generate a RF Power for Plasma Heating.

Present inquiry describes the scope, roles and responsibility for detail design, manufacturing, component testing, supply, installation and acceptance testing of 8 numbers of PSM based MW level IC HVPSs. Following annexures to the present document details specific requirements as mentioned below:		
Annexure-A	*Management Specifications*	*Including Legal regulatory requirements, accepted sound project management practices, safety and QA requirements*
Annexure-B	*Technical Specifications*	*Including Design, testing and interfaces*
Annexure-C	*Quality and site specification*	*Including Quality & site specifications*

2 Extent of Supply

The scope of work for providing the IC HVPS foresees supply of the following components:

	Rating	**Quantity**
IC HVPS*	Dual Output (1) 8-14 kV, 250 kW (2) 12-27 kV, 2.8 MW	8 Nos. viz. Unit 1 to 8

*Inclusive of

1. HV Cables (AC)
2. Multi Secondary Transformers
3. LV Cables (AC)
4. SPS Modules (with soft charging)
5. HV Cabinets
6. Output DC Filter
7. DC Co-axial Cable
8. DC Disconnector / Earthing Switch
9. Equipment Control Cubicles (Inclusive of monitoring and protection equipment)
10. Instrumentation, hydraulic circuit, relay blocks for transformer protection, associated cable works, etc. shall be the integral part of the IC HVPS

Also includes for the complete lot of IC HVPSs is Dummy Load, short circuiting device for testing purpose, spare parts covering 24 months operational life, any specific handling tool, test zigs.

If needed some of the components may be sourced from local supply at site, such provisions/arrangements to be identified during manufacturing design.

In addition to the supply of the above mentioned items, the scope of work shall also include activities consisting of (in consultation with ITER-India);

- Detailed design, justification and manufacturing design approval
- Preparation of the procedure specifications for tests and inspections
- Preparation of procurement specifications for IC HVPS components and execution, as part of the sub contracted activities
- Management of sub contracts if any
- Supervision of the Sub Suppliers during all the phases of design, manufacture, and testing
- Production of the Technical and Quality Documentation required at various gate review defined by ITER-India.
- Supervision of Installation, site testing of the component objects of the contract, following approved procedure specification for assembly and tests
- Acceptance test of the IC HVPS, in accordance with approved procedures.

All the components shall be designed, manufactured and tested according to the applicable standard and Quality System.

The main boundaries between the IC HVPS and the PURCHASER's SITE- ITER Organization (IO), France are summarized below. This list indicates the equipment are not included in the Contract and are provided at PURCHASER's SITE:

- The infrastructures needed to accommodate the IC HVPSs device. This includes all civil works in addition to the buildings where the IC HVPS system and the relevant control systems will be located and more in general for every civil work needed for proper installation of the electric devices.
- The 22 kV AC distribution
- The 400V AC distribution, both normal and uninterruptible
- Grounding Grid (buildings)
- Compressed air distribution system;
- The IC H & CD Plant control system
- The cooling water system and HVAC
- Fire protection, detection and intervention systems
- Utilities during installation, commissioning and testing
- Access control to RF building, Cable Trays including for Medium voltage cables & Output Coaxial cables.

A dedicated 22kV feeder facility and other interfaces to simulate actual site conditions (as PURCHASER's SITE - ITER Organization, France) is established at ITER-India lab, Gandhinagar to demonstrate assembly/integration, performance specifications of various ITER supplies before the equipment is dispatched to PURCHASER's SITEs.

3 Scope of Work

The scope of work includes detail design, manufacturing, component testing, supply, installation and acceptance testing of 8 nos. of IC High Voltage Power Supplies (IC HVPSs) at PURCHASER's SITE - ITER Organization, France according to the terms and conditions and specifications defined in the inquiry. Contractor/supplier owes the full responsibility for the performance of the IC HVPSs complying to the Technical Specifications as outlined in Table 1-1 of HVPS Tender Part A (II-2) - Annexure B : Technical Specifications for IC HVPS.

Roles and responsibility under the contract shall be followed as:

- ✓ Design & manufacturing
  - Contractor/supplier to perform detailed design, manufacturing, factory testing of 8 nos. of IC HVPS.

- ✓ Supply
  - Contractor/supplier to offer 8 nos. of IC HVPSs complete in all aspects with export sea worthy packaging and required documentation.
  - Contractor/supplier to deliver IC HVPS on FCA [supplier's site]
  - *ITER-India to assume transportation from supplier's site & unloading at PURCHASER's SITE - ITER Organization, France.*

- ✓ Installation and acceptance testing at PURCHASER's SITE
  - Contractor/supplier shall provide prescription for equipment storage & preservation, Site preparation, Installation of various equipment, standalone testing, integrated testing
  - *ITER-India to engage service provider to support the services required for site preparation, installation, standalone testing, integrated testing of IC HVPSs in compliance with IO safety norms.*
  - Contractor/supplier shall remain responsible for fulfilment of Health, Safety and Environment (HSE) requirements, to ensure that installation is performed in line with the requirements of the IC HVPS at PURCHASER's SITE - ITER Organization, France.
  - Contractor/supplier shall remain responsible for standalone testing of the equipment, integrated testing and final acceptance of IC HVPSs at PURCHASER's SITE on Dummy load.

However, if the CONTRACTOR/SUPPLIER anticipates constraints in conducting the Factory test due to interface requirements, under the responsibility of Contractor/supplier, Unit 1 of IC HVPS shall be assembled and tested at ITER-India Lab (II Lab), Gandhinagar on the resistive load in a simulated environment of actual site. The test of first IC HVPS at II LAB shall be considered as ***extension of factory acceptance test (Extended FAT).*** CONTRACTOR/SUPPLIER remains responsible for supervision of works including the availability of OEMs if needed during installation and standalone testing of Transformers and SPS modules-The terms for utilizing the ITER-India facility shall be agreed upon.

After successful Factory Acceptance Test, IC HVPS Unit-1 shall be transferred to ITER-India lab, Gandhinagar. CONTRACTOR/SUPPLIER shall provide the prescription for equipment storage &

preservation, site preparation, installation of various equipment, standalone testing and integrated testing. The Power supply shall be demonstrated for installation, assembly/integration and operations perspective as per the prescription at ITER-India lab.

For the purposes of demonstration at ITER-India lab, Gandhinagar, complete scope of works including transportation, installation, assembly/integration, standalone testing and integrated testing shall be the responsibility of CONTRACTOR/SUPPLIER. After the successful demonstration, the CONTRACTOR/SUPPLIER shall dismantle, repack and transfer this unit back to Supplier's site and refurbish as required.

Components of all units of IC HVPS shall be consolidated at Supplier's site from where all IC HVPSs to be dispatched to PRUCHASER's SITE.

Contractor/supplier shall confirm along with the offer that work should be performed in accordance with the statutory and legal requirements associated with ITER-India and PRUCHASER's SITE.

4 Interface Boundaries

Contractor/supplier will be responsible for interfacing the IC HVPS with the following systems made available at PRUCHASER's SITEs:

- Building and respective facilities
- 22 kV PPEN network
- 400 V/230 V SSEN auxiliary supply
- Grounding system
- The component cooling water system (CCWS) and HVAC
- IC Plant system controller
- IC RF sources for interface functions
- Cable Trays including for MV and DC Cables

5 Technical Specifications

IC HVPS ratings are summarized in Table 1. However, the contractor shall consider the detailed specifications as mentioned in the of HVPS Tender Part A (II-2) - Annexure B : Technical Specifications for IC HVPS

Table 1: IC HVPS Ratings

Power Supply	Rating	Reference section
IC HVPS	Dual Output (1) 8-14 kV, 250 kW (2) 12-27 kV, 2800 kW	Tender Part A (II-2) - Annexure B : Technical Specifications for IC HVPS

6 Spares/Accessories

During the detailed design stage, list of spares to be proposed covering 24 months of equipment operational life. These spare parts can be used during warranty period to ensure a high availability by a faster repair of the equipment. Typically the spares should include SPS modules, signal conditioning cards, controller

spare parts, fan modules, cables (HV, LV and fibre), transformer spare parts, cooling hoses, measurement devices and other accessories relevant to each equipment. Detail list to be updated based upon failure analysis and maintenance requirements.

7 Acceptance tests

Equipment supplied by the Contractor/supplier/sub-vendor shall conform to specified requirements and applicable IEC standards.

IC HVPSs shall have component testing as well as test on complete assembled IC HVPS unit/s.

It is assumed that IC HVPS units will utilized identical components/equipment, in this case the Factory acceptance test will be performed on the first unit of completely assembled IC HVPS. For the remaining IC HVPSs component testing is acceptable.

7.1 Component Testing

For COTS item, Manufacturer's Test Certificate (TC) will be the acceptable document.

The non-COTS components, viz. Multi-Secondary Transformer, SPS Modules, and dummy load will be inspected at various manufacturing stages at manufacturer's site based on detailed manufacturing and inspection plan (MIP).

These tests will include, Routine, type and special tests prescribed by the relevant IEC Recommendations. In particular, IEC 60076-11 and IEC 61378-1 specify the test for the transformers; IEC 60146 series specifies the test for the converters. Type test conducted on the components should comply with the validity requirements set by authorized body

7.2 IC HVPS Factory Acceptance Test (FAT/Extended FAT)

The Factory test will be performed on assembled Unit of IC HVPS at supplier's site. Test Procedure to be prepared by the Contractor/supplier and approved by ITER-India before starting the tests. The acceptance tests shall demonstrate that the performance specifications are met.

The acceptance tests shall include:

- End to End Interface checks
- Voltage to Ground Withstand Test
- Functional tests under IC HVPS controller to verify the performance specifications on Dummy Load.
- Wire Burn Test
- Shut Down & Restart Test

Integrated Factory acceptance will be effective upon successful testing as above and delivery of all relevant documentation.

More detailed prescription for these tests are specified in the 5.1 of *HVPS Tender Part A(II-2) – Annexure B: Technical Specifications for IC HVPS*

However, if the CONTRACTOR/SUPPLIER anticipates constraints in conducting the Factory test due to interface requirements, under the responsibility of CONTRACTOR/SUPPLIER, the IC HVPS unit 1 shall be assembled and tested at ITER-India Lab, Gandhinagar on the dummy load. The test of Unit 1 at ITER-India Lab shall be considered as ***extension of factory acceptance test (Extended FAT)***. The first unit once installed and tested with ***dummy*** load at ITER-India Lab, shall be dismantled, refurbished as required, repacked and transported to Supplier's site.

7.3 Assembly/Integration demonstration of Unit-1

After successful Factory Acceptance Test, IC HVPS unit-1 shall be transferred to ITER-India lab, Gandhinagar. CONTRACTOR/SUPPLIER shall provide the prescription for equipment storage & preservation, site preparation, installation of various equipment, standalone testing and integrated testing. The Power supply shall be demonstrated for installation, assembly/integration and operations perspective as per the prescription at ITER-India lab.

Assembly/Integration demonstration shall be complete upon successful testing and delivery of all relevant documentations as above.

More detailed prescription for these tests are specified in the section 5.2 of *HVPS Tender Part A(II-2) – Annexure B: Technical Specifications for IC HVPS.*

8 Document deliverables

A project review gate is a decision point at the end of each phase where a formal review or phase review gate is held to determine the success of the last phase. The purpose of each review is to evaluate the design against its requirements in order to verify that the system is being built correctly and that the right system is being built. A successful review will establish the baselines and solidify the design. Phase review gates directly corresponded to the end of each phase they are linked to.

Contractor/supplier has to produce necessary documents as per agreed input data package (to be provided later) for review & approval during the following gate reviews;

1) Final Design Review (FDR)
2) Manufacturing Readiness Review (MRR)
3) Delivery Readiness Review (DRR)
4) Construction Readiness Review (CRR)
5) Construction Completion Review (CCR)

8.1 Documents considered during Final Design Review.

Following is the tentative non-exhaustive list of documents;

- Design Report including electrical & seismic analysis.
- RAMI analysis report.
- I&C analysis and design report as defined in the Plant Control Design Handbook.
- Electrical Single Line Diagram (SLD), Process Flow Diagram (PFD), Process and Instrumentation Diagram (P&ID).
- Factory and Site Test Plan.
- Spare parts and storage requirements.
- Installation and Assembly procedure.
- CAD exchange according to DCIF.
- Design Change Requests and Non-Conformity / Deviation Reports if any

8.2 Documents to be submitted for Manufacturing Readiness Review (MRR)

Manufacturing Readiness Review is a set of verification activities to be performed before the start of manufacturing activities in order to assure that required activities are adequately and ready to be effectively performed according to approved documents and the relevant technical criteria of the components to be manufactured are specified in the documents.

Following is the tentative non exhaustive list of documents;

- Quality plan
- I&C deliverables (I&C related updates if any)_
- Manufacturing and Inspection Plan
- Factory test procedure
- Site Acceptance plan and procedure
- Specifications for Handling and Transportation
- Final Site Installation Plan
- Final Site Commissioning Plan
- Final spare parts list and storage requirements
- Revised CAD exchange
- Manufacturing and Inspection Plans

8.3 Documents to be submitted for Delivery Readiness Review (DRR)

This gate review process is to ensure the required and relevant documentation and data has been provided in accordance with the contractual requirements and associated procedures; such as having a unique identifier for each item-type, matching part numbers on goods and packing list, preservation & storage requirements, that the Delivery Report and Contractor Release Note (with manufacturing dossier) are reviewed and approved, etc. Furthermore, the part numbers physically on the goods and the packing list also need to match the as-designed and as-manufactured BOMs (Bill of Materials). Detailed agreed list to be exchanged later.

8.4 Documents to be submitted for Construction Readiness Review (CRR)

CRR is a key step to verify that all the conditions are satisfied to execute a related scope of construction on purchaser's site. Accordingly, the CRR constitutes a "Hold Point" that must be satisfactorily completed prior to instruct the works contractor to be mobilized on PURCHASER's SITE- ITER Organization (IO), France and to start construction execution. This stage shall establish if engineering is consistent with the Baseline & sufficiently mature for construction preparation against a confirmed scope and shall identify any issues related to material availability (e.g. delivery date delay, material non-compliance, etc.) and work site conditions (e.g. access difficulties, co-activity, etc.) which may impact the commencement / execution of the works.

Following is the tentative non-exhaustive list of documents;

- Draft instruction manual on the installation, assembly and operation procedures

8.5 Documentation to be submitted for Construction Completion Review (CCR)

Following is the tentative non-exhaustive list of documents;

- Operation and maintenance manuals
- Site acceptance test report
- Final design report
- Final instruction manual on the installation, assembly and operation procedures

The final documentation shall include all the documentation described as above, covering both the "as built" configurations and all the revisions performed during the installation, the tests and the commissioning.

The documentation shall be provided in English language in electronic version. The electronic version shall be based on standard formats, as Microsoft Word, Excel, PowerPoint, Portable Document Format (PDF) and CATIA models/drawings.

9 Warranty

Contractor/supplier shall provide a standard commercial warranty on each unit of IC HVPS for the scope of supply covering repair or replacement up to 33 months after delivery at FCA supplier's site or up to 24 months after Final Acceptance at PURCHASER's SITE, whichever event occurs earlier.

10 Delivery period

Required delivery period is mentioned in table below,

Table 2: Delivery milestones

Important milestones	Expected Duration
Contract Award	T0
Kick Off meeting	T1= T0 + 1 month
Detailed Design Review	T2= T1 + 3 months
Manufacturing Readiness Review start	T3= T2 + 3 months
Manufacturing Readiness Review complete	T4= T2 + 5 months
Manufacturing & Component level Testing of 5 Units IC HVPSs	T5= T4 + 24 months
Factory test of Unit-1 with Dummy load	T6= T5 + 4 months
Assembly/integration demonstration of Unit-1 at ITER-India lab, Gandhinagar	T7= T6 + 6 months
Delivery Readiness Review (DRR) and its closure	T8= T6 + 3 months
Start of Delivery of IC HVPS Units	T9= T8 + 3 months
Manufacturing & Component level Testing of remaining units of IC HVPSs (including DRR)	T10= T5 +19 months
Completion of Delivery of 8 IC HVPS Units	T11= T10 + 3 months

10.1 Consolidation of Supplies

Components of IC HVPSs, all 8 units must be consolidated under the responsibility of Contractor/supplier (at supplier's site) to enable ITER-India to organise the logistics related to transport to PURCHASER's SITE. The equipment must be offered with export sea worthy packing, documentation including declarations. IC HVPS components must be stored in a controlled indoor environment as specified below.

- Clean and dry location free from direct sunlight and corrosive fumes.
- Ambient temperature range of -20 °C to 35 °C
- Relative humidity < 90% and non-condensing
- Area with rapid changes in temperature must be avoided and equipment not to be placed directly on the ground.
- The site should be spacious enough to accommodate handling tools
- Stored components must be adequately insured.

11 Contractor release/DRR

Contractor Release note (CRN) will be effective upon successful testing as per section 7.1, 7.2, 7.3 and availability of agreed number of IC HVPS units complete in all aspects. Contractor Release Note shall be prepared based upon successful review and approval of all relevant documentation. DRR (as per section 8.3) shall be performed and deliveries in multiple batches is also envisaged depending upon the availability of site, logistics, and resources for the complete scope. Having CRN/DRR does not relieve CONTRACTOR/SUPPLIER from the obligations under the Contract.

12 Packing and Transport requirements

Details related to packing & transport, refer section 7 of Tender Part A(II-2), Annexure – C.

13 Site Installation and Testing period

Site Installation at Purchaser's site shall begin typically 6 months after the delivery, includes possibility of early start. Complete duration of Site installation and Acceptance test for all IC HVPS units is considered as 14 months.

Table 3: Site Installation key milestone

Important milestones	Expected Duration
Start Delivery of IC HVPS units to PURCHASER's SITE - ITER Organization, France *(to be organized by ITER-India)*	T0
Finish Delivery of IC HVPS units to PURCHASER's SITE - ITER Organization, France *(to be organized by ITER-India)*	T1= T0 + 12 months
Start Installation and acceptance test of IC HVPS units at PURCHASER's SITE - ITER Organization, France in Sequence	T2= T0 + 6 months
Completion of Installation and acceptance test of IC HVPS units at PURCHASER's SITE - ITER Organization, France in Sequence	T3= T2 + 14 months
Final documentation approval	T4=T3 + 3 months

14 Acceptance at Purchaser's site

IC HVPS shall be installed and commissioned at the PURCHASER's SITE - ITER Organization, France. The tests will be done according to the Site Test Procedure to be prepared by the Contractor/supplier and approved by ITER-India before starting the tests. The acceptance tests shall demonstrate that the performance specifications are met.

The acceptance tests shall include:

- End to End Interface checks
- Voltage to Ground Withstand Test
- Functional tests under IC HVPS controller to verify the performance specifications on Dummy Load.
- Wire Burn Test

Final acceptance will be effective upon successful testing as above on Dummy Load and delivery of all relevant documentation.

More detailed prescription for these tests are specified in the Section 5.4 of HVPS Tender Part A(II-2): Annexure-B Technical Specifications for IC HVPS Annexure-B

15 Maintenance Support

After delivery/final acceptance, if it is deemed necessary Contractor/supplier should be able to provide maintenance support directly or indirectly. A separate arrangement shall be agreed for this purpose.

16 Training

Contractor/supplier shall provide training for the working staff concerning the operation, maintenance and troubleshooting of the systems in the Procurement.
The training shall be realized in four forms:

1. Preparation of an "Operation and Maintenance Manual" adequate to allow the on-site technical staff to get a good understanding of the equipment, of its operating modes and of the procedures to carry out settings and checks of protections, control loops, maintenance interventions, etc.
2. Informal instruction during the execution of the Contract, especially during the factory and site testing and commissioning. When the ITER-India or its representatives are present, they will be allowed to ask a reasonable number of questions and to seek clarifications without unduly delaying the activities.
3. A formal presentation to the on-site technical staff lasting up to 2 days. Contractor/supplier shall give the presentation, unless differently agreed.

Contractor/supplier shall be available to provide additional training, at additional expenses, if requested within one year from the acceptance of the system.

17 Reference documents

References appearing in Annexures can be found in zip folder on ITER-India website as per below link under Public/Global Tender Category.

https://www.iterindia.in/tenders

Part A(II-2), Annexure A: Management Specifications for IC HVPS

GeM Bid No.	**GEM/2025/B/6267679**
Title	**Part A(II-2), Annexure A: Management Specifications for IC HVPS**

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Acronyms & Abbreviations

CE	: Conformité Européenne, meaning "European Conformity"
EC	: Electron Cyclotron
FDR	: Final Design Review
HP	: Hold Point
HVPS	: High Voltage Power Supply
IO	: ITER Organization
IC HVPS	: Ion Cyclotron High Voltage Power Supply
MIP	: Manufacturing and Inspection Plan
NP	: Notification Point
PS	: Power Supply
QA	: Quality Assurance
QP	: Quality Plan

1 Introduction

This document defines the management specifications in order to comply with the legal regulatory requirements, accepted sound project management practices, safety and ITER-India QA requirements for the manufacturing, testing and supply of IC High Voltage Power Supplies (IC HVPS).

2 Planning and Scheduling

Contractor/supplier shall prepare detailed manufacturing and delivery schedule on Primavera and shall submit monthly schedule progress updates. Contractor/supplier can use other planning and scheduling software after the written approval of ITER INDIA.

3 Procurement Execution

The scope of work includes detail design, manufacturing, component testing, supply, installation and acceptance testing of 8 nos. of Ion Cyclotron High Voltage Power Supplies (IC HVPSs), each rated for (27 kV DC, 3050 kW at PURCHASER's SITE - ITER Organization, Frances).

This contract shall be executed in three phases:

- **Phase I: Engineering Work and pre-manufacture Phase;** This phase comprises the Design (detail & manufacturing design) and Call for Tender and Contract Award of sub supplier for the IC HVPS components
- **Phase II: Manufacturing, factory acceptance, Assembly/Integration demonstration at ITER-India Lab, and Consolidation of the Items;** This phase comprises the manufacture of the IC HVPS components, and factory acceptance. First IC HVPS unit shall be demonstrated for installation, assembly/integration and operations perspective at ITER-India lab. The first unit once demonstrated at ITER-India Lab, shall be dismantled, refurbished as required, packed and transported back to SUPPLIER's SITE. Components for the other seven IC HVPS shall be consolidated at SUPPLIER's SITE from where all IC HVPSs to be dispatched to PURCHASER's SITE.
- **Phase III: Installation and Final Acceptance Tests of the Items;** This phase comprises the installation and final acceptance test of 8 IC HVPSs units on dummy load at IO, France.

4 Procurement Process

The procurement responsibilities for all the IC HVPSs components shall be undertaken by Contractor/supplier. Contractor/supplier shall procure the major components (Multi-secondary transformers, SPS modules) through OEMs by standard methodology with following phases.

- **Phase 1 – Tender notice and issue of tender document:**
  Interested suppliers, who meet the eligibility criteria[1] given in the Tender notice, shall be issued the tender document.

- **Phase 2 - Pre-Bid meeting:**
  During this phase, Contractor/ITER-INDIA shall explain the overall scope of work, schedule requirements and any technical queries. All the parties are allowed to put up their questions/clarifications. This meeting shall clarify the scope of works and address technical issues.

[1] *Eligibility Criteria for procurement of Multi-secondary transformers and SPS modules are detailed in Section 7 of* 'ITER_D_ 9AYQNM - IC HVPS Procurement Description Document

Following this meeting suppliers can submit their bid in the specified format.

- **Phase 3 - Bid evaluation and contract award:**
  Bid evaluation and contract award to technically acceptable lowest supplier. Contractor/ITER-INDIA reserves the right to award or cancel the contract in case of single bid.

  Contractor/supplier shall provide ITER-INDIA with an advance notification of 15 (fifteen) calendar days prior to evaluation meetings in order to give the ITER-INDIA the opportunity to participate in an advisory role in such meetings.

ITER-INDIA reserves the right to observe and advise in the procurement tendering process used under the contract. However, the parties shall mutually agree on the contents of the procurement tendering process which shall be placed for ITER-INDIA's advice before the Call of Tender.

5 Monitoring, Evaluation and Verification

Figure 1 shows major activities and milestones with corresponding Notification Points and Hold Points. A Notification Point (NP) is a milestone where Contractor/supplier is required to notify ITER INDIA that it has completed a specific task or a specific deliverable and is proceeding to the next task or to the next action on the specific deliverable. A NP is meant to enable ITER INDIA to follow the progress of the contract and possibly to witness a critical manufacturing step at the Contractor/supplier & its supplier's premises. The Notification shall be sent by the Contractor/supplier to ITER INDIA at least 10 working days prior to the scheduled manufacturing step. A NP shall not affect the production flow of the Supplier that shall continue the work even without a reply from ITER INDIA.

A Hold Point (HP) is a milestone where the Supplier is required to notify the ITER-India, that it has completed a specific task or a specific deliverable and must stop the associated processes until a HP Clearance is issued. The HP Clearance shall be issued on the basis of clearly identified Quality Control and data and acceptance test results to be provided to the ITER-India at the time of the request. ITER INDIA shall have a maximum of 10 working days to review the Suppliers data to confirm or reject it. In case of clearance, the Supplier shall resume its activity. In case of rejection, the Supplier shall develop a recovery plan that shall be submitted and reviewed by the ITER-India within 10 working days of submission. In case of ITER-India objection, the ITER-India shall detail its reasons in writing and Contractor/supplier shall have 10 working days to answer the ITER-India objection and, whenever suitable, develop a revised recovery plan.

Any contact with the suppliers of the Contractor/supplier under the contract by the ITER-INDIA shall be managed and coordinated by the Contractor/supplier

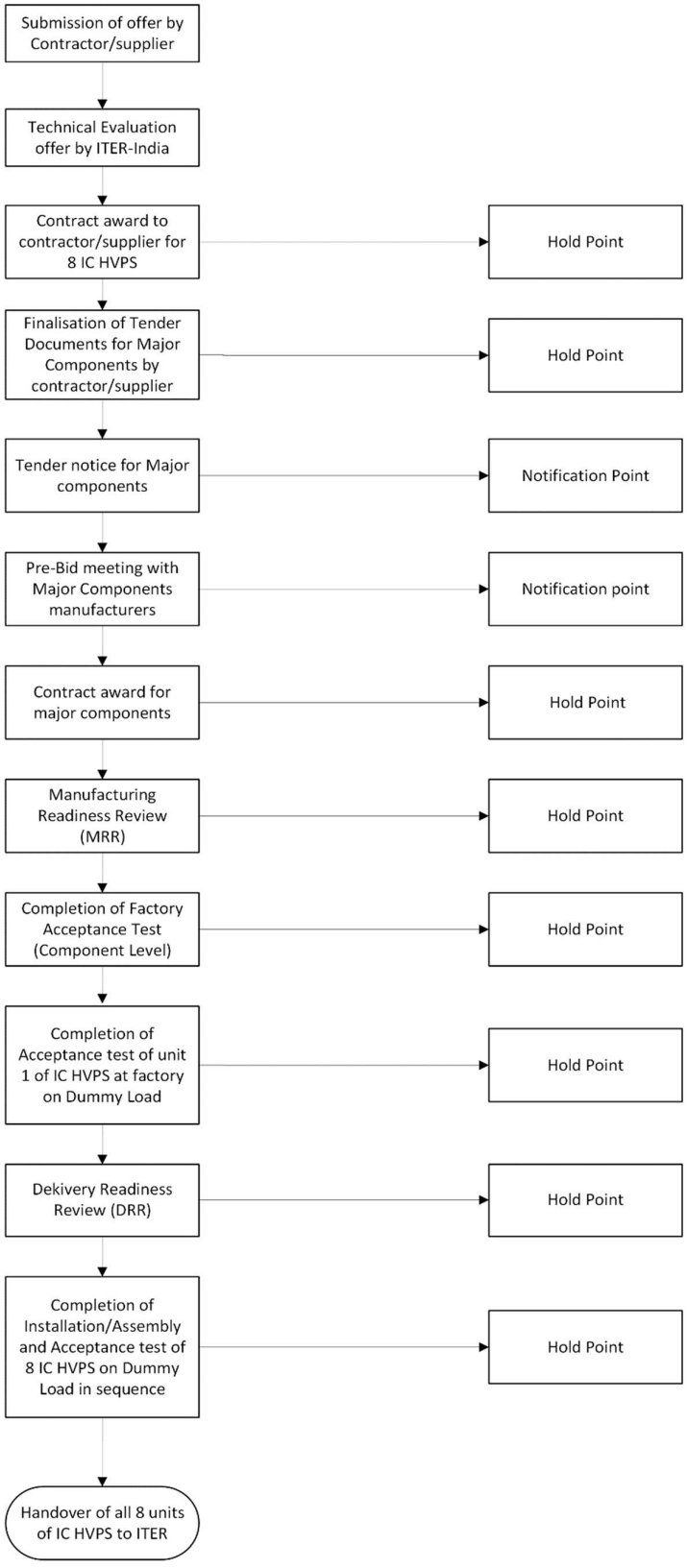

Figure 1 : Major activities/milestones & corresponding monitoring points

5.1 Periodic Reports and Meetings

5.1.1 Reporting

5.1.1.1 The Contractor/supplier shall ensure that its suppliers submit periodic reports to the Contractor/supplier and agree on periodic review meetings with the Contractor/supplier in order to monitor contract execution. The Contractor/supplier shall also ensure that its suppliers maintain data and documents and make them available upon Contractor/supplier's request to verify that the contract requirements have been implemented and satisfied. Such reports, data and documents shall be transmitted to ITER-INDIA, for the approval/acceptance of milestones by the ITER-INDIA.

5.1.1.2 The Contractor/supplier shall provide to the ITER-INDIA a monthly progress report on all works under the contract by the 2nd calendar day of each month.

5.1.1.3 The Contractor/supplier shall hold at the disposal of the ITER-INDIA and make available to it such information and documentation as the ITER-INDIA deems necessary to determine the progress, quality and status of the work. Final documentation for ITER-INDIA's records shall be in English. Quality control documents at the supplier level (such as procedure specifications) need to be translated into English unless specifically requested by the ITER-INDIA

5.1.1.4 The Contractor/supplier shall report immediately to the ITER-INDIA of any occurrence which could delay or jeopardize the proper execution of activities related to the contract.

5.1.2 Progress meetings

5.1.2.1 Progress meetings shall be conducted as required by the ITER-INDIA or the Contractor/supplier upon mutual agreement. The frequency of such meetings shall vary throughout the progress of the contract, typically from once per month during the initial phases to once per two months at the end, assuming no qualification or production problems arises. The meetings shall be held by video conference, teleconference or physically on the ITER-INDIA or the Contractor/supplier premises or on the supplier's premises.

5.1.2.2 Meeting minutes shall be prepared by the Contractor/supplier and submitted to the ITER-INDIA not later than 7 (seven) calendar days after the meeting.

5.1.2.3 The ITER-INDIA shall forward to the Contractor/supplier any comments within 7 (seven) calendar days of the receipt of the minutes. If no comments are made within this time frame, the minutes are deemed to be accepted.

5.2 Reviews and Inspections

5.2.1 Reviews

5.2.1.1 Reviews shall be carried out according to Figure 1.

5.2.1.2 In case of concerns regarding the quality of production, the ITER-INDIA shall have the right to request the Contractor/supplier to carry out on-the-spot checks in addition to the checks foreseen in the technical specifications. In such a case, the ITER-INDIA has to provide a description of its concerns and the rationale behind such request. Upon receipt of such request, the Contractor/supplier shall evaluate the potential impact of such additional spot checks on the production costs and schedule. Based on all these considerations, the Parties shall agree

on a course of action to resolve such issues. The actual date(s) of the on-the-spot checks shall be determined by agreement between the Parties.

5.2.2 Right of Access

5.2.2.1 The Contractor/supplier shall ensure that its suppliers inform the Contractor/supplier of all locations where contracts are implemented. The Contractor/supplier shall provide the ITER-INDIA with such information as soon as available. It shall further ensure that contracts include the rights of on-the-spot access to specified locations subject to the following provisions in this section.

5.2.3 Right of access of the Contractor/supplier

5.2.3.1 The Contractor/supplier shall ensure that its representatives are granted access to the premises of the suppliers and sub-suppliers in order to witness on-site tests and critical fabrication operations, and to participate in periodic review meetings.

5.2.3.2 The Contractor/supplier shall also ensure that its representatives are granted access to the premises of the suppliers at all reasonable times in order to carry out on-the-spot checks in addition to the tests foreseen in the technical specifications.

5.2.4 Right of access of the ITER-INDIA or its representatives

5.2.4.1 The Contractor/supplier shall grant access rights to the ITER-INDIA representatives and regulatory body representatives to its facilities and records and those of its supplier(s) for the purposes defined in the Quality Plan & Manufacturing and Inspection Plan (MIP).

5.2.4.2 When visits for purposes other than indicated in section 5.2.4.1 are envisaged, the request of ITER-INDIA must be submitted at least 15 (fifteen) calendar days in advance, unless otherwise agreed by the Parties. The Contractor/supplier shall make its best efforts to ensure that appropriate facilities are available for use by such representatives.

5.2.4.3 In case of marked up interventions in the Manufacturing and Inspection Plan, it is the Contractor/supplier's responsibility to ensure that adequate notice is given to the ITER-INDIA to facilitate such interventions and make travel arrangements.

5.2.4.4 The ITER-INDIA shall agree with the Contractor/supplier in advance of the appointed ITER-INDIA representatives who shall participate in activities described in the preceding sections. The appointed ITER-INDIA representatives may be accompanied by Contractor/supplier representatives on their visits to the Contractor/supplier's and/or its suppliers' premises unless otherwise agreed by the Parties.

5.2.5 Right of access of the Contractor/supplier to the Delivery Destination

5.2.5.1 The ITER-INDIA shall ensure that the IO grants appropriate right of access to its facilities to the representatives of the Contractor/supplier and its suppliers in order to supervise/perform the installation and/or the acceptance testing of the Items at the facilities of the Delivery Destination, where necessary.

5.2.5.2 The ITER-INDIA shall ensure that the IO provides the Contractor/supplier with the necessary information and assistance in the performance of the installation and/or the acceptance testing of the Items at the facilities of the Delivery Destination

6 Quality Assurance

6.1. Quality Requirements shall be in accordance with ISO 9001 requirements. The Contractor/supplier shall also ensure the quality of all components and services meet the requirements of Annex-B of the CONTRACT.

6.2. Should any question whatsoever arise with respect to the requirements defined in the *'Quality Requirements for IO Performers(ITER_D_22MFG4)'*, the Contractor/supplier shall ask the ITER-INDIA for clarification prior to proceeding with the work.

6.3. The Contractor/supplier Quality Plan subject to approval by the ITER-INDIA shall be applied to all the work under the CONTRACT. For this purpose, the Contractor/supplier shall ensure that the suppliers carrying out contracts placed under the contract are in compliance with the QA requirements under the relevant QA classifications.

6.4. A list of the documentation associated with the Quality Requirements is given in Table 1 below. Moreover, on completion of the tender process, a description of the supplier's quality system shall be submitted to the ITER-INDIA for information.

Table 1: Quality Requirements

ITER-INDIA Quality Requirements
Prior to commencement of work on the contract: ▪ Obtain ITER-INDIA's approval of Contractor/supplier's Quality Plan
Prior to commencement of sub-contract work : ▪ Obtain ITER-INDIA's approval of sub-supplier's (major components viz. SPS modules , Multi secondary transformers) dedicated Quality Plan
Prior to start of manufacturing: ▪ Obtain ITER-INDIA's acceptance and mark up of Contractor/supplier and its Sub-Supplier's Manufacturing Inspection Plan"
During manufacture: ▪ Update Quality Plans as necessary and seek ITER-INDIA's re-acceptance ▪ Notify ITER-INDIA's representatives of any intervention points as marked up on the "MIPs" ▪ Sign the relevant operations and interventions in the "MIPs" as work progresses.
During contract implementation: ▪ Issue "Deviation Request" and "Non-Conformance Reports" as necessary
Prior to delivery: ▪ Complete the "Contractor Release Note" as per *'Quality Requirements for IO Performers (ITER_D_22MFG4)'*

6.5. Quality Plans shall follow *'Quality Requirements for IO Performers(ITER_D_22MFG4)'*

6.6. Manufacturing and Inspection Plans (MIPs) are used to monitor Quality Control and acceptance tests and must be produced by Contractor/supplier and its suppliers. Contractor/supplier mark up its intended intervention points on the Supplier's MIP, approves the plan and sends it to ITER-India for acceptance and mark-up of any ITER-India interventions. It should be noted that interventions additional to those required in Technical specifications may be included on the MIP by ITER-INDIA if justified. MIP shall follow *'Quality Requirements for IO Performers(ITER_D_22MFG4)'*

6.7. Suppliers not performing critical quality activities may be exempted from the requirement to produce Quality Plans and MIPs at the discretion of the ITER-India Quality Assurance Responsible Officer and in discussion with the Contractor/supplier Quality Assurance

Responsible Officer. This decision shall be dependent on the level of detail about Suppliers work in the Contractor/supplier Quality Plan. In such cases, the work can be included in the Contractor/supplier's MIP and managed in accordance with the Contractor/supplier's management system.

6.8. Contractor/supplier shall ensure that its suppliers do not start work on any contract without a Quality Plan in place that has been accepted by the ITER-INDIA.

6.9. Contractor/supplier shall ensure that its suppliers do not start manufacturing without an MIP in place that has been accepted by ITER-INDIA.

6.10. Contractor/supplier shall implement, in compliance with Quality Plan the monitoring activities including quality audits and any inspections to verify the compliance with the requirements.

6.11. ITER-INDIA shall designate appropriate certified auditors to conduct quality audits to verify compliance with Contractor/supplier's and its suppliers Quality Assurance Program. The audit teams may be composed of ITER-INDIA personnel and/or specialist contracted personnel.

6.12. ITER-INDIA shall designate appropriate inspectors to perform inspections of the Contractor/supplier's suppliers to verify compliance with quality related activities. These inspections shall be performed in accordance with the MIPs. The inspectors may be ITER-INDIA personnel or specialised inspectors contracted for that purpose.

7 CE Markings

7.1. CE Markings shall be implemented in accordance with European directives requirements, if applicable.

7.2. The list of European directives concerning CE marking is available on the following web site *http://www.conformance.co.uk/directives/index.php* Other useful information can be found in the "Guide of implementation of directives based on the New Approach and the Global Approach": *http://ec.europa.eu/enterprise/policies/single-market-goods/files/blue-guide/guidepublic_en.pdf*.

8 Change Management

8.1 All requirements of the contract and subsequent changes proposed by either the ITER-INDIA or the Contractor/supplier during the course of execution of the contract are subject to the Deviation Request process that shall be described in Quality Plan. Deviation and Non-conformance shall be processed according to, *'Procedure for the management of Deviation Request, ITER_D_2LZJHB'* & *'Procedure for Management of Nonconformities, ITER_D_22F53X' respectively*.

9 Information and Documentation Requirements

9.1 General Documentation Requirements

9.1.1 Contractor/supplier shall prepare the following documents in the English language unless otherwise provided in the contract:

- Intellectual Property provisions,
- each definitive technical specification for a sub-contract under this contract,
- day-to-day correspondence and administration between the Parties,
- all documents that are necessary to determine the progress and status of work and validate the capabilities of involved suppliers,
- all QA and safety related documentation,

- all other documentation necessary to verify the sound management of the procurement under the contract.
- Risk Plan shall set out a register of the risks which may impinge on the successful execution of the works.

9.1.2 Contractor/supplier shall issue, manage and control its documents and records in accordance with its QA Programme. Tools and software to be utilized according to 5.1.P4.IN DCIF for IC HVPS (5.1.P4.IN_DCIF_for_IC_HVPS_2LPGDP)

9.1.3 Contractor/supplier shall ensure that all documents and records are uniquely identified and traceable by contract references, including subsequent revisions, and are made accessible to ITER-INDIA authorized individuals.

9.2 Design Documentation Requirements

9.2.1 Contractor/supplier shall exchange CAD data relevant for the design and associated site interfaces in the CATIA version indicated by the Design Office of the ITER-INDIA. CAD data associated only with production may be exchanged in other formats if compatible with the ITER-INDIA software and agreed by the ITER-INDIA. The Contractor/supplier shall ensure then that CAD data from suppliers is accurately converted to such version of CATIA.

9.2.2 All 3D models and 2D drawings are subject to the Procedure for the Management of CAD Work & CAD Data.

9.3 Quality Records

9.3.1 Quality Control and Acceptance Test records shall be maintained according to the procedures of Quality Plan. Availability to ITER-INDIA of the required data is a pre-requisite for granting Authorizations to proceed and Hold Point clearances.

10 Environment, Safety and Health

10.1 Contractor/supplier and its suppliers shall observe all applicable environment, safety and health provisions for work on the PURCHASER's SITE - ITER Organization, France, as well as specific requirements set out in this tender document.

10.2 Any activity by Contractor/supplier personnel or its Suppliers at PURCHASER's SITE - ITER Organization, France shall be subject to the "Internal Regulations" (Ref: ITER_D_27WDZW). Any additional applicable provisions regarding environment, safety and health shall be communicated by the ITER-India to Contractor/supplier at least 30 calendar days in advance of the activities to be performed at the PURCHASER's SITE - ITER Organization, France.

Part A(II-2), Annexure-B: Technical Specifications for IC HVPS

GeM Bid No.	**GEM/2025/B/6267679**
Title	**Part-A(II-2): Annexure-B, Technical Specifications for IC HVPS**

ITER-India, Institute for Plasma Research
Block A, Sangath Skyz, Bhat-Motera Road, Koteshwar,
Ahmedabad 380005, Gujarat, India

Table of Contents

Acronyms & Abbreviations

IC H & CD	Ion Cyclotron Heating & Current Drive
IC HVPS	Ion Cyclotron High Voltage Power Supply
CfT	Call for Tender
IEC	International Electrotechnical Commission
IN-DA	Indian Domestic Agency or ITER-India
IO	ITER International Organisation
IPR	Institute for Plasma Research
TBD	To be defined
PSM	Pulse Step Modulation
IGBT	Insulated Gate Bipolar Transistor
SPS	Switched Power Supply
HVPS	High Voltage Power Supply
HVAC	Heating ,Ventilation & Air Conditioning
CWS	Cooling Water System
ECC	Equipment Control Cubicle
THD	Total Harmonic Distortion
PPEN	Pulse Power Electrical Network
PLC	Programmable Logic Controller
PS	Power Supply (short for IC HVPS)
SSEN	Steady State Electrical Network
LSOHFR	Low Smoke Zero Halogen Flame Retardant
V/F Converter	Voltage to Frequency Converter
Rx.	Receiver
Tx.	Transmitter
F.O.Link	Fibre Optic Link
HES	Hall Effect Sensor
CODAC	Control Data Acquisition and Communication
HMI	Human Machine Interface
COTS	Commercially off the shelf
EMI/EMC	Electromagnetic Immunity/ Electromagnetic Conformity
FDP	Final Design Phase

1 System Overview & Performance Specifications

1.1 System Overview

The present case for ITER IC RF sources needs two amplifier chains operating in parallel and use of a combiner at the output to achieve the required RF power. Each chain has High power RF Amplifier (HPA) 1, HPA2 and HPA 3 which amplifies RF power in stages. HPA2 is connected to Driver stage of HVPS and HPA3 is connected to End stage of HPA3 as shown in Fig.1-1. The IC HVPS shall provide electrical power to amplifier chain, by applying controlled and regulated individual voltages between anode and cathode of end stage & driver stage tubes of the RF generators. This part of tender describes technical specifications, system description for the IC HVPS along with configuration and component selection.

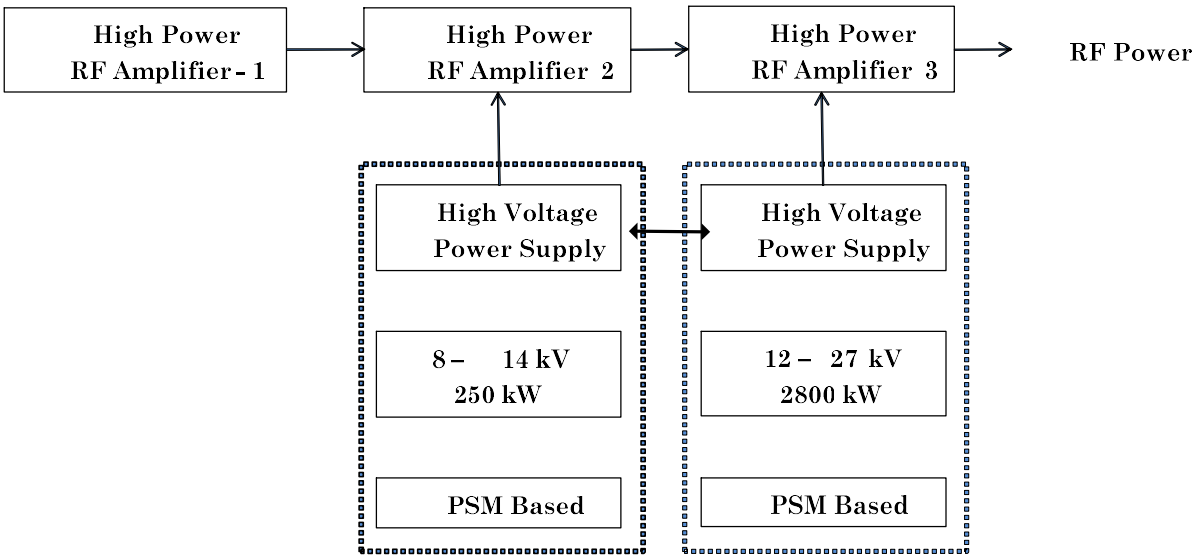

Figure 1-1: Cascaded chain of Amplifier

1.2 Specifications

The contractor shall consider the HVPS system specification as specified in the table 1-1 below.

Table 1-1 : Main requirements for IC HVPS system

	Parameters	Value
IC HVPS Input	Input voltage	22kV±10%
	Min Power Factor at full output power	≥ 0.9
IC HVPS Output	Total continuous power Requirement	3050 kW
	Max pulse duration	3600 s
	Duty cycle	¼
	HVPS output for End stage	
	Voltage range above driver stage voltage	4 – 14 kV*
	Maximum absolute voltage	27 kV
	Maximum current to one end stage tube	170 A
	Maximum output continuous power to one end stage tube	2800 kW
	Voltage rise time (10% to 90% of flat top value)	50 ms

	Accuracy of the voltage control	± 1% of the Maximum value
	Voltage Ripple	± 1% of the Maximum value
	Transient response from 18 kV to 27 kV	5 ms
	HVPS output for Driver stage	
	Voltage range	8 - 14 kV*
	Maximum current to one Driver stage tube	20 A
	Maximum output continuous power to Driver stage tube	250 kW
	Voltage rise time (10% to 90% of flat top value)	50 ms
	Accuracy of the driver stage voltage control	± 1% of the Maximum value
	Ripple of driver stage voltage	± 1% of the Maximum value
	Load fault	
	Fault energy (short circuit energy in case of load fault)	≤ 10 J
	Time to be ready to restart after fault	200 ms
	Max driver/end stage voltage overshoot	2 kV
	HV Dummy load	
	Rating	(1) 16 - 27 kV, 2800kW (2) 14 kV, 250 kW Total power limited to 3050kW. Duration 1 Second
	Duty Cycle	1 pulse / 15 min
	Short circuiting device	
	Rating	27 kV
	Sustainable voltage	30 kV

* Voltage range at rated power operation. Power supply ramp-up may begin at 3kV for driver stage and 5kV for end stage.

The HV dummy load system used for the acceptance tests shall be able to test both driver and end stage output at the same time.

The harmonic content rejected in the PPEN by the IC HVPS rectified currents should comply with the IEC guidelines. The Supplier shall adopt all the actions necessary to minimize the harmonic distortion (e.g. phase shift of the transformers' 3-phase voltages, management of the modules switch-on/off).

The limitation prescribed for the power transformers' in-rush current entails the need of design practices. In-rush current shall be limited to ~10 times the transformers rated current.

Both the terminals (Driver and End stage) of the IC HVPS consist of insulators sized for the nominal voltage (27 kV). The negative terminal grounded at RF source end.

The PSs shall have over-current and over-voltage protections with adjustable thresholds. Their tripping can produce the output voltage shutdown.

The IC HVPS shall be able to provide a set of measurements concerning its internal status and parameters. The characteristics of such measurements (in terms of accuracy, resolution, times, etc.) shall be adequate to verify all the specifications reported in Table 1-1.

2 System description

In the present tentative design, there are 8 identical IC HVPS units covered by this tender, each one supplying both driver and end stage tubes of one amplifier chain of an RF source. Thus, an RF source is supplied by two dedicated power supplies units. In this way, each RF source can be driven independently. The PS units are based on PSM technology. Each of the two PS units needed to supply one RF source is connected to the 22 kV cables from the PPEN and comprises the main following components:

- Input/output disconnectors/earthing switches
- two special multi-winding transformers (Cast resin dry type). Each secondary winding individually supplies a Switched Power Supply (SPS) module.
- 48 individually operable small power supplies, called SPS modules, which are all connected in series;
- two output filters to limit the ripple on end stage and/or driver stage output;
- control equipment for SPS module monitoring and feed forward regulation.

A PSM based power supply unit basically consists of 48 in series connected switching modules (note that this number is a tentative estimation, The final number has to be decided by the manufacturer taking into account the final parameters of the components. Additional couple of modules can also be added for redundancy to cope with a module failure and reach high availability target for the plant. The total output voltage of the power supply is the sum of the output voltages of all the modules. Each SPS can be electronically switched in and out of the circuit. In this way, the output voltage can be rapidly varied to meet the voltage requirements of the tubes.

Two special multi-winding transformers per power supply unit, provide the ~530 V 3-ph. power from the 22 kV PPEN and guarantee galvanic isolation between the individual SPMs.

Each of the 3-ph outputs of the multi-winding transformers will be connected to one SPS. Each winding must be isolated by ~740 V from adjacent circuits and by 27 kV from ground.

One SPS typically contains an input contactor, a 6-pulse diode rectifier, a filter inductor, a storage capacitor bank (intermediate dc-circuit), a solid state switch (IGBT), a free wheeling diode and a control system

The output of each module is either zero for the IGBT switch open or equal to ~740 V for closed switch. By switching on N modules, the voltage at the output terminals is Vout=N x 740. By this method, the voltage at the output can be controlled by the number of switched on modules in quantization steps of 740 V. To obtain voltages between step sizes and to regulate line ripple, a superimposed Modulation PWM (Pulse Width) is employed.
The output voltage to supply driver tube is taken between SPS 01 and SPS 24 (preliminary value), and is thus fully supplied by the first multi-windings transformer. The end stage output voltage is taken between SPS 01 and SPS 48.

Load protection is accomplished by rapidly switching off all voltage steps by blocking the gating pulses to all SPS modules.

A single line diagram showing the major features of this power supply is shown in Figure 2-1

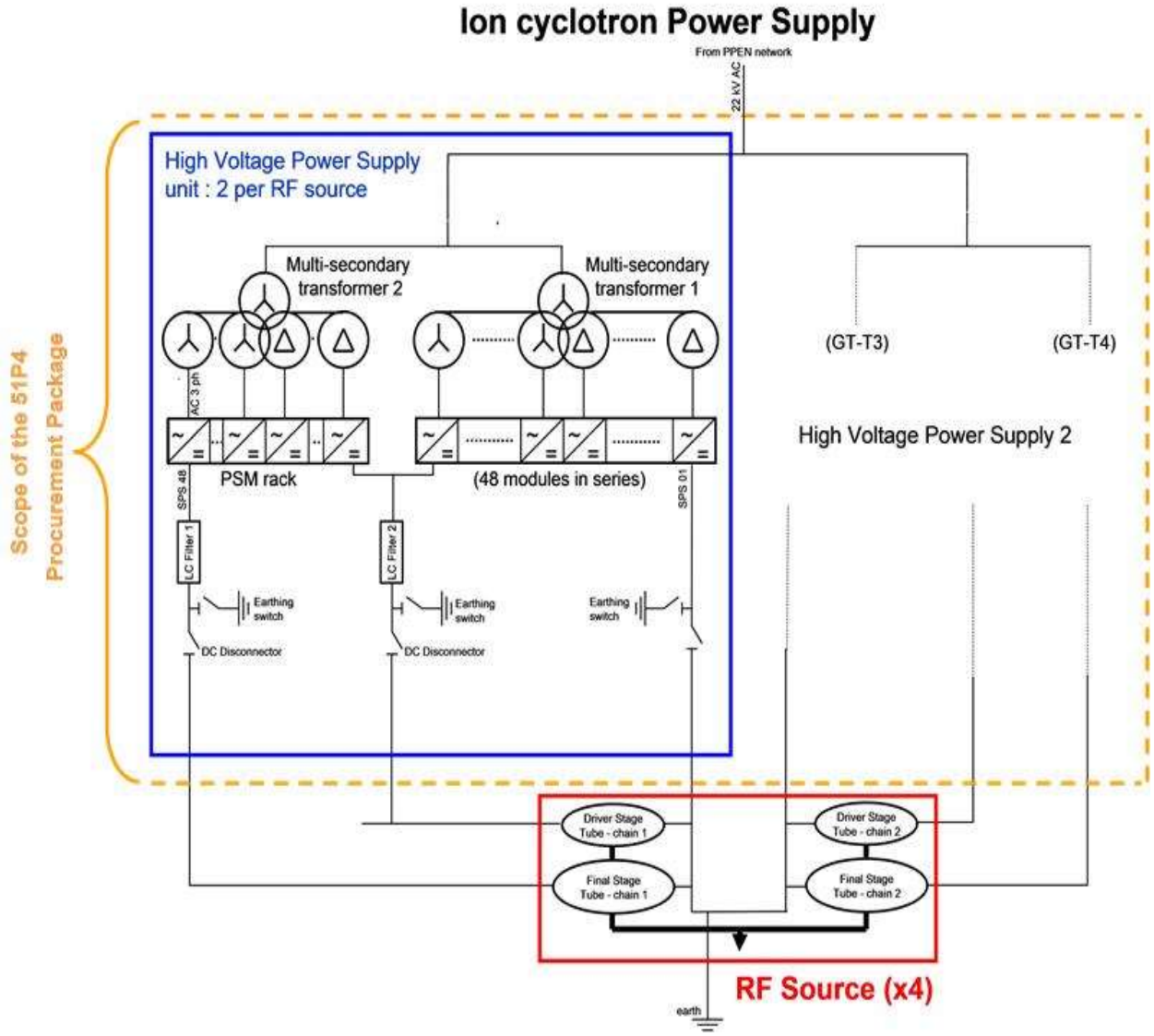

Figure 2-1 : Single line diagram of an IC HVPS unit

3 Interfaces

The main interfaces between the equipment of IC HVPS system and the ITER facilities are summarized below. This list indicates the equipment and functional blocks which are not included in the scope and are provided by the IO.

- The infrastructures needed to accommodate the PS device. This includes all civil works in addition to the RF Building
- The RF sources
- The ITER 22 kV AC distribution
- The 400V AC distribution, both normal and uninterruptible i.e. class 2 and class 4
- Earthing system for IC HVPS system (Note that specific grounding conductors to provide ground reference up to the RF source is part of this procurement)
- The IC plant Instrumentation and Control system (which interfaces with CODAC)
- The auxiliary systems like the compressed air, special gas, etc.
- The Component Cooling Water System, HVAC
- The fire-prevention systems both for detection and intervention, inside the PS building and outside for the protection of the equipment installed outside.
- Access control to RF building (note that individual fencing/enclosure for HVPS unit or couple of HVPS units and associated interlock key system is included in the scope of this tender)

Any change to a configuration item arising from supplier's design activities in the course of this IC HVPS deliverables must be addressed by supplier through the appropriate ITER change procedures (refer Annex C)

Location of IC HVPS installation is to be changed from existing allocated Building 15 to Building 20, as all information is yet not available. For initial design information available for building 15 to be used, later to be updated for building 20.

Following sections list all technical interfaces of the IC HVPS system.

3.1 Interface with the ITER Component Cooling Water System (CCWS)

The AC/DC converters of the IC HVPS require cooling by the ITER CCWS. The physical interface between CCWS and the IC HVPS system is at the isolation valves located on the CCWS supply and return distribution headers inside Building 15. The pipe connection from this point onwards to the final units is part of the IC HVPS system.

The physical interface between IC HVPS and CCWS is shown on Figure 3-1:

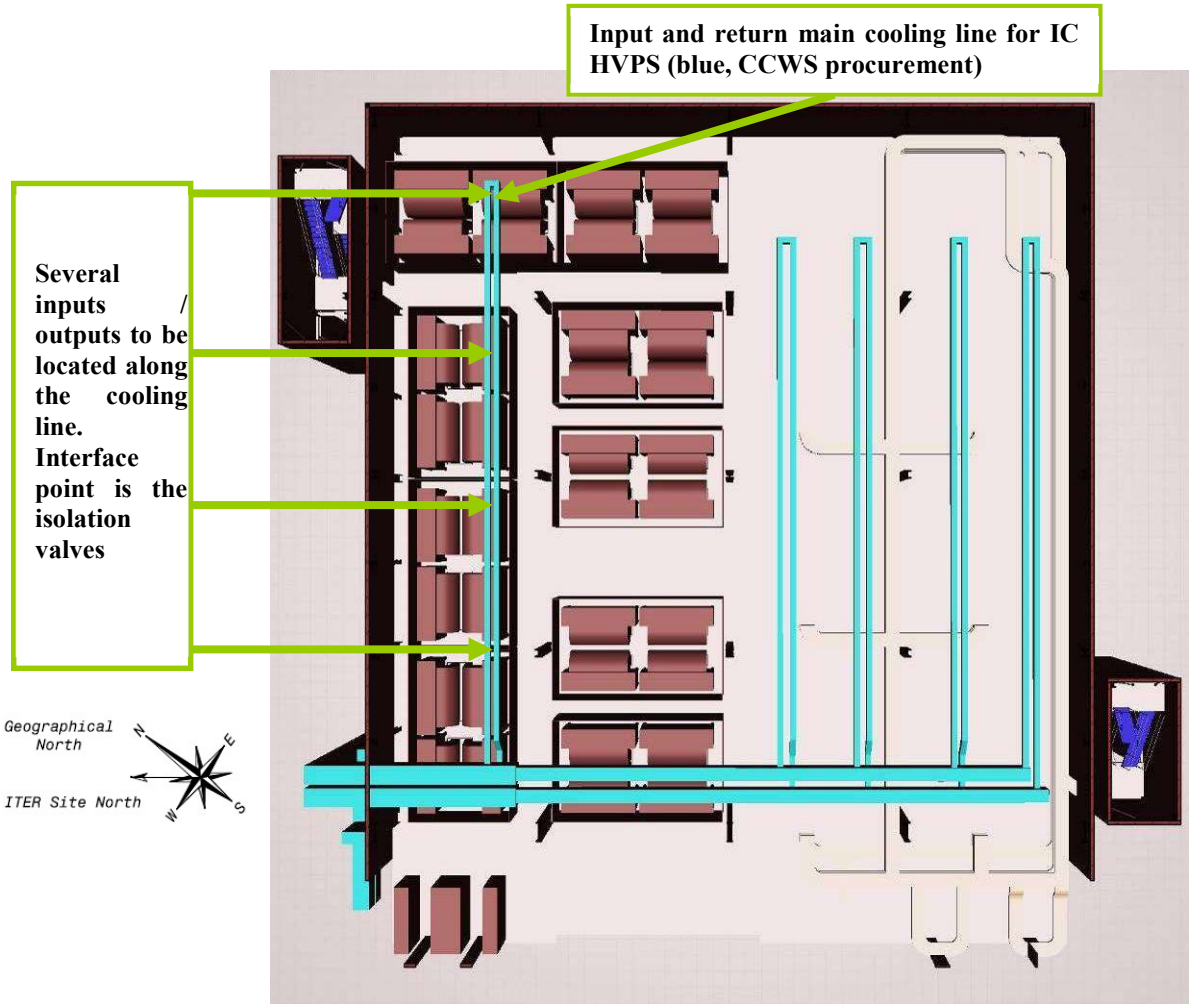

Figure 3-1 :Physical interface between IC HVPS and CCWS (conceptual layout)

Electrical conductivity of the ITER CCWS water shall be ≤ 1 µS/cm.

The characteristics of the cooling water provided by the CCWS to the IC HVPS are tentatively established as follow :

Table 3-1 : Tentative parameters of IC HVPS inlet cooling water provided by CCWS

Loop of PBS-26.CC Serving Client →	CCWS-2A							
Branch Name and interface location	HVPS Branch 1 15-L2-002	HVPS Branch 2 15-L2 -002	HVPS Branch 3 15-L2-002	HVPS Branch 4 15-L2-002	HVPS Branch 5 15-L2-002	HVPS Branch 6 15-L2-002	HVPS Branch 7 15-L2-002	HVPS Branch 8 15-L2-002
Heat to be removed by CW (max, MW)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
CW supply temp. to client (max/min,°C)	(31)	(31)	(31)	(31)	(31)	(31)	(31)	(31)
CW return temp. from client (max, °C)	49.5	49.5	49.5	49.5	49.5	49.5	49.5	49.5
CW supply/return ΔT (max, °C)	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
CW supply pressure (max, MPa G)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Pressure drop of CW within client system (max @ nominal flow, MPa)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Required CW flow rate (nominal, kg/s)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Heat to be removed by CW (max, MW)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Required CW flow rate (nominal, kg/s)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Heat to be removed by CW (max, MW)	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Required CW flow rate (nominal, kg/s)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6

** The flow rate allocated to the full IC HVPS system is 21 l/s. 9.5 l/s are allocated*

3.2 Interface with the ITER Pulse Power Electrical Network (PPEN)

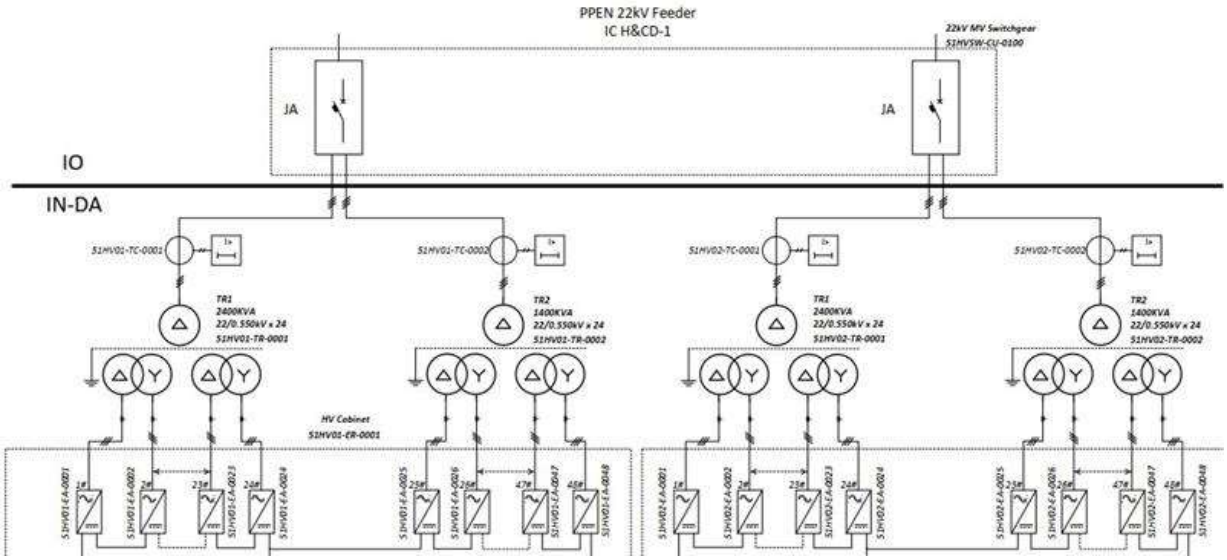

Figure 3-2 : Interface with 22kV network

The ITER PPEN supplies the IC HVPS system with 22 kV AC electrical power. The physical interface between the PPEN and the IC HVPS is located at the arrival terminals of the power cables coming from the 22 kV distribution board of PPEN. These cables are connected to the disconnectors of the IC HVPS system . The cables will be supplied and installed by PPEN, while the DC disconnector and earthing switch is part of the scope of this tender.

Concerning the interface for protection, a direct link between the IC HVPS Local Control System and the 22 kV ITER breaker actuator shall be provided; this link shall be able to trip the breaker in case of serious fault in the respective power supply.

PPEN Power Quality specifies the characteristics for the distribution power supply coming to the interface point.

Table 3-2 : PPEN 22kV Power Quality

Rated nominal voltage (kV)	Maximum voltage variation during normal operating conditions	Nominal AC voltage frequency	Total Voltage Harmonic Distortion THDV (%)
22	± 10%	50 Hz ± 1%	< 6%

3.2.1 Characteristics

4 separate 22 kV lines of PPEN are available to supply AC power to the full IC HVPS system. 4 feeders will be allocated to the 8 HVPS units covered by this tender

During the operation pulse, the line voltage variation is in the range from +10% to -10%. The IC HVPS components shall be designed to withstand the short circuit current of the PPEN. The short circuit power at the end of the 22 kV lines will be confirmed during PPEN PDR The PPEN max short circuit current at the end of the 22 kV lines shall be ≤ 31.5 kA

3.2.2 Circuit Breakers

4 feeders are provided for the 8 HVPS units covered by this procurement arrangement. In each connecting cable, circuit breaker with associated earth switch and current transformer are provided by PPEN.

3.2.3 Connecting Cables

The cables connecting feeder breakers and the related IC HVPS units input disconnector are to be provided by PPEN. The boundary between the IC HVPS system and the AC distribution systems is the terminal of connecting cable in the Building 15.

3.2.4 In-rush current

4 transformers are supplied from the same PPEN cable, causing large in-rush current in the cable when operating circuit breaker. In-rush current shall be limited to ~10 times the transformers rated current. Short circuit protection associated to the circuit breaker must be designed accordingly (note that this protection is not under the scope of this tender). Selection of soft charging device for DC link of Switching modules is advised.

3.2.5 Command and Interlock Signals

The circuit breaker of PPEN provides the protection function against circuit faults, including the short circuit event of the connecting cable. Moreover, the breaker can be operated on request of the related IC HVPS unit in the fault condition. This protection for the IC HVPS system is assumed as a backup protection.

Table 3-3 : Hardwired Interface between ICHVPS and 22kV MV Cell

Signal Name	From	To	Signal Type	Cable type code
Circuit breaker Trip command	LVDFM CU-1002	22kV MV Board CU-0100	230V AC	MS0414LN
Circuit breaker ON status	22kV MV Board CU-0100	Marshalling box of transformer CU-1003	24 V	MS0414LN
Circuit beaker OFF status	22kV MV Board CU-0100	Marshalling box of transformer CU-1003	24 V	MS0414LN
Earth Switch OFF status	22kV MV Board CU-0100	Marshalling box of transformer CU-1003	24 V	MS0414LN
Earth Switch ON status	22kV MV Board CU-0100	Marshalling box of transformer CU-1003	24 V	MS0414LN
MOD Bus Communication	22kV MV Board CU-0100	LVDFM CU-1002	I&C	P40418LN

3.3 Interface with the ITER Steady State Electrical Network (SSEN)

The ITER SSEN supplies the IC HVPS system auxiliaries with 230/400 V AC electrical power.
The interface between the SSEN and the IC HVPS system is located at the corresponding distribution board of SSEN in Building 15. The distribution board and the upstream of the distribution are part of the SSEN system. The cables downstream of the distribution board are part of the IC HVPS System procurement.

The main characteristics of the ITER SSEN are summarized in Table 3-4 (characteristics according to IEC60038 and NF EN50160).

Table 3-4 : Main Characteristics of ITER SSEN

Rated nominal voltage	Voltage variation range	Nominal AC voltage frequency:	Total harmonic distortion
230/400 V	± 6% (normal operating conditions) ± 8% (including the transients produced by motor starting)	50 Hz ±1%.	< 5%

To allow for inaccuracies in the analysis, the IC HVPS loads will be specified in order to work satisfactorily with a supply voltage of 230/400 V ±10% (±5% for class 2).

Table 3-5 : Main specifications of the AC LV network (SSEN).

Parameter	Estimated values for ICHVPS	As per IS
Nominal voltage	400/230 V	400/230 V
Voltage operating range	400 V ± 10 %	400 V ± 10 %
Nominal frequency	50 Hz	50 Hz
Frequency range	50 Hz ± 1 %	50 Hz ± 1 %
ITER Voltage Class	IV	IV
3-phase distribution system	3Ph+N+PE	3Ph+N+PE
1-phase distribution system	1Ph+N+PE	1Ph+N+PE
Total harmonic distortion (Voltage)	< 5 %	< 5 %
Class-IV Input Power/IC-HVPS/L1-02 (1-Ph)	800 W	800 W
Class-IV Input Power/IC-HVPS/L2-02 (3-Ph)	2.2 kW	2.5 kW
Class-IV Input Power/IC-HVPS/L2-03 (1-Ph)	400W	450 W

3.4 Interface with the ITER Liquid and Gas Distribution System

ITER Liquid and gas distribution system will provide Liquid and gas to the IC HVPS

- These Interfaces are required at the time of Commissioning and Maintenance activity.
- Interface to these connection points, shall be done using Flexible Hoses on need basis.
- This interface will be used for testing of welding joints at site, for pneumatic tools etc

3.5 Interface with IC RF sources

The purpose of the IC HVPS system is to supply the RF sources driver and end stages with electrical power. The physical interface between the IC HVPS system and the IC RF sources is located at the connection point on the RF sources. The cables and cable connector between the IC HVPS units and the RF sources are included in this procurement. Co-axial cable (with screen) will be preferred for connection,

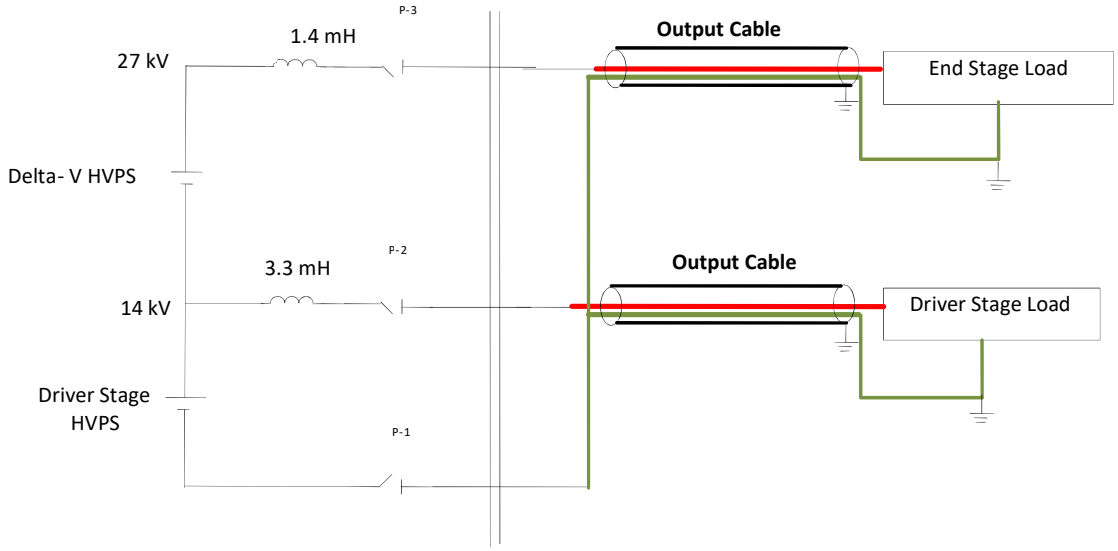

Figure 3-3 : Output load connection scheme

Apart from Power Cables, number of fiber optic cables also to be routed between HVPS and IC RF Source Fast controller. Following are details of Optical interface between HVPS and RF source.

Table 3-6 : Preliminary signal interface with RF source

Signal Name	From	To	Signal Type
PS Ready	HVPS Controller	RFPS	Boolean
HVPS On	HVPS Controller	RFPS	Boolean
HVPS Fault 1	HVPS Controller	Driver Screen Grid PS	Boolean
HVPS Fault 2	HVPS Controller	End Screen Grid PS	Boolean
HVPS Fault 3	HVPS Controller	RFPS ECC	Boolean
PS Request	RFPS ECC	HVPS Controller	Pulse
Reference Voltage Delta	RFPS ECC	HVPS Controller	PWM Pulse
Reference Voltage Driver	RFPS ECC	HVPS Controller	PWM Pulse
Enable / Disable	RFPS ECC	HVPS Controller	Boolean
Immediate OFF	RFPS ECC	HVPS Controller	Boolean
External TRIP – HPA2 CG	RF Source	HVPS Controller	Boolean
External TRIP – HPA3 CG	RF Source	HVPS Controller	Boolean
Driver Voltage Monitor	HVPS	RFPS	PWM pulse
End Voltage Monitor	HVPS	RFPS	PWM pulse
Driver Current Monitor	HVPS	RFPS	PWM pulse
End Current Monitor	HVPS	RFPS	PWM pulse
HVPS Reset	RFPS	HVPS	Pulse

3.6 Interface with IC Plant control and instrumentation (IC PC&IS)

The IC PC&IS is the interface between all IC subsystems (including IC HVPS) with CODAC Plant System Host (PSH, PBS 45), Central Interlock System (CIS, PBS 46) and Central Safety System (CSS, PBS 58). Thus, the IC HVPS hasn't any direct interface with CODAC (PBS 45), CIS (PBS 46) and CSS (PBS 48) (see section 4.3).
The IC PC&IS ensures communication and synchronization between IC subsystems and also between IC subsystems and other ITER systems during plasma and shut down operations.
The IC PC&IS includes the IC "Plant Interlock System" (PIS) which will provide protection of the whole IC system, including IC HVPS component when the IC operating conditions are outside their normal operational range. The IC PIS will interface with the ITER Central Safety System (CIS) of PBS 46 and will forward to IC HVPS the interlock signals from CIS for inhibiting or accepting operations of the IC HVPS system based on the status of systems external to the PBS 51.IC to protect either IC HVPS components or components of any other ITER systems.

Additional description of this interface can be found in chapter 4.3

3.7 Interface with the RF building

The space allocated for the IC HVPS system is at the L1 and L2 levels of the RF Building (Building 15). On each level, the 2 north end bays are dedicated to the full IC HVPS system. Some of this space is also dedicated to auxiliary systems (HVAC, CCWS) On each level, 8 of the 2 north end bays is allocated to the IC HVPS system. The surface allocated to the HVPS units is to be allocated in one block either on West or East side of the building. This is illustrated on Figure 3-4. The IC HVPS system

shall fit within the space allocated in the RF building, as described on Figure 3-4. Figure 3-5 provides tentative values for the height of the RF building levels.

Additional space outdoor, along the RF building north side wall, can also be used for the IC HVPS (switchgear panels).

Large openings (1 per PS unit) are required in RF building between L1 and L2 for the cable connections between the transformers and AC/DC converters

Layout scheme for the 8 of IC HVPS will be assessed more carefully during the Design phase. Layout need to be optimised to accommodate all 8 of IC HVPS in the allocated space for maintenance & safety consideration.

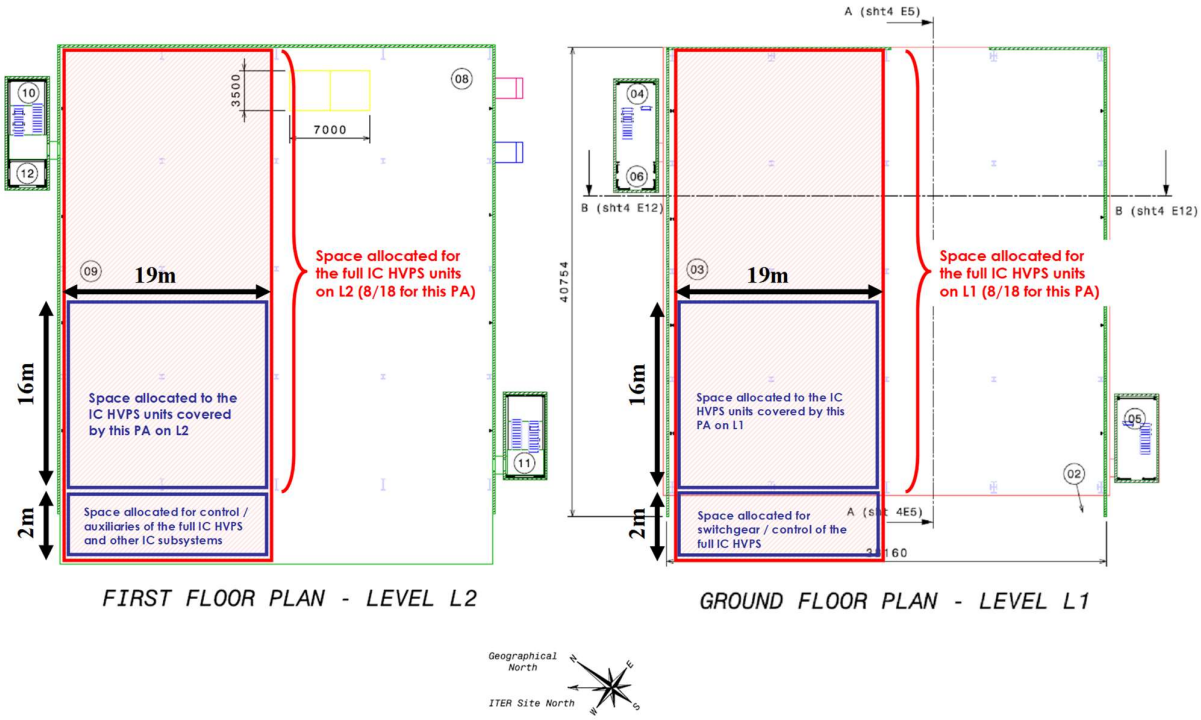

Figure 3-4 : Principle of space allocation in the RF building

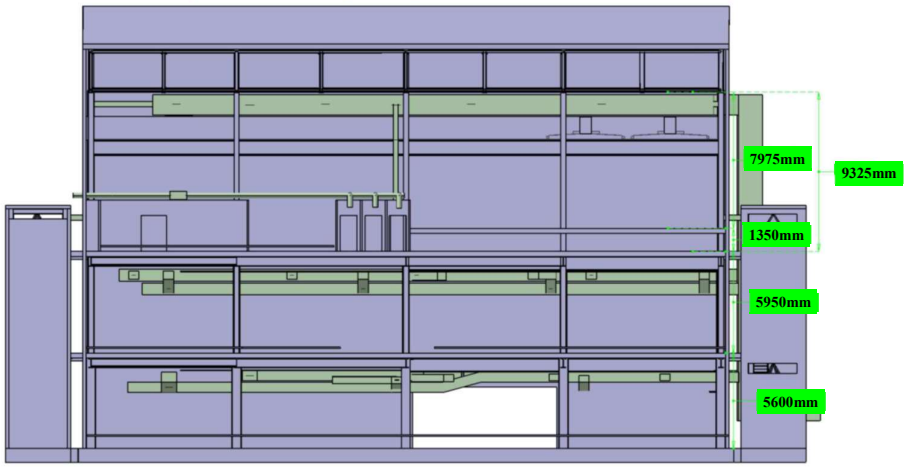

Figure 3-5 : Height of the RF building levels (see CMM for last version)

4 Technical Requirements

4.1 Earthing/Grounding of the IC HVPS

ITER general earthing concept is described in the reference document under title *ITER Electrical Design Handbook.*

4.1.1 IC HVPS grounding.

Connection to ground will take place at the load end (ie at the RF sources). One Connection point shall be provided by each RF source.

4.1.2 IC HVPS components earthing

Equipment earthing shall be in conformance with safety requirements at PURCHASER's SITE.
In order to permit safe access to the power supply systems, disconnectors and earthing switches shall be provided at DC output of the IC HVPS system., as shown in Figure 4-1.

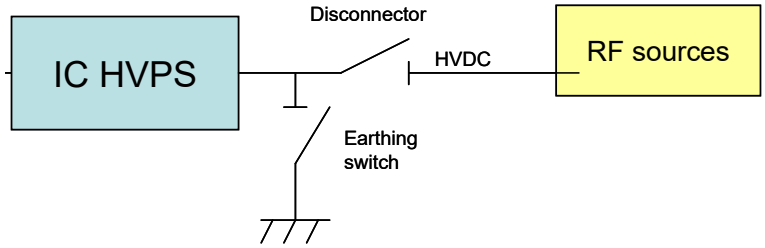

Figure 4-1 : Disconnector & earthing switches at input & output of IC HVPS

The earthed contacts of these switches are normally disconnected from the live parts of equipment during operation. The earthing switches must be closed during shutdown/maintenance periods to connect the power supply components and their loads to earth, thus, providing safe access to the components by personnel. For safe access to the SPS modules, which include DC charged capacitors, IEC 60215 must be applied.
Equipment items to be earthed include

- Housings for electrical equipment (transformers, switchgear, motors, pumps, control cubicles etc.),
- Cores of transformers, except for cascaded configurations,
- Bus bar cases and separators,
- Cable shields and armour, etc.
- Structural items to be grounded include building steelwork, fences, support structures, cable trays, etc.

Insulation of components shall be tested with test voltages in accordance with relevant IEC Recommendations.
Provision of an adequate number of earthing points at various locations in Building 15 is under Site's responsibility.

4.2 IC HVPS protection function

4.2.1 General Concepts for IC HVPS Protection

Two essentially different categories of protection are foreseen in the IC HVPS as follows:

- Self-protection of the power supply components;
- Protection of the RF source loads.

4.2.2 IC HVPS self-protection

Each power supply unit shall have self-protection capabilities. Self-protection is initiated by fault signals which indicate an abnormal operating condition. The choice of any further protective actions will be made by the local control system of the HVPS unit.

4.2.3 Load Protection

The power supplies must be capable of protecting the power supply loads (RF generators) from serious or propagating damage due to an abnormal operating condition. The PSM technology intrinsically has fast switch off capabilities (< 10 μs) which ensure protection of the load. This protection will be activated upon receipt of any load fault condition signalled from the load (external system) or sensed in the power supply.

4.2.4 Abnormal events

(Non-exhaustive lists, to be completed during detail design phase)

Abnormal operations which shall initiate power supply self-protection will include:

1. Abnormal events sensed by HVPS system (detection system under the scope of this Tender :)
   - Loss of input power
   - Loss of cooling
   - Over current
   - Over temperature
   - Undervoltage
   - Overvoltage
   - 3 phases current imbalance
   - Fuse operation
   - Ground fault
   - Controller malfunction
   - Emergency off command

2. Abnormal events sensed by an external system (detection system not under the scope of this tender)
   - Fire alarm
   - Seismic alarm

In some cases the protective action includes the opening the incoming 22kV circuit breaker and bringing the power supply to the OFF state.

Abnormal operations which may initiate power supply load protection will include:

1. Abnormal events sensed by HVPS system (detection system under the scope of this tender :)

- Instantaneous over current

2. Abnormal events sensed by an external system (detection system not under the scope of this tender)
   - Tube arc
   - Load over temperature
   - Vacuum leak
   - Arc in transmission line, matching network, or antenna
   - High VSWR

4.3 Instrumentation and Control (I&C)

Plant System Instrumentation & Control shall conform to standards, specifications and interfaces as documented in the Plant Control Design Handbook (IDM 27LH2V). Note that the HVPS "embedded control", as defined in the PCDH, is not required to be compliant with the PCDH.

Each HVPS unit shall have one Local Control Cubicle (LCU) for the operation of the IC HVPS system. The main functions of the LCUs are:

- real time operation control and monitoring;
- emergency operation requests;
- occupational safety control.

All signals from and to IC HVPS system will be made available at the terminal blocks in the LCUs. The LCUs will have the necessary functional ability to operate the IC HVPS unit and Communicate with the IC Control (remote or local).

The definition of the logic to be used in the LCUs is under the responsibility of the Supplier.
The logic directly related to the equipment to be supplied, for instance, considering in this case the reference design described in section 2:System description, the Pulse Step Modulator, is the responsibility of the Supplier.

Scope of the tender includes commissioning of the LCUs with the simulated testing of the signals to be exchanged between the LCUs and IC instrumentation and control system cubicles (at terminal boxes of the LCU).

4.3.1 Local Control

Each IC HVPS unit shall be delivered with its own LCU and data acquisition offering the possibility to operate the unit in local control. The main specifications are as follow:

a) to manage in real time:
   - all the necessary digital inputs and outputs (available locally and at IC instrumentation and control system);
   - all the analogue inputs and outputs required for operation (available locally and at IC instrumentation and control system);

b) to ensure its own protection in case of an internal failure, to memorise the information at a fault instant and to inform IC PC&IS of these events. In particular:
   - the fault information required for protective actions on the other equipment must be delivered in real time;

- all the existing fault information must be available for diagnostics locally and at IC PC&IS but not in real time;

c) to be able to operate locally when external safety conditions are satisfied, in particular for commissioning;

d) to exchange fast interlock signals with the Interlocks and General Alarms

4.3.2 Instrumentation

The IC HVPS transducers shall provide accurate voltage and current measurements for IC HVPS system. Therefore, the output signals of these transducers shall be transmitted on line to the IC instrumentation and control system.

4.3.3 System Architecture

In the proposed architecture, the IC HVPS control system will be a sub-system of the whole IC H&CD control system which is considered as a Plant System in accord with the ITER Plant Control Design Handbook (IDM 27LH2V) definitions.

Each Power Supply unit will have its own LCU. Each LCU is expected to be operable as an independent system complete with its safety and interlocks.

The architecture of IC HVPS control system, integrated into the whole IC H&CD control system is shown in Figure 4-2 . The red shaded portion indicates the scope of the tender.

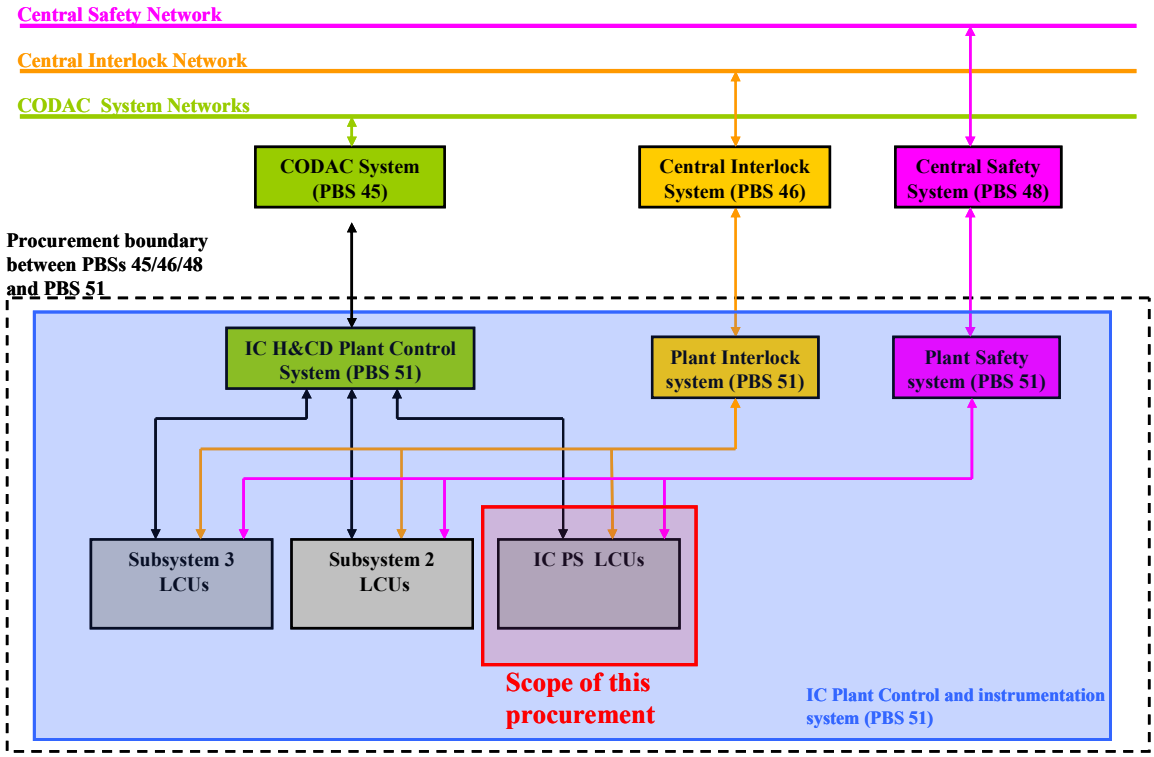

Figure 4-2 : IC System Plant Control Architecture

4.3.4 Functions of LCUs:

The local control cubicles (LCUs) shall have adequate electronic hardware and software for the following functions (Non exhaustive lists, to be completed during detail design phase):

- Communication and synchronisation with IC Plant Instrumentation and Control System
- Run the basic control operations on the Power Supply unit for regulation of the outputs.
- Set-up all relevant parameters (reference value, timing, etc.) for the operation of the PS unit from the next higher level of controller (in 'Remote' mode) for 'automatic' operation.
- Allow local operation (start, stop, alarms, etc.) of the PS unit, in 'Local' mode, selectable by either a toggle switch or a control signal.
- Provide adequate Human Machine Interface (HMI), in the form of indications, meters, knobs, switches, push-buttons, key-pads, etc. or mimics implemented with touch panel devices.
- Monitor safety of the power supply, issues alarm signals and provide necessary interface to the next higher level of control.
- Start up coordinated actions against internal faults, with logging of events.
- Provide all necessary interlocks to guarantee the correct operation of the system and the safety of personnel both during normal operation and commissioning.
- Display the status of all control and protective devices of the PS unit, including auxiliaries and interface to the next higher level of control system.
- Acquire essential data from the transducers of the power supply unit, log them as necessary, and provide necessary interface to the next level of data acquisition.

4.3.5 Design of the LCU:

Each major unit of the system shall have its own LCU, as identified in the system architecture.

- The LCU shall be designed in order to meet the requirements of the reference design regarding operation, performance, local and remote monitoring of the PS.
- The LCU shall provide interface to the next higher level of control, according to a mutually agreed protocol.
- The control actions of the LCU shall be strictly restricted to the control of the respective PS and to the coordination of the different devices of that PS.

While the design of the LCU may include proprietary hardware and software of the manufacturer, hardware and software relevant to interface shall be on a single protocol and shall be divulged in details. If PLCs or such control products are used, they will be selected within the limits of ITER standardization, to the extent possible.

5 Testing

Equipment supplied by the Supplier is expected to conform to applicable IEC standards, applicable local codes and standards at the PURCHASER's SITE.

5.1 Factory Testing

Component and system tests will be accomplished at the Supplier's site. These tests will include:

- Routine type and special tests prescribed by the relevant IEC Recommendations. In particular, IEC 60076 and IEC 61378 series specify the test for the transformers; IEC 60146 series specifies the test for the converters.
- Special tests specific to the design and as quoted in the Technical Specifications.
- Physical Dimensions and interface characteristics checking.

5.2 Assembly/Integration demonstration

The demonstration of Unit-1 at ITER-India lab, Gandhinagar shall include:

- Equipment unloading, handling, unpacking and movement to site
- Demonstration for equipment storage & preservation
- Equipment marking, drilling/penetration
- Holding arrangement of components
- Standalone Testing of IC HVPS components
- Installation of IC HVPS components
- Layout as per layout plans and clearances
- End to End Interface connections and checks
- Voltage to Ground Withstand Test
  IC HVPS operation, equipment maintenance and troubleshooting

5.3 Testing at PURCHASER's SITE

The IC HVPS system shall be installed and commissioned at PURCHASER's SITE- ITER Organization (IO), France. The tests will be done according to the Site Test Procedure to be prepared by the Supplier and approved by ITER-India before starting the tests. The acceptance tests shall demonstrate that the performance specifications as listed in Section 1.2 are met. Each parameter of the performance specification shall be demonstrated by a dedicated test. These tests shall include in particular the tests as described in IEC 60146 series.

The acceptance tests shall include:

- insulation tests (according to IEC Recommendations);
- functional tests;
- tests of protection;
- integrated tests.

The functional tests shall include:

- end to end tests of all signals (digital and analog) from the transducers in the field (HVPS) to the terminal boxes in the LCUs with injection of signals at the transducer/ source end and simulate thresholds;
- operation of active components (PSM, IGBT switches, etc);
- interlock and status functions;

The integrated tests shall include:

- operational tests performed under LCUs control, with dummy loads.
- Wire burn test performed under LCUs control, with dummy loads.

Final acceptance will be effective upon successful testing as above and delivery of all relevant documentation. Operation of interfacing systems necessary to perform the integrated tests of the IC HVPS will be under IO responsibility.

5.4 Final Acceptance

After the preliminary acceptance of the delivery, the components shall be subject to the final acceptance tests at the PURCHASER's SITE, as set out in Section 5.3.
The final acceptance of the delivery by ITER-India shall be granted after the successful completion at the PURCHASER's SITE of this acceptance tests.

6 Codes and Standards

The design, manufacture and testing of all the supplied equipment shall be in accordance with the most updated issue of the relevant IEC Standards and Recommendations.
Components associated with the IC HVPS procurement shall comply with the European directives concerning CE marking, if applicable
(see: http://www.conformance.co.uk/directives/index.php)

A detailed list will be prepared during design stage (as per reference document, *Electrical Design Handbook*. Latest amendments will be adapted for all standards.

Part A(II-2), Annexure C: Quality & Site Specifications for IC HVPS

GeM Bid No.	**GEM/2025/B/6267679**
Title	**Part A(II-2), Annexure C: Quality & Site Specifications for IC HVPS**

ITER-India, Institute for Plasma Research
Block A, Sangath Skyz, Bhat-Motera Road, Koteshwar,
Ahmedabad 380005, Gujarat, India

Table of Contents

Acronyms & Abbreviations

CE	: Conformité Européenne
IC	: Ion Cyclotron
IC HVPS	: IC High Voltage Power Supply
EDH	: Electrical Design Handbook
ESP	: Equipment's Sous Pression meaning "Pressure Equipment's"
H&CD	: Heating and Current Drive
HV	: High Voltage
HVAC	: Heating, Ventilation and Air Conditioning
HVPS	: High Voltage Power Supply
IEC	: International Electrotechnical Commission
LV	: Low Voltage
M&TE	: Measuring and Test Equipment
NA	: Not Applicable
NSC	: Non-Seismic Category
PS	: Power Supply
QA	: Quality Assurance
QC	: Quality Class
RF	: Radio Frequency
SL	: Seismic Level
SPS	: Switched Power Supply
SIC	: Safety Important Component

1 Introduction

This document describes the Quality & site specifications for detail design, manufacturing, testing, supply and integration of the IC HVPSs. The objective of the "QUALITY PLAN" is to ensure that the product quality requirements and customer requirements are accurately determined and satisfactorily complied.

The purpose of this document is to implement the methodology to be adopted and ensure that the quality policy adopted for design, procurement, outsourcing, subcontracting, in house development/manufacturing, factory inspection and testing, shipping release, integrated testing at ITER-India site at Gandhinagar to meet ITER-India quality requirements.

2 Quality Classification for IC HVPSs components

The IC-HVPS System of Ion Cyclotron Heating & Current Drive System is assigned the following Quality Class according to the ITER Quality Classification Determination document (IDM Ref: ITER_D_24VQES). Components categorized as Quality 2 and 3, with no nuclear safety requirements.

IC HVPS is assigned the following Quality Class (Table 1).

Table 1 : Quality class for IC HVPS Components

Component Name	Quality See (B)	ESP	Safety	Seismic
22 kV input power cabling and associated trays	QC2	NA	Non-SIC	NSC
HVPS Multi-Secondary transformers	QC2	NA	Non-SIC	NSC
HVPS (converter/inverter/static switches modules, insula frames, etc.)	QC3	NA	Non-SIC	NSC
Output filter and passive protection components	QC3	See (A)	Non-SIC	NSC
HV Relays	QC3	NA	Non-SIC	NSC
27 kV output cabling and associated tray	QC3	NA	Non-SIC	NSC
Local Control and Protection Systems	QC3	NA	Non-SIC	NSC
Signal cabling between power and control sections and associated trays	QC3	NA	Non-SIC	NSC
Control cubicles	QC3	NA	Non-SIC	NSC
Cooling hydraulic circuit	QC3	NA	Non-SIC	NSC
Dummy Load with devices for wire-burn test	QC4	NA	Non-SIC	NSC

QC3 has been selected for components with short time replacement delay (off the shelf components) or for components with limited impact on IC system operation. QC2 has been selected for components with long replacement delay (multi-windings transformers) and which failure has an impact on IC system operation (loss of part of system power).

3 Safety requirements at site

The IC HVPS is classified as non-SIC (Safety Importance Component)

The primary hazards associated with the IC HVPS are those associated with high power electrical power conversion systems to ensure personnel safety, all aspects of the IC HVPS design and installation shall conform to applicable French codes and standards. The fences must be connected to the ground grid of the Site; all their metallic parts (frame, doors, panels etc.) will be linked to the ground bolt. ITER general earthing concept is described in the 'Electrical Design Handbook'.

Contractor/supplier shall ensure that all earthing connections between items of the supply, equipment enclosures and local earth connection points are provided. Provision of an adequate number of earthing points at various locations in building is responsibility of ITER site. Contractor/supplier shall ensure that the earthing connections shall be designed and performed for a single short-circuit withstand and consistent with the IEC 61140, NFC 13 200 and NFC 15 100. All the ground connections shall be easily spotted.

Connection to ground will take place at the load end (i.e. at the RF sources). One Connection point shall be provided by each RF source. Equipment earthing shall be in conformance with safety requirements at the ITER site. In order to permit safe access to the power supply systems, disconnectors and earthing switches shall be provided in each DC output of the IC HVPS system. Isolation and earthing of AC input is out of the scope of this tender. The earthed contacts of these switches are normally disconnected from the live parts of equipment during operation.

The earthing switches must be closed during shutdown/maintenance periods to connect the power supply components and their loads to earth, thus, providing safe access to the components by personnel. The switches or equivalent devices (e.g.: earthing stick) are to discharge the HV cables and ground them prior to human access within the HV enclosures to avoid all the dangerous states for the PS. The opening of the HV enclosures shall be allowed only after the switch has been closed (grounded). Similarly, the opening of the switch shall be possible only after the HV enclosures have been closed.

Individual fencing/enclosure for HVPS unit or couple of HVPS units and associated interlock key system shall be provided.

Contractor/supplier shall ensure that emergency push-buttons are provided at appropriate location. The emergency pushbutton shall Trip 22 kV IC HVPS input Circuit Breaker and notifies the controller. Insulation of components shall be tested with test voltages in accordance with relevant IEC Recommendations.

4 Hazard Analysis

The IC HVPS is considered as non- SIC (Safety Importance Component). The primary hazards associated with the IC PS are those associated with high power electrical power conversion systems. To ensure personnel safety, all aspects of the IC PS design and installation shall conform to applicable French codes and standards, and the European Directives as listed in the latest approved version of the 'Electrical Design Handbook'. Cast-resin transformers (F1 fire behaviour class) are required to limit fire risk and maintenance requirements.

All equipment shall operate without undue vibrations and with the lowest possible audible noise (also required during stationary conditions) to avoid any harmful effect to the equipment. All equipment prone to vibrations or loud audible noises are to be properly isolated (from adjacent structure) and/or insulated (from noise).

5 RAMI

RAMI requirements are specified in the ITER Project requirements document for the main functions necessary for the ITER machine operation and for the additional main functions necessary for the physics program. The IC HVPS sub-system shall contribute to the inherent availability objectives for

the IC H&CD system. The availability requirement for the ICH&CD PS is 99.8% to allow reaching an availability requirement of the overall ICH&CD system higher than 97%.

6 Investment Protection

IC HVPS feeds 3MW power to RF source; the power supply comprises of major components like multi-secondary transformers, SPS modules, controller etc. While fulfilling functional performance, power supply design is supposed to provide investment protection of all related equipment against possible damaging events.

Investment Protection analysis should include analysis with identification of such risk functions along with recommended/ included mitigating measures and derives ITER Interlock Integrity Level. according to MQP policy for ITER Investment protection (ITER_D_3VUMVWv4.1).

7 Requirements for Cleaning, Packaging, Transport and Storage

Contractor/supplier to provide "Specifications for Handling and Transportation" of all the procured components. These Specifications shall include, at least, the dimension and weight of each transported package and the detailed instructions for properly handling and transporting each package.

Contractor/supplier shall include in each package any stress sensor and provision to make possible an effective and easy monitoring of the package conditions and to ensure that the package itself and anything included is substantially sound.

The packaging must provide adequate mechanical and environmental resistance to road and/or ship transport. The packaging must provide adequate attachments for loading and unloading by crane or equivalent lifting/moving tools and for its stable fixation on trucks and ships.

The sub-components forming the IC HVPS system and their parts shall be packaged and loaded for overland transport respecting the size and weight limits indicated in the European Directive 96/53/CEE dated 25 July 1996. It is assumed that standard limits will be respected.

In order to ensure a clear identification of the components transported in the package, the Contractor/supplier shall identify all the components by a metallic or plastic plate attached to the component, where the identification code (ID) is written. The ID will be deduced from the reference document "ITER Numbering System (ITER_D_28QDBS)".

The packaging of the components, ready for shipment, shall be inspected at the manufacturer premises to verify the respect of the requirements for transport. The inspection shall consist of a visual verification of the packaging and of a review of the formal and technical documentation for transport. The inspection and documentation verification shall be performed with the presence of representatives of the ITER-India. An official note of the inspection shall be prepared and approved by the representatives.

The handling must be performed adopting procedures that minimize the risk of damages to the components. The storage must prevent any possibility of contact with any contaminant agent.
ITER-India shall under take road and ship transports using the most appropriate carriers.

Contractor/supplier shall provide all the documentation requested by the local authorities to deliver the components to PURCHASER's SITE.

At the arrival in the ITER site, the packaging containing the components ready for unloading shall be checked. This check shall consist in:

- Visual verification of the packaging;

- Checking of shock recorders and/or acceleration sensors prepared to monitor shocks and vibrations during transport;
- Checking of all the requested administrative documentation.

An official note of the check shall be prepared and approved by representatives of the Supplier/ITER-India.

Specific preservation plan be produced by Contractor/supplier if needed for specific components. Preservation duration may last up to 30 months after the equipment is received at PURCHASER's SITEs.

8 Site conditions

8.1 Ambient conditions

Ambient conditions for the ITER Building is summarized in the Table 2

Table 2: Indoor ambient conditions controlled by the HVAC system

Conditions	Value
Indoor temperature range	10 to 35 °C
Indoor temperature range tolerance	±2 °C
Room relative humidity	15 to 85 %
Minimum fresh air requirement	30 m^3/hr/person
Room pressure relative to outside environment	Positive
Minimum filtration efficiency: filter class (EN 779)	G4/F7

8.2 Seismic Conditions

The IC HVPS is classified NSC (Non-Seismic Category) according to ITER Seismic Nuclear Safety Approach (no seismic requirements for safety) and shall be subject to a seismic analysis. The IC HVPS shall be designed to restart and operate after an SL-1 event without special maintenance or test. Floor response spectra for the system are to be considered as per the Load Specification for the IC H&CD HVPS (ITER_D_898A2R v2.0).

8.3 Facilities in the ITER Building

The RF Building structure shall provide the following systems and services (in general, may not be accessible to Contractor/supplier) to ensure the necessary conditions and a suitable environment both for the staff and the equipment:

- Protection and containment for any water leaks from the assorted cooling water systems that are to be distributed through the building
- Lighting and service power;
- Fire detection, alarm and suppression;
- Drainage systems;
- Earthing system and lightning protection;
- Heating, Ventilation and Air Conditioning system, including associated hot and chilled water distribution systems;
- 5-tonne SWL Electric Overhead crane
- Potable water and drainage for personnel requirements where necessary;
- Access control system;
- Internal Communication system;

- Compressed air (dry) system.
- Nitrogen
- Temporary power supplies during installation for tooling etc.
- Access control system, security systems and communication services
- Local support
- Office space
- Use of workshop
- Telephone lines/ internet access etc.