	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q


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<b>Title</b>	<p><b>GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources</b></p> <p><b>Part A(ii): Technical</b></p>
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Author	ITER-India, IPR
Contributors	ITER-India, IPR

Distribution list	Potential Bidders
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Written by	Reviewed by	Approved by
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**Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources**

***TWO PART TENDER***


**ITER-India, Institute for Plasma Research**

**Block A, Sangath Skyz, Bhat-Motera Road, Koteswar,**

**Ahmedabad 380005, Gujarat, India**


<https://www.iterindia.in>




	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
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## Acronyms

A	Ampere
ATTP	Authorization to Proceed
AM	Amplitude Modulation
AC	Alternating Current
CCE	Control Command Embedded
CODAC	Control, Data Access and Communication (ITER subsystem)
COG	Centre of Gravity
COTS	Commercial of The Self
CG	Control Grid
CGPS	Control Grid Power Supply
CW	Continuous Wave
DAE	Department of Atomic Energy
DC	Direct Current
DDC	Digital Down Conversion
DMDI	De-mineralized De-Ionized
DL	Dummy Load
DRR	Delivery Readiness Review
FM	Frequency Modulation
EDR	Engineering Design Review
FDR	Final Design Review
FRR	Fabrication Readiness Review
FAT	Factory Acceptance Test
FPGA	Field-Programmable Gate Array
FPS	Filament Power Supply
GUI	Graphical User Interface
GIP	Generated Intellectual Property
HPA	High Power Amplifier
HPA2	Driver Stage Amplifier
HPA3	Final Stage Amplifier
HVPS	High Voltage Power Supply
HP	Hold Point
Hz	Hertz
ICH&CD	Ion Cyclotron Heating & Current Drive
ICD	Interface Control Document
IO	ITER Organization
IP	Intellectual Property
IIP	Information and Intellectual Property
IPR	Institute for Plasma Research
JIA	Joint ITER Agreement
kV	Kilo Volt
LCU	Local Control Unit
LoI	Letter of Intent
LPM	Litre per minute

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MMTL	Mismatch Transmission Line
MTBF	Mean Time Between Failure
MIP	Manufacturing & Inspection Plan
MRR	Manufacturing Readiness Review
NP	Notification Point
PM	Pulse Modulation
P&ID	Piping & Instrumentation Diagram
PFD	Process Flow Diagram
PDR	Preliminary Design Review
PON	Plant Operation Network
PRV	Pressure Reducing valve
PSH	Plant System Host
PSM	Pulse Step Modulation
PS	Power Supply
ph	Phase
PE	Protective Earth
RAMI	Reliability, Availability and Maintainability Inspection
RF	Radio Frequency
Req	Equivalent Resistor
R&D	Research & Development
RMS	Root mean Square
SAT	Site Acceptance Test
SDN	Synchronous Databus Network
SG	Screen Grid
SGPS	Screen Grid Power Supply
SSPA	Steady State Power Amplifier
TCN	Time Communication Network
TED	Thales Electron Devices
TL	Transmission Line
TTL	Transistor-Transistor Logic
VSWR	Voltage Standing Wave Ratio
V	Volt
+Ve	Positive Voltage
VAC	AC Voltage
Vref	Reference voltage

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## 1 Introduction

ITER is a multinational R&D project, which aims to demonstrate scientific & technical feasibility of fusion power. The ITER project is being jointly constructed at St. Paul lez Durance Cedex, France by the 7 Countries (European Union, Japan, China, India, Korea, Russia and USA). The Institute for Plasma Research (IPR) which is an aided scientific institute under DAE, Govt. of India, is nominated as a nodal agency for implementation & coordination of some of ITER-subsystems through its ITER-India empowered body. One of such subsystems is the Ion Cyclotron Heating & Current Drive (ICH&CD) RF source.

The ITER ICH&CD system requires **1 (prototype) + 8 (bulk production) RF sources**, each providing 3.0 MW / 3600s / 40 - 55 MHz at VSWR 1.5 with any phase of reflection coefficient. However, measuring devices shall have capability to measure RF power up to  $\geq 3.5$  MW and VSWR 2.

Each RF source shall be made with two identical chains, 3dB Hybrid combiner and a local control unit (LCU) controlling the function of RF source. The RF chain shall be tuneable for the frequency range of 35-65MHz. However, the operating frequency range shall be 36-60MHz to check the full performance at high power and 1dB bandwidth for  $\pm 1$  MHz, as per **Section 6.1** and **Section 6.2**

Each chain consists of low power RF section, high power tube-based amplifiers, related electrical power supplies.

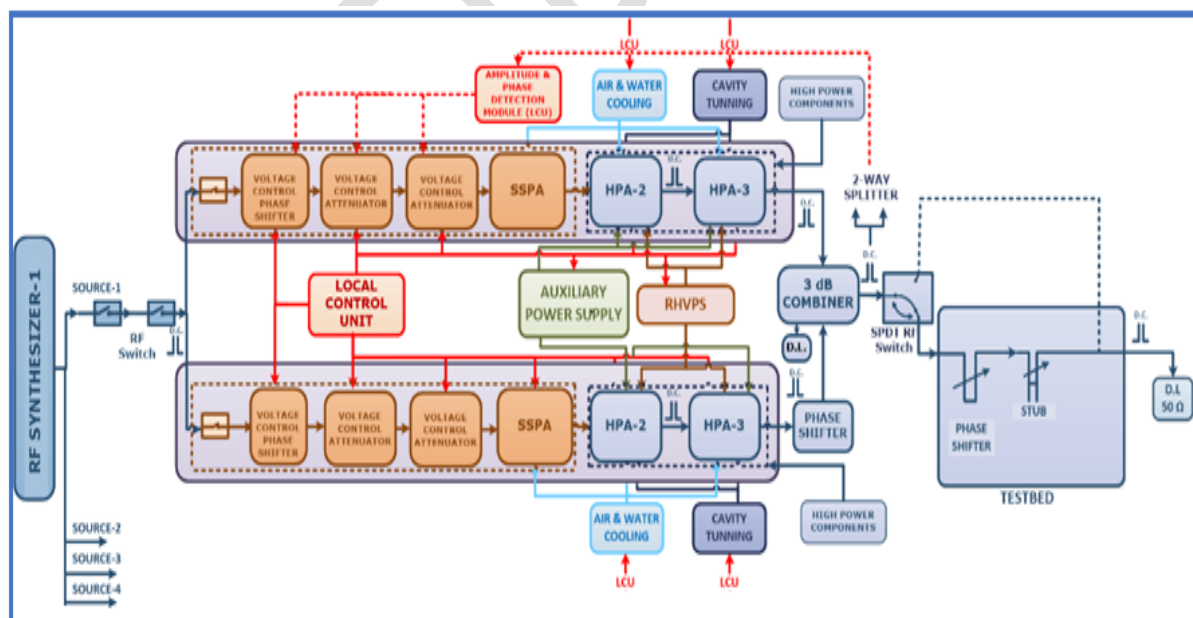



Fig. 1: Block diagram of 3.0 MW RF Source

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The different phases of this project are as follows:

**Phase 1:** Tube qualification phase using single chain (R&D) experimentation - 1.5 MW / 2000s / 35- 65 MHz at VSWR 2.0 with any phase of reflection coefficient.

**Phase 2:** Prototype phase (2 no. of RF Source i.e. Prototype + Unit-1 RF Source) - 3.0 MW / 3600s / 40 - 55 MHz at VSWR 1.5 with any phase of reflection coefficient.

**Phase 3:** Bulk production (2 no. of RF sources i.e. Unit-2 to Unit-3 RF Sources) - 3.0 MW / 3600s / 40 - 55 MHz at VSWR 1.5 with any phase of reflection coefficient.

**Phase 4:** Bulk production (5 no. of RF sources i.e. Unit-4 to Unit-8 RF Sources) - 3.0 MW / 3600s / 40 - 55 MHz at VSWR 1.5 with any phase of reflection coefficient.

ITER-India has completed R&D phase (**Phase 1**) in March 2019 and presently in a position to initiate the procurement activities related to **Phase 2**. ITER-India is seeking a suitable offer for components & subsystems other than Driver and Final stage amplifiers for ITER ICRF Sources under Phase 2 from the Bidder

**This tender document is for 2 sets of components & subsystems other than Driver Stage Amplifier (HPA2) & Final Stage Amplifier (HPA3) for two RF sources of Phase 2.**


**Bidder shall be responsible for transportation of their supplied components to ITER-India lab. At ITER-India lab bidder will be responsible for assembly and validation of their supplied component/sub-system. Bidder shall be responsible for integration and commissioning of their supplied components/sub-system with Prototype and Unit-1 RF source.**

**For prototype RF source, bidder will support for integrated performance demonstration of 3 MW RF power under responsibility of the ITER-India at ITER-India lab. However, bidder will be responsible for the integrated performance demonstration of their supplied components and subsystems.**

**For Unit-1 RF source, bidder will be responsible for integrated performance demonstration of 3MW RF power with support from ITER-India at ITER-India lab for integration<sup>#</sup> & operational<sup>##</sup> perspective.**

**At Purchaser's site (ITER Organization, Saint-Paul-Lez-Durance, France) the bidder will support for validation of interfaces related to each supplied component/subsystem. Bidder need to supervise for assembly & integration of their supplied component/sub-system at Purchaser's site as well as supervising of preparatory activities and commissioning work of prototype and unit 1 RF source. Bidder will be responsible for integrated performance demonstration of 3MW RF power with support from ITER-India for integration<sup>#</sup> & operational<sup>##</sup> perspective. ITER-India will be responsible for**

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**arranging an integrator (through separate contract) for assembly, integration & commissioning of the bidder's supplied components and sub-system of the Prototype and Unit 1 RF source.**

**Driver Stage Amplifier (HPA2) & Final Stage Amplifier (HPA3) for two RF sources will be provided by ITER-India during the assembly, integration and integrated performance demonstration at ITER-India lab and SAT at Purchaser's site.**

***# Integration means interconnection of bidder supplied components with rest of the system as per finalized layout and with respect to signal exchange/communication.***

***##Operation perspective means functional demonstration of bidder supplied components with rest of the system to achieve 3 MW RF power.***


**The reference design of different components & subsystems will be provided by ITER-India, Bidder need to;**

- 1) Improve the design for making components & sub-systems to the industrial grade, compact and apply the required standardization and certifications, to use the system at Purchaser's site, without hampering functional requirement.
- 2) Fabricate sets of components & subsystems for prototype RF source, conduct required tests to get CE certifications wherever applicable, legal inspection clearances to comply ITER requirements. Bidder need to conduct FAT, perform integrated performance demonstration at ITER India lab and SAT at Purchaser's site.
- 3) Fabricate similar sets of components & subsystems for Unit-1 RF source, conduct FAT, perform integrated performance demonstration at ITER India lab and SAT at Purchaser's site.
- 4) Participation in testing of all the RF chains as per technical specifications **Table 3** and responsible for performance of their supplied components & sub-systems as per responsibility sharing matrix defined in **Table 1**.
- 5) Participation/Responsibility in testing of prototype and Unit 1 RF sources as per Responsibility sharing Matrix defined in **Table 1** and as per technical specifications mentioned in **Table 5: Major specifications for 3.0 MW RF Source**.
- 6) Preparation of required documents for FDR, FRR and MRR and participation in review meetings accordingly.

Major components & sub-systems as required for prototype and unit-1 RF source are listed below:


### ***1.1 List of components:***

The list of deliverables (Purchaser's Site) components & sub-systems is mentioned below:

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S. No.	Description of item	Quantity		Design Input Data references
		Prototype RF source	Unit 1 RF source	
1.	Mechanical system as per layout <b>Annexure-I</b> : Proposed RF source Layout, Grounding materials as per grounding scheme, Cable trays, Complete water-air cooling headers, water- & air-cooling accessories along with instrumentation and cables for monitoring & control purpose of the components supplied, specific jigs, fixtures & lifting arrangement etc. RF source enclosure, support frame, Base frame, service platform with ladder to accommodate components supplied by the Bidder and component supplied by ITER-India for RF source	01 set of mechanical systems	01 set of mechanical systems	See Section 17.1(Annexure-H1)
2.	HPA1 (~8 kW Solid State Power Amplifier-SSPA) including Low Power RF Section: Power Divider (s), RF Switch, Voltage Controlled Attenuator, Directional Coupler	01 set containing 02 units of SSPA	01 set containing 02 units of SSPA	See Section 17.3 (Annexure-H3)




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S. No.	Description of item	Quantity		Design Input Data references
		Prototype RF source	Unit 1 RF source	
3.	Low Power RF Components (for LCU cabinets)	01 set of low power RF components	01 set of low power RF components	See Section 17.4 (Annexure-H4)
4.	Auxiliary Power supplies (Aux.PS) with required cables, Grounding strips/cables with connecting accessories etc	01 set containing 02 units of Aux. PS	01 set containing 02 units of Aux. PS	See Section 17.5 (Annexure-H5)
5.	LT Panels (one for Class IV and one for Class II AC systems) with required output cables to connect with different load points	01 set containing 01 unit of LT Panel	01 set containing 01 unit of LT Panel	See Section 17.6 (Annexure-H6)
6.	Local Control Unit (LCU) with required fibre optic and copper cables to connect with different systems / sub-systems.	01 set containing 1 unit of LCU	01 set containing 1 unit of LCU	See Section 17.7 (Annexure-H7)
7.	ARC detection system with required fibre optic cables to connect with different detection points	01 set containing 02 unit of ARC detection system	01 set containing 02 unit of ARC detection system	See Section 17.8 (Annexure-H8)
8.	Transmission line components as per layout (Tx-line): Inter-connecting transmission line sections including all directional couplers & Gas Barriers and Gas Inlet Tees in between  (1) 3 inch for HPA1 to HPA2 (2) 6 inch for HPA2 to HPA3	01 set of Transmission line and additional Transmission line components	01 set of transmission line components and additional transmission line components	See Section 17.9 (Annexure-H9)



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S. No.	Description of item	Quantity		Design Input Data references
		Prototype RF source	Unit 1 RF source	
	(3) 12 inch for HPA3 to 3dB Hybrid combiner (4) 12 inch for 3dB Hybrid Combiner output to Test bed  additional Transmission line components:  1. 3 inch-N, 6 inch-N & 12 inch-N adaptors 2. 3dB Hybrid Combiner with 12 to 6-inch reducer, 6-inch Tx line components & 6-inch directional coupler			
9.	RF Accessories like Fixed attenuators of various values & power ratings, various RF adaptors, RF filters, RF detectors, RF cable assemblies, 50 ohms terminations of various power ratings, 200kW dummy load for combiner assembly, integration and commissioning of all components/Sub-systems in RF source	01 set of RF accessories	01 set of RF accessories	See Section 17.10 (Annexure-H10)
10.	Key-Management System	01 set of Key-Management System	01 set of Key-Management System	See Section 17.11 (Annexure-H11)
Components & subsystems common for prototype and Unit 1 RF sources				
11.	RF Signal Generator	01 Set	-	See Section 17.2 (Annexure-H2)
12.	Low Power RF Components (for Plant I&C)	01 set (Plant I&C)	-	See Section 17.4 (Annexure-H4)

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S. No.	Description of item	Quantity		Design Input Data references
		Prototype RF source	Unit 1 RF source	
13.	Test & Measuring Instruments	01 set	-	See Section 17.12 (Annexure-H12)
14.	Measuring Instruments and Software packages	01 set (Measuring Instrument)	01 set (Software Packages)	See Section 17.13 (Annexure-H13)

**Note:** Bidder shall manage the commissioning spares during assembly, integration and integrated performance demonstration at ITER-India lab and SAT at Purchaser's site as well as during warranty period.

## 2 Contract Execution

### 2.1 Kick off meeting

Kick off meeting will be held within 1 month from effective date of contract.

All technical data related to interfaces or Components supplied by ITER India will be confirmed at the kick off meeting. Detailed schedule, preliminary quality assurance plan, Manufacturing & Inspection Plan with all control points listed will be discussed during this meeting.


The input data package for the preparation of FDR documents will be provided by ITER-India after getting approval from IO.

The description of components and subsystems, its scope of work, specification, condition for acceptance etc. are described in respective **Annexure-H (Section17)**.

Bidder will present their understanding for FDR management scheme, if any during the kick off meeting so that IO/ITER-India can be satisfied to understand that the bidder is fully aware about the design review process.

### 2.2 Accommodation of components as per Layout

The bidder will be involved in finalization of RF source layout based on the reference layout as shown in **Annexure-I (Section 18)**. The bidder needs to accommodate their supplied components & sub-systems in the final layout.

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### 2.3 Phase-2 (Prototype + Unit-1 RF source): Manufacturing and testing

- A. The components & sub-systems with their supports will be fabricated by the Bidder as per Table 2 required for prototype & Unit-1 RF source. Bidder will test these components/sub-systems at the factory as per condition for acceptance (respective **Annexure-H (Section 17)**) before transportation to ITER-India lab.
- B. During assembly, integration and integrated performance demonstration at ITER-India lab, the components/sub-systems shall be supplied as per **Table 2**, tested as standalone mode, assembled and integrated by the Bidder with High Power Amplifiers (HPA2 & HPA3) provided by ITER-India.
- C. Bidder need to provide detail work package containing assembly/integration/commissioning procedures with user and maintenance manual for their supplied components & sub-systems.
- D. Under the supervision of ITER-India, bidder need to support for validation of various components/sub-systems (interfaces provided by IO) at purchaser's site. Bidder also need to carry out all the necessary activities to get the clearance (legal inspection) for their supplied components and sub-systems operational at Purchaser's site.
- E. Bidder need to supervise for assembly, integration of their supplied component/sub-system at Purchaser's site and commissioning of prototype and unit 1 RF source.

### 2.4 FDR, FRR, MRR & DRR


After placing the contract, Final Design Review [29] (FDR) will be conducted.

The fabrication of components & sub-systems of prototype RF source will be initiated only after closure of final Design Review (**FDR**). The Go-ahead signal will be given by ITER-India to bidder for initiation of fabrication.

There will be Fabrication Readiness Review (**FRR**) performed for components under this tender, by ITER-India after successful factory acceptance testing of 1<sup>st</sup> unit of components/subsystems of the prototype RF source to continue the production of balance components/sub-systems. After FRR, if minor changes are required in components/sub-systems supplied by the Bidder, those changes will be implemented in the system and validated again at MRR.

There will be Manufacturing Readiness Review (**MRR**) to get formal approval from ITER Organization after successful assembly, integration and integrated performance demonstration of the prototype RF source at ITER-India lab. During Manufacturing Readiness Review (**MRR**) [30] retrofitting action will have to be implemented on the prototype RF source, if required. After completion of MRR, no changes are anticipated for bulk production of components & sub-systems.

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There will also be Delivery Readiness Review (**DRR**) to get formal approval from ITER-Organization to deliver the component/subsystem at Purchaser's Site. During **DRR** [27], the complete set of documents need to be submitted for review & approval.

As these components are ITER deliverables, ITER Organization will be involved during technical activities of this project.

## 2.5 Overall Time Schedule

The Bidder shall produce a detailed Schedule for each components/sub-system showing all phases of the Contract and showing how the overall ITER-India Schedule will be complied with the required delivery date defined in **Annexure-C (Section 12)**. This detailed schedule shall be submitted along with bid to the ITER-India for final agreement during the bid evaluation.

Bidder should complete the activities as per approved schedule.

## 3 Main Responsibilities

The main responsibilities between the Parties is summarised in **Table 1** and is further detailed are specified in **Section 3** the scope of work and scope of supply.

Following letters are used in the **Table 1**

R = Responsible

A = Review/Comment/Accept/Approve


S = Support

Su = Supervision


**Table 1: Responsibilities between ITER-India/IO and the Bidder**

Activity	Bidder	ITER-India	IO
<b>Technical Report</b>			
Submission of technical reports & execution plans to complete the overall scope of work including ROX and MIPs	R	A	A
<b>Manufacture, FAT and Delivery of components-Sub-systems.</b>			
Final Design Review (FDR)	S	R	A
Material procurement and Manufacturing.	R	A	A
Factory Acceptance Testing (FAT) in compliance to different certification requirements.	R	A	A
Fabrication Readiness Review (FRR)	R	A	A
Packing	R	A	A
Transportation to the ITER-India lab.	R	S	-

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Activity	Bidder	ITER-India	IO
<b>Receipt &amp; Acceptance of components-Sub-systems at ITER-India lab</b>			
Receipt and Physical verification of packing box	A	R	
Unpacking and physical inspection of supplied components	R	S	
Assembly, integration and performance demonstration in standalone mode of <b>components &amp; Sub-systems</b>	R	A	A
Assembly and integration of bidder supplied <b>components &amp; Sub-systems</b> in the prototype and Unit 1 RF source (Two RF chains with Combiner per RF source) as per RF source layout	R	A	A
Integrated performance demonstration of bidder supplied components & Sub-systems for 1.6 MW RF power <b>from each chain of RF source</b>	R	A	A
Integrated performance demonstration of proto-type RF source	S	R	A
Manufacturing Readiness Review (MRR)	S	R	A
DRR for Proto type RF source	R	A	A
De-assembly and Packing of supplied components for Prototype RF source (FCA) at Contactor's Site	R	S	-
Shipment of supplied components/sub-systems of Proto type RF source to Purchaser's site	S	R	S
Integrated performance demonstration of Unit-1RF source	R	A	A
DRR for Unit-1 RF source	R	A	A
De-assembly and Packing of supplied components for Unit-1 RF source (FCA) at Contactor's Site	R	S	-
Shipment of supplied components/sub-systems of Unit-1 RF source to Purchaser's site	S	R	S
<b>Receipt &amp; Acceptance of components/Sub-systems for prototype and Unit 1 RF source at purchaser's site</b>			
Receipt, Physical verification and unpacking of supplied components	Su	R	A
Validation of various interfaces provided by IO	A	S	R
Assembly & integration of bidder supplied <b>components &amp; Sub-systems</b> in the prototype and Unit 1 RF source (Two RF chains with Combiner per RF source) as per RF source layout	Su	R	S
Integration checks of each <b>components/Sub-systems</b> in the amplifier chains / RF sources as per agreed layout	R	A	A
Integrated performance demonstration of bidder supplied components & Sub-systems for 1.6 MW RF power <b>from each chain of RF source</b>	R	A	A
Integration of RF chain output or RF source output with 3.0 MW Dummy load	Su	A	R

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Activity	Bidder	ITER-India	IO
Performance demonstration of the RF sources (Proto-type & unit-1) during SAT	R	A	A

#### 4 Scope of work and Scope of Supply

**Table 2** in **Section 4.1** is describing the main items to be delivered. The preliminary bill of material for individual components & subsystems defined in **Table 2** shall be submitted along with offer.

The reference design of components/Sub-systems will be provided by ITER-India. However, modifications may be required to fit with IO interfaces, integration requirements, CE marking, legal inspection & French regulation certification requirement. The same will be reviewed and approved by ITER-India/IO.

The bidder shall take services of sub-contractors/consultants as listed in the **Annexure-E (Section 14)** for fabrication/CE/legal inspection/French regulation, etc.

Bidder shall perform analysis tasks as described in **section 4.3**

Essential services will be provided by the Bidder as described in **section 4.4** for assembly, integration of components supplied by bidder at ITER-India lab and Purchaser's site. Bidder shall provide support in acceptance process of the RF sources.

Documents to be delivered by Bidder during the execution of the contract are described in **section 4.5**.

##### 4.1 Hardware deliverable:


Bidder shall be responsible for components & sub-systems as per **Table 2**, to fulfil the requirements for prototype & Unit-1 RF source.

**Table 2** describes list of the major items as deliverables related to Prototype & Unit-1 RF Source, however, it shall be detailed out by the Bidder.

**Table 2: Hardware deliverables (Prototype + Unit-1 RF Source)**

Sr. no.	Description of item
1	Mechanical system as per lay out: Grounding materials as per grounding scheme, Cable trays, Complete water-air cooling headers with PRV, water-air cooling accessories along with instrumentation and cables for monitoring & control purpose of the components supplied, specific jigs, fixtures & lifting arrangement etc. RF source enclosure, support frame, Base frame, service platform with ladder




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Sr. no.	Description of item
	to accommodate components supplied by the Bidder and component supplied by ITER-India for RF source
2	HPA1 (~ 8kW Solid State Power Amplifier-SSPA) including Low Power RF Section: Power Divider (s), RF Switch, Voltage Controlled Attenuator, Directional Coupler
3	Low Power RF Components: For LCU cabinet
4	Auxiliary Power supplies (Aux.PS) with required cables, Grounding strips/cables with connecting accessories etc.
5	LT Panels (one for Class IV and one for Class II AC systems) with required output cables to connect with different load points
6	Local Control Unit (LCU) with required fibre optic and copper cables to connect with different load points
7	Arc Detection System with required fibre optic cables to connect with different detection points
8	<p>Transmission line components as per layout (Tx-line): Inter-connecting transmission line sections including all directional couplers &amp; Gas Barriers and Gas Inlet Tees in between:</p> <ol style="list-style-type: none"> <li>(1) 3 inch for HPA1 to HPA2</li> <li>(2) 6 inch for HPA2 to HPA3</li> <li>(3) 12 inch for HPA3 to 3dB Hybrid combiner</li> <li>(4) 12 inch for 3dB Hybrid Combiner output to Test bed</li> </ol> <p>Other Tx line components:</p> <ol style="list-style-type: none"> <li>1. 3 inch-N, 6 inch-N &amp; 12 inch-N adaptors</li> <li>2. 3dB Hybrid Combiner with 12 to 6-inch reducer, 6-inch Tx line components &amp; 6-inch directional coupler</li> <li>3.</li> </ol>
9	RF Accessories i.e. Fixed attenuators of various values & power ratings, various RF adaptors, RF filters, RF detectors, RF cable assemblies, 50 ohms terminations of various power ratings, 200kW dummy load for combiner assembly, integration and commissioning of all components/Sub-systems in RF source
10	Key-Management System
11	RF Signal Generator (Each will be used for four RF sources, 1 for Purchaser's site & 1 for ITER-India lab)
12	Low Power RF Components: For Plant I&C
13	Test & Measuring Instruments
14	Measuring Instruments & software

Bidder shall be responsible for transportation of items from factory to ITER-India lab [7].

#### 4.2 Tasks related to integration

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This task is focused on the integration of the component with RF sources (prototype + Unit-1). It includes verification of the interface details and accommodation in the overall layout. It includes in particular:

- The components/sub-systems fabricated by Bidder shall be accommodated in the finalized layout based on reference layout shown in the **Annexure-I (Section 18)**.
- Bidder shall generate final 3D models of components/ sub-systems based on inputs given by ITER-India as per **Annexure-I (Section 18)** and submit to ITER-India for approval. This information is required for structural and seismic analysis of overall RF source as per **Section 6.4**
- To provide technical report describing interfaces, protections, motor configuration, assembly & dis-assembly plan, test procedures and formats of test report for components & sub-systems as per Manufacturing and Inspection Plan (MIP).
- To provide implementation scheme for key management system (for protection against electrical hazards during maintenance) for approval of ITER-India.
- All the CAD design work for electrical & mechanical works bidder shall follow the CAD design manual [23]

#### 4.3 Analysis tasks


- ITER-India will provide necessary inputs for HP components to bidder. Bidder need to generate necessary parameter for RAMI analysis for their components & subsystems and perform RAMI analysis for full RF source as per doc [35] using latest version of software ReliaSoft BlockSim.
- To provide details of applicable standards & procedures to get required certifications of the individual components/sub-systems. Details of individual components/sub-systems are given in **Annexure-H (Section 17)**.
- To perform structural and Seismic Analysis as per **section 6.4**.

#### 4.4 Tasks related to performance demonstration at ITER-India lab

The following tasks are required from the Bidder:

- To submit final quality assurance plan and MIP as per guidelines [2], [4], for ITER-India/IO approval.
- To procure the material/components and fabricate/integrate the deliverable hardware as per **section 4.1**
- To get applicable certifications (i.e. CE marking & French legal inspection) of the individual components & sub-systems, to deliver, install and commission at Purchaser's site.
- To prepare factory acceptance test (FAT) procedures mutually with ITER-India for components/sub-systems and submit it to ITER-India/IO for approval




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- To conduct Factory Acceptance Test (FAT) of components/sub-systems to meet the specification as per “Conditions for Acceptance at factory” as described in respective sections of **Annexure-H (Section 17)** in presence of ITER-India/IO representative.
- LCU design document shall be in line with PCDH guideline [11], ICH operation mode as defined in "ICH System Concept of Operation[34] "
- To transport the components/sub-systems from factory to ITER-India lab.
- To unpack, assemble, integrate and conduct performance demonstration for components/sub-systems as stand-alone mode as per “the condition for acceptance at ITER-India lab” as described in each section of **Annexure-H (Section 17)**, in presence of ITER-India/IO representatives.
- To generate the validation report as given in **Annexure-G (Section 16)** for interfaces at ITER-India lab.
- To demonstrate integrated performance of their supplied components/sub-systems at ITER-India lab as per responsibility sharing matrix **Table 1**.
- To participate in the high power RF test of RF chain at 1.6 MW as per responsibility sharing matrix given in **Table 1**. Error! Reference source not found. Demonstration of performance of their supplied components/sub-systems will be the responsibility of Bidder.
- To Integrate and install the combiner and related transmission line components supplied by the Bidder at the outputs of HPA3 as per responsibility sharing matrix given in **Table 1**. Error! Reference source not found.
- To participate in the combined RF high power test at 3.0 MW as per responsibility sharing matrix **Table 1**. Demonstration of performance of their supplied components/sub-systems will be the responsibility of Bidder. ITER-India will be responsible for performance demonstration of 3MW output for prototype RF source. Bidder will be responsible for performance demonstration of 3MW output for Unit-1 RF source at ITER-India lab for integration & operational perspective.
- To prepare documents, presentation and participate remotely or in-person as a team with ITER-India in Final Design Review/Fabrication Readiness Review/Manufacturing Readiness Reviews/Delivery Readiness Reviews (FDR/FRR/MRR/DRR) conducted with IO as per responsibility sharing matrix given in **Table 1**. and resolve the queries, if any, including performing necessary modification, re-calculation and submission of report etc. for the components/Sub-systems supplied by the Bidder.
- To de-assemble and re-pack the supplied components/Sub-systems and handover for FCA at Contactor’s Site.
- To repair/ replace of components /sub-systems supplied by Bidder free of cost, in case of failure during installation, commissioning and integrated performance demonstration at ITER-India Lab.

#### **4.5 Supervision tasks at Purchase’s Site**

Purchaser shall intimate the contractor about the date of deputation for supervision work at Purchaser’s site in minimum 45 days in advance. The contactor shall depute their expert manpower at defined date without fail. The date of reporting of contractor’s manpower at Purchaser’s Site for the first job is considered as mobilization.

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The following tasks are required from the Bidder:

- Contractor shall ensure to depute their supervisor/s<sup>1,2</sup> as per the schedule at Purchaser's Site and shall be present throughout the activities.

#### **Preparatory activities:**

- To Supervise the validation of interfaces provided by ITER and generate validation reports as given in **Annexure-G (Section 16)** for interfaces at purchaser's site.
- To supervise assembly, installation and integration of two sets of components/sub-systems for Prototype & Unit-1 RF source at Purchaser's site as per **Table 1**.
- To supervise testing of individual component as per approved test procedure.

#### **Integrated Performance Demonstration activities:**

- To supervise site acceptance test of two sets of components/sub-systems related to prototype & Unit-1 RF source at Purchaser's site as per Table 1. Error! Reference source not found.. Bidder will be responsible for performance demonstration of 3MW output for Prototype & Unit-1 RF source at Purchaser's site for integration & operational perspective.

#### **Other Activities:**

- To repair/ replace of components /sub-systems supplied by Bidder free of cost under warranty, in case of failure during installation & commissioning at Purchaser's site.

Note 1: Deputation of contractor's personnel for supervision shall be from the relevant field & will be finalized mutually well before deputation.


Note 2: ITER-India will notify the Contractor about deputation date in 45 days (minimum) advance of the mobilization.

### **4.6 Documents to be delivered by Bidder**

#### **4.6.1 General Instruction**

- All the documents shall be in duplicate as hard copy print and soft copy.
- The Bidder shall prepare all documents in English only.
- The Bidder shall ensure that all documents and records are uniquely identified and traceable by tender references, including subsequent revisions, and are made accessible to ITER-India and IO authorized individuals [24].
- Bidder shall provide:
  - All documentation necessary to determine the progress and status of the work;
  - All documentation necessary to control and management of non-performing components within the scope of this tender.
  - Day-to-Day correspondence and administration between the Parties (ITER-India & Bidder) need to be documented.
- The Bidder shall issue, manage and control its documents and records in accordance with its own QA Program.
- All units which will be used for execution of this tender shall be in ISO metric only

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- All the CAD design work for electrical & mechanical works bidder shall follow the CAD design manual [23].

#### 4.6.2 During offer

- Inco term
- Document (SUD) and compliance matrix **Annexure-K (Section 20)** of the tender document.
- Bidder shall submit confirmation to Intellectual Property Rights (IPR) provision as per **Annexure-B (Section 11)**. The Bidder shall declare all Intellectual Property and Information which is held by the Bidder prior to the signature of the Contract or outside its scope and which is needed for carrying out the Contract.
- Detailed Bill of material (BOM) [32] for the items/systems/sub-systems/components with respect to Annexure-H1 to H13 (**Section 17** of Part-A(ii)) and plan for 10 years' availability from the date of contract signature.
- Procurement plan for COTs (with proposed make/s) & Non-COTs items, including qualification requirement.
- Submit the obsolescence management plan of components/sub-systems.
- Submit plan for engaging third party services for CE certifications & NFC compliances.
- QMP documentation shall be submitted.
  - Quality plan along with implementation procedure
  - Realistic Schedule with links and logics
  - Risk Mitigation Plan
  - Packing & transportation plan

#### 4.6.3 During execution

- Technical report for components/sub-systems supplied by Bidder containing the following data/content:
  - Detailed part wise 3D model (submission of compatible files as per ITER-India's requirement) of components supplied by Bidder containing assembly, sub-assembly and components, as per layout [23] and confirmation on weight of individual components and Sub-systems.
  - Updated Bill of Material (BOM) according to IO bill of material template provided by ITER-India.
  - Material procurement documents (unpriced PO copy).
  - Interface Control Document (ICD) with respect to components supplied by Bidder
  - Detail of peripherals containing:
    1. Structural and seismic analysis for the support structure as per **section 6.4**.
    2. Hydraulic diagrams (PFD & P&ID) for water & air-cooling distribution system along with instrumentation, sensors etc.
    3. Cabling diagrams (different types of cables, connectors, cable trays etc.) with cable TAG identification according to IO numbering system (document will be provided by ITER-India), Wiring diagram inside system/cubicles
- MTBF values of components supplied by Bidder.
- For LCU (refer **Annexure-H (Section 17)** of Part-A(ii)):


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- Necessary signal list (digital as well as analog) related to monitoring, local protection, remote operation and control of the RF source through LCU.
- Interface control document based on information given in **Annexure-F (Section 15)**.
- Lookup/conversion tables for measuring parameters for cooling (water & air).
- All the information/documentation as per **Annexure-H (Section 17)** of Part-A(ii) shall be made available for smooth operation of LCU
- Updated Quality Management Plan (QMP) documentations emphasizing the following points for approval by ITER-India/IO:
  - Manufacturing & Inspection Plan (MIP) according to IO MIP template (provided by ITER-India)
  - Updated Packing & transportation plan;
  - Updated Schedule & Risk Mitigation Plan;
  - Test plan and test procedure for components supplied by Bidder at factory site;
  - Test plan and test procedure for components supplied by Bidder at ITER-India lab/ Purchaser's site.
- FDR: Final Technical Reports for components/systems supplied by Bidder, which will be part of Final Design Review.
- FAT documents:
  - FAT procedure for each component as it is linked to hold point.
    - Submission of factory test report of the components/sub-systems either manufactured by the Bidder or purchased/fabricated by outside sub-Bidder/sub-vendor.
    - Factory Acceptance Test report along with approved Deviation Request/Non-Conformance Reports, if applicable, for getting dispatch clearance certificate from ITER-India.
    - Codes and standards conformity certificates.
    - CE Certification, NFC conformity certificate and other relevant documents.

Note: Pre-FAT fabrication, measurement and test data shall be stored by the Bidder for easy traceability

**FRR:** Updated technical Reports for components/systems supplied by Bidder, which will be part of Fabrication Readiness Review.

- Contractor release note (CRN), delivery report & packaging list should be prepared before delivery to Purchaser's site. See Contractor Release Note [7].
- Detailed engineering work package providing step by step details of standalone as well as integrated assembly/disassembly, installation and commissioning plan applicable at ITER-India lab & Purchaser's site.
- Validation reports of all the interfaces provided by ITER-India which will be connected with components/sub-systems supplied by Bidder.
- Assembly, integration and integrated performance demonstration report at ITER-India lab, along with approved Deviation Request/Non-Conformance Reports, if applicable.

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**MRR:** Updated technical Report of components/system supplied by Bidder, which will be part of Manufacturing Readiness Review.

- User Guide containing operation & maintenance manual including trouble shooting & maintenance procedure specifying typical time interval for regular maintenance as per ITER MIP template
- Assembly & disassembly procedure for each system/sub-system
- Document specifying equipment storage & preservation requirement

**DRR:** The purpose of the DRR is to validate that the IO has the

- Contract Release Note (CRN), Delivery Report, the native-file Packing List, the Storage & Preservation requirements, customs documents, and/or any other technical or logistical information that is needed so that the material can be adequately managed through transportation, reception, storage, and integration & assembly at Purchaser's Site.
- The DRR is a Hold Point, and therefore it shall be fully completed by all of the concerned stakeholders before the transportation of components to the ITER Site begins.

**SAT Documents at Purchaser's site:**

- Relevant documents for French legal inspection clearance.
- Day to day work plan and progress report during installation & commissioning
- Validation reports of all the interfaces provided by IO which will be connected with components/sub-systems supplied by Bidder.
- Site Acceptance Test report at Purchaser's site, for acceptance of the components/sub-systems by ITER-India & IO.

**Note:**

1. Numbering System for Components and Parts as per IO's guidelines [10], which will be shared by ITER-India.
2. The access to the ITER-India and IO data management system will be provided to the Bidder, if required, after signing of contract.


## 5 Additional information

- Cost for travel, accommodation and others which will be necessary for execution of this contract will be borne by respective parties.
- It is to be noted that IP generated through execution of contract belongs to ITER-India's property.

## 6 Technical Specifications of RF Source for bidder's reference

The technical specification in this section is only for the information/reference to the Bidder. Bidder shall confirm that the supplied components/sub-systems will meet these functional requirements as a standalone mode or integrated mode in the overall RF source.




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### 6.1 Technical specification for single RF chain (1.6MW)

Table 3 shows the specifications for one complete RF chain of amplifiers.

**Table 3: Major specifications for 1.6 MW Single RF Chain**


Sr. no.	Specification	Level & Units	Remarks
1	Tunable Frequency Range	35-65 MHz	The system shall be tunable for the frequency band 35 – 65 MHz.
	Operating Central Frequency Range	36-60 MHz	The system performance shall be checked for full power, duration & bandwidth requirement.
2	System tuning	within 360s	Any lower frequency to any higher frequency or vice versa, within 35-65 MHz frequency range.
3	Frequency deviation over any central frequency (1dB bandwidth point)	±1MHz	1dB bandwidth point shall be demonstrated at four central frequencies i.e. 36 MHz, 42 MHz, 53 MHz & 60 MHz, with 1.6 MW output power without changing the tube biasing or input RF power.
4	Constant forward power with specified load conditions  Note: Maximum 8kW input power to HPA2 shall be provided by ITER-India	1.6MW/3600s/ matched load  1.5MW/2000s/ VSWR 2:1 & 1.6MW/3600s/ VSWR 1.75:1	Matched load condition: RF Power shall be demonstrated at 36 MHz, 42 MHz, 53MHz & 60 MHz for 2000s. Mismatched load condition: RF Power shall be demonstrated at 36 MHz, 42MHz, 53MHz & 60MHz for 2000s for specified duration and VSWR conditions with a single pulse without any break
5	Accuracy in output power measurement	5%	For full scale power.
6	Max. Output harmonic level	-20 dBc	Measured on matched load.
7	Electrical efficiency	65% to 45%	Depending upon load conditions.
8	Pulse duration: ON time	2000s	System shall be tested for 2000 s operation for

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Sr. no.	Specification	Level & Units	Remarks
			acceptance at 36 MHz, 42 MHz, 53MHz & 60MHz.
9	Duty cycle	25%	5 successive pulses of 2000s at full power with a duty cycle of 25% on matched load.
10	Maximum VSWR for 1.5MW for 1.6MW	2.0:1 1.75:1	With any phase of reflection coefficient.
11	Transient VSWR for 1.5MW for 1.6MW	2.5:1 (1s max.) 2.0:1 (1s max.)	Output power may be reduced.
12	Input and Output impedance	50 $\Omega$	Input & output impedance of HPA2 and HPA-3 shall be matched with 50 $\Omega$ .
13	Size of HPA3 output port	12"	Same as demonstrated R&D chain.
14	Size of HPA2 input port	3 1/8 inch EIA compatible	Same as demonstrated R&D chain.
15	Validation of Anode, Screen grid and Control grid power supply	As per tube data sheet	Wire burn test/fuse test is carried out for different power supplies as per tube data sheet to switch off the power supply when OC (over current) is detected and wire/fuse shall not be burnt.
16	Emergency RF power cut-off response	<10 $\mu$ s	
17	RF radiation limit	<1mW/cm <sup>2</sup>	It shall be within the limits recommended by the International Non-Ionizing Radiation Committee (INIRC). European directive 2013/35/UE referring to 1999/519/CE relating to workers' exposure to electromagnetic risks are applicable.

#### Specific requirement for control system:

The amplitude and phase of each RF source are controlled in a closed control loop and compared with a time variable suitable reference, provided by the associated subsystem controller. All equipment (Including RF amplifiers) of the HP components shall comply and

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support with the RF power control requirements. Following **Table 4** specifies the control loop requirements, which are for the information to Bidder.

**Table 4: Output power control specifications per RF chain**

Sr. No.	Specification	Level & Units
1.	Forward power control range	100kW to 1.75MW
2.	Power modulation accuracy of full-scale power (%)	5.0
3.	Power modulation frequency (3dB break) (kHz)  (3dB break points means, power will be ramped up from half to full for 300 micro sec, then 200 micro sec flat tops of full power, then 300 micro sec ramped down from full to half power and then 200 micro sec flat tops for half power)	1.0
4.	Max RF power rise time (full modulation range) (ms)	200
5.	Response to a trip request (μs)	< 10
6.	Overshoot	< 5%
7.	Max residual power with RF power source ready (power reference at 0) (kW)	1.0


## 6.2 Technical requirement for RF Source (3.0MW)

**Table 5** shows the specifications for one complete RF Source (two RF chains + one combiner).


**Table 5: Major specifications for 3.0 MW RF Source**

Sr. no.	Specification	Level & Units	Remarks
1	Tunable Frequency Range  Operating Central Frequency Range	35-65 MHz  40-55 MHz	The system shall be tunable for the frequency band 35 to 65 MHz. The system performance shall be checked for full power, duration & bandwidth requirement.
2	System tuning	within 360s	Any lower frequency to any higher frequency or vice versa, within 35-65 MHz frequency range.
3	Frequency deviation over any central frequency (1dB bandwidth point)	±1MHz	1dB bandwidth point shall be demonstrated at four central frequencies i.e. 40 MHz, 42 MHz, 53MHz & 55 MHz at 3.0 MW output power without changing tube biasing or input RF power.
4	Nominal output power on matched load	3.0MW	–Matched load condition: RF Power shall be demonstrated at



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Sr. no.	Specification	Level & Units	Remarks
	Nominal output power on Mismatched load (VSWR 1.5:1)  Note: Maximum 8kW input power will be provided by ITER-India to individual HPA2 of each RF chain. Note: The Bidder's responsibility shall be limited to the performance of each RF chain having 1.6MW/2000s in the frequency range 36-60 MHz at VSWR 2:1 at any phase angle of reflection coefficient.	3.0MW	40 MHz, 42MHz, 53MHz & 55 MHz for 3600s. – Mismatched load condition: RF Power shall be demonstrated at 40 MHz, 42 MHz, 53MHz & 55MHz for 3600s with VSWR 1.5:1 at 5 different phase angles.
5	Accuracy in output power measurement	5% of full-scale power	
6	Max. Output harmonic level	-20 dBc	Measured on matched load
7	Electrical efficiency	65% to 45%	Depending upon load conditions
8	Pulse duration: ON time	3600s	System shall be tested for 3600 s operation for acceptance at 40 MHz, 42 MHz, 53MHz & 55MHz.
9	Duty cycle	25%	5 successive pulses of 3600s at full power with a duty cycle of 25% on matched load.
10	Maximum VSWR	1.5:1	With any phase of reflection coefficient
11	Transient VSWR	2.0:1 (1s max)	Output power may be reduced
12	Input and Output impedance	50 $\Omega$	
13	Emergency RF power cut-off response	<10 $\mu$ s	
14	RF radiation limit	<1mW/cm <sup>2</sup>	It shall be within the limits recommended by the International Non-Ionizing Radiation Committee (INIRC).

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Sr. no.	Specification	Level & Units	Remarks
15	Max frequency modulation frequency (Response time)	1 kHz	Joint Responsibility of ITER-India & Bidder
16	Power modulation range at the load	2kW-3.0MW	Responsibility of ITER-India, but HPA shall support this requirement
17	Max amplitude modulation frequency (Close-loop response time)	100Hz	Responsibility of ITER-India, but HPA shall support this requirement
18	Max phase modulation frequency (Close-loop response time)	10 kHz (at fixed reference/any frequency)	Responsibility of ITER-India, but HPA shall support this requirement

### Specific requirement for control system:


The amplitude and phase of each RF source are controlled through a closed control loop and compared with a time variable suitable reference, provided by the associated subsystem controller. All equipment (Including RF amplifiers) of the HP components shall comply and support with the RF power control requirements. Following **Table 6**, **Table 7** and **Table 8** are specifying the control loop requirements, which are for the information to Bidder and will have to be refined during kick off meeting.

**Table 6: Output power control specifications per RF Source**

Sr. no.	Specification	Level & Units
1.	Forward power control range	200kW to 3.5MW
2.	Power modulation accuracy of full-scale power (%)	5.0
3.	Power modulation frequency (3dB break) (kHz)  (3dB break points means, power will be ramped up from half to full for 300 micro sec, then 200 micro sec flat tops of full power, then 300 micro sec ramped down from full to half power and then 200 micro sec flat tops for half power)	1.0
4.	Max RF power rise time (full modulation range) (ms)	200
5.	Response to a trip request (μs)	< 10
6.	Overshoot	< 5%
7.	Max residual power with RF power source ready (power reference at 0)	2.0kW

**Table 7: Frequency modulation specifications per RF Source**

Sr. no.	Specification	Level & Units
1.	Output frequency range (MHz) (main centre frequency will be set off-line)	36-60 MHz
2.	Frequency step (kHz)	1. 0
3.	Offset frequency (kHz)	0.1

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4.	Frequency modulation (MHz) (frequency will be set on-line within 1dB bandwidth)	$\pm 1.0$
5.	Closed loop response to a frequency step ( $\Delta f < \pm 1.0$ MHz) ( $\mu s$ )	100
6.	Frequency overshoot (kHz)	$< 20$

**Table 8: Phase modulation specifications per RF Source**

Sr. no.	Specification	Level & Units
1.	Phase control range ( $^{\circ}$ )	360
2.	Minimum output power level allowing phase control (kW)	5
3.	Absolute phase accuracy, including offset and noise ( $^{\circ}$ )	3
4.	Closed loop response to a phase step ( $\Delta \phi < \pm 90^{\circ}$ ) ( $\mu s$ )	20
5.	Phase overshoot ( $^{\circ}$ )	$< 20$
6.	Max time interval to lock (any frequency and phase) (ms)	10

### 6.3 Interface requirements

All the following interfaces will be discussed & confirmed during the pre-bid meeting.

The main interfaces of components supplied by Bidder are described in the following subsections.

#### 6.3.1 Mechanical interfaces

The components supplied by the Bidder shall be compliant with:


- The transmission line interface in between:
  - SSPA & HPA2 [17];
  - HPA2 & HPA3 [18];
  - HPA3 & Test bed (Dummy Load + MMTL) [19];
  - HPA3 & 3dB Hybrid combiner [19].
  - 3dB Hybrid Combiner & Test bed (Dummy Load + MMTL) [19];
- The Key management system
- The Cable Trays (which will be attached with service platform) for laying power cables and control/monitoring cables.

#### 6.3.2 RF interfaces

The components supplied by Bidder shall be compliant with the HPA2 and HPA3 supplied by ITER-India.

#### 6.3.3 Electrical interfaces

- Electrical power availability for components/sub-systems: The utility power  $\sim 250$  kW per RF source at ITER-India lab and Purchaser's site.

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- Connection of the component's grounding to the global Earthing/Grounding network [15].
- Auxiliary power supplies supplied by Bidder shall interface with HPA2 and HPA3 (Filament, Screen Grid & Control Grid)
- Tuning motors and blowers of HPA2 & HPA3 will interface with LT distribution.

#### **6.3.4 Water cooling interface**

The components shall be compliant with the water-cooling loop characteristics:


- Inlet & outlet flange of main water supply line with water cooling distribution for SSPA, HPA2 & HPA3 etc.
- The water-cooling facility at ITER-India lab and at Purchaser's site:
  - Inlet pressure 5 bar;
  - Maximum inlet temperature 31°C;
  - Flow rate 1950 litre per minute per RF source;
  - Maximum pressure drops 3.5 bar.
refer diagram in **Annexure-J (Section 19)**.
- The water-cooling components/sub-systems of the circuits for RF source shall use stainless steel or copper.

#### **6.3.5 Air cooling interface**

- Air cooling for HPA2 and for Transmission line components refer diagram in **Annexure-J (Section 19)**.
- The maximum value of heat exhaust inside the lab environment shall be within 1% of total power of RF source, the Bidder shall specify the value of heat exhaust for their supplied components/sub-systems inside the lab environment.

#### **6.3.6 LCU Interface with all the sub-systems of the RF source**

- Each RF power source shall ensure its own protection first of all by reducing the RF output power level, and shall be protected against:
  - Load VSWR variations on the RF output, for any phase of reflection coefficient;
  - All internal malfunctioning (over current, over voltage, over temperature, breakdowns etc.);
  - All abnormal commands (over range signals, non-consistent commands);
  - Water/air cooling interruption;
  - Pressurized air interruption if applicable;
  - Electrical power supply interruption;
  - Internal/external arc interruption (Individual arc detection signal shall be provided at critical location of amplifier for protection);
  - Any other parameters as required.
- For safe operation of RF amplifier, no operational parameter shall exceed the pre-established thresholds and nominal values (e.g. electronic tubes grid current, anode

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power dissipation etc.) during operation. Safety thresholds shall be set as per the requirement and the same shall be managed by Local Control Unit (LCU) supplied by Bidder.

- In this regard, Bidder's responsibility is to interface the associated signals from the equipment/sub-systems of RF source with LCU.
- Supply of cables & connectors for the same is under ITER-India/Bidder's responsibility; refer **Annexure-F (Section 15)**.

#### 6.3.7 Building interface

- At ITER-India lab and Purchaser's site, 5-ton crane will be available with a hook height of 6.5m (max) for assembly/disassembly purpose at 3<sup>rd</sup> floor at ITER-India lab and level 3 of RF building-20 at IO lab. Overall dimension of one 3.0MW RF source shall be within footprint of **3.4 m (w) X 9 m (l) X 5 m (h)** and weight shall be less than **18 ton**. The tentative foot print of HPA components is **3.4 m (w) X 4.9 m (l) X 5 m (h)** and weight is about **10.5 ton**.
- Bidder shall accommodate two sets of components/sub-systems within a footprint given in the layout of overall RF source.
- RF enclosure (if applicable), service platform along with ladder should be compliant with the supporting structure of HPA2, Trombone & HPA3
- Outside temperature range at ITER-India is from 20 to 46°C with RH range of 65-95%. However, inside ITER-India lab & IO temperature ranges from 18-30°C and RH ~55% ± 5%.

#### 6.4 Structural & Seismic Requirements

Bidder is responsible for supply of components/sub-systems with support structures. Bidder need to submit simulation results for structural stability of the full RF source with static loads as well as seismic loads for approval by ITER-India/IO. The floor response spectrum needed to carry out the seismic simulation shall be provided by ITER India.


Bidder shall submit the final 3-Dimensional model of RF source and the total mass of each components/sub-systems (including cooling distribution), along with support structures and the co-ordinates of their Centre of Gravity (COG).

After the analysis performed by Bidder, some minor modifications on support structure/components that includes the anchorage point shall have to be implemented by the Bidder.

**Annexure-D (Section 13)** detailing the ITER seismic requirements for information only to Bidder.

#### 6.5 Codes and Standards

The following standards are provided as a reference which needs to be applied for the components & sub-systems during execution of this contract as and where applicable. Bidders

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may seek the guidance of qualified third-party experts when determining the relevant standards and their respective clauses for different components and subsystems.

ITER-India will not supply/issue any standards hard copy/soft copy to bidder. Bidder is responsible to arrange the required standards as and when required during the execution of the project.

#### **6.5.1 Codes and Standards for high power RF Equipment**

- IEEE C 95-1-1991 OR European directive 2013/35/UE standard defines the limit of exposure for peoples to the RF electromagnetic fields.
- EN 55011: 2007 OR EN 55011:2011 at system level.
- Décret 2016-1074 du 3 août 2016 relatif à la protection des travailleurs contre les risques dus aux champs électromagnétiques (Decree 2016-1074 of 3 August 2016 relating to the protection of workers against the risks due to electromagnetic fields): [www.legifrance.gouv.fr/jo\\_pdf.do?id=JORFTEXT000032974358](http://www.legifrance.gouv.fr/jo_pdf.do?id=JORFTEXT000032974358)  
(This decree is taken for transposition of Directive 2013/35/EU of 26 June 2013 into French law) In particular, the radio-frequency exposure for personnel working in areas adjacent to sources of hazard should comply with the limits recommended by the International Non-Ionizing Radiation Committee (INIRC), part of the ICNIRP statement (Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)). The exposure limit for workers expressed as Equivalent Power density for plane waves is: < 1.0 mW/cm<sup>2</sup>. Requires the application of European directive 2013/35/EU, which refers to directive 1999/519/EC regarding workers exposed to risk

OR updated standards as:

#### **Applicable Standards and directives:**


- Electromagnetic Compatibility (EMC): European directive 2014/30/EU
- Machinery: European directive 2006/42/EC
- Pressure equipment: European directive 2014/68/EU
- Restriction of hazardous substances in electrical and electronic equipment (RoHS 2) 2011/65/EU
- Ionizing radiation: European directive 2013/59/EURATOM
- REACH

#### **6.5.2 Codes and Standards for RF Transmission lines.**

High power RF transmission line flanges are the interface between ICRF source system & main transmission line system. No specific standards are indicated in ITER standards. Therefore, flanges [17] [18] [19] shall be used.

#### **Pressure equipment: Directive 2014/68/EU:**



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- NF EN 13480-1 V1 (December 2017 + A1 April 2019 + AC1 July 2020) Industrial metal piping - Part 1: general.
- NF EN 13480-2 V1 (December 2017 + A1/A2/A3 October 2018 + A7 April 2020+ AC1 July 2020 + A8 October 2021) Metallic industrial piping - Part 2: materials.

### 6.5.3 Codes and Standards for mechanical components

Commercial material shall conform to the applicable standard (ASTM, JIS, DIN, and Material Handbook of IO) for the definition of their grade, physical, chemical, and electrical properties and related testing. All materials for which a suitable certification from the Bidder is not available shall be tested to determine the relevant properties, as part of the procurement. A complete traceability of all the materials, including welding materials, shall be provided. RF Source system will be built using Cu/SS/Brass/Al/Be-Cu/Teflon etc.

Corrosion-free materials shall be used in the water-cooling pipes. Especially, mild steel, Aluminium and brass fittings & connections are forbidden for DMDI water circuits.

#### **Mechanically welded structures and cooling circuits:**

- NF EN 1993-1-1 + NA (black steels), NF EN 1993-1-4 + NA (stainless steels).

The use of any chemical compound or product shall comply with the REACH regulation and shall be approved on the basis of its material safety datasheet.

All fasteners shall be ISO metric thread type.

Codes and standards for IC H&CD mechanical components shall follow the General ITER specifications: Codes and Standards for ITER Mechanical Components [31].


In addition, the following codes and standards shall be applied:

- ASME B31.3, process piping
- ASME ANSI B16.25 - pipe, valve, fitting and flange butt weld ends
- ANSI-ASME B16.34 - valves - flanged, threaded, and welding end
- ASME B36.19 - stainless steel pipe
- ASME Section IX - welding and brazing qualification
- Pressure Equipment Directive (PED)

For bought-out components (OEM), design limits shall be set according to manufacturer's recommendations.


#### **Machinery: directive 2006/42/EC:**

- NF EN ISO 12100 (31/12/2010) general principles for design, risk assessment and risk reduction

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- NF EN ISO 13849-1 (03/03/2016) safety of machinery-parts of control systems related to safety- part 1: general principles for design
- NF EN ISO 13849-2 (14/10/2012) Safety of machinery - safety-related parts of control systems
- NF EN 60204-1 (14/09/2018) safety of machinery - electrical equipment of machines - part 1: general requirements
- NF EN IEC 60204-11 (January 2019) safety of machinery-electrical equipment of machines - Part 11: requirements for equipment operating at voltages above 1 000 V a.c. or 1 500 V d.c. and not exceeding 36 kV
- NF EN ISO 13857 (October 2019) safety of machinery-Safety distances preventing upper and lower limbs from reaching hazardous areas
- NF EN ISO 14122-1 (01/03/2017) safety of machinery-permanent means of access to machinery-Part 1: selection of a means of access and general access requirements
- NF EN ISO 14122-2 (01/03/2017) safety of machinery-permanent means of access to machinery-part 2: working platforms and gangways
- NF EN ISO 14122-3 (01/03/2017) safety of machinery-permanent means of access to machinery-part 3: stairs, step ladders and guard rails
- NF EN ISO 14122-4 (01/03/2017) safety of machinery-permanent means of access to machinery- part 4: fixed ladders
- NF EN 619+A1 (24 December 2010) safety and EMC requirements for equipment for mechanical handling of insulated loads
- NF EN ISO 13850 (18/12/2015) safety of machinery - emergency stop function - design principle
- NF EN ISO 14120 (16/01/2016) safety of machinery-guards-general requirements for the design and construction of fixed and movable guards.
- NF EN ISO 14119 (06/12/2013) safety of machinery-interlocking devices associated with guards-principles for design and selection
- NF EN ISO 12198-1 (November 2008) safety of machinery-estimation and reduction of risks arising from radiation emitted by machines
- NF EN ISO 12198-2 (November 2008) safety of machinery - estimation and reduction of risks arising from radiation emitted by machines - Part 2: Procedures for measuring radiation emissions
- NF EN ISO 12198-3 (November 2008) safety of machinery - estimation and reduction of risks arising from radiation emitted by machines - part 3 : Reduction of radiation by attenuation or shielding
- NF EN 61010-1 (January 2011+A1 February 2019) Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements
- NF EN 50664 (November 2017) Generic standard for demonstrating compliance of equipment, used by workers, with the limits for human exposure to electromagnetic fields (0 Hz - 300 GHz), at the time of commissioning or on site
- NF EN IEC 62311 (January 2020) Assessment of electronic and electrical equipment in relation to human exposure restrictions to electromagnetic fields (0 Hz - 300 GHz)
- NF EN IEC 61439-1 (May 2021) Low-voltage switchgear and control gear assemblies - Part 1: General rules
- NF EN IEC 61439-2 (May 2021) Low-voltage switchgear and control gear assemblies - Part 2: power switchgear and control gear assemblies



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- Decree of December 16, 2011 relating to the special provisions applicable to certain laboratories and test platforms
- NF EN 50191 (February 2011) Installation and operation of electrical test equipment

#### **6.5.4 Codes and Standards for electrical components:**

All the system components shall be designed, manufactured and tested in compliance with the latest issues of the standards published by IO (Electrical Design Handbook Part 3: Codes and Standards [12] and EDH Guide A: Electrical Installations for SSEN Client Systems [13] and Plant Control Design Handbook [11]) and the International Electro Technical Commission (IEC) and NFC 15-100 & NFC 13-200. Applicable standards shall be listed by the Bidder. They shall be submitted to ITER-INDIA for review and approval/acceptance.

All applicable French local and national rules, regulations and decrees shall be strictly followed.

#### **6.6 Safety Requirements**

The RF sources are considered as Non-Safety Important Component (Non-SIC) by IO. Therefore, nuclear safety rules/standards are not applicable for this tender.

##### **6.6.1 Safety design criteria**

X-ray radiation and RF radiation near the vicinity of the equipment will follow the ITER standards (EN 55011, IEEE C 95-1991) OR Applicable directive: X-Ray 2013/59/EURATOM & shall be monitored by ITER-India at Indian test facility and by IO at Purchaser's site.


During operation of the ICRF source, RF leakage may be observed at certain locations, which needs to be prevented to avoid hazardous RF exposure to the staff.

Equipment shall be fabricated to limit the propagation of fire to adjacent components. The inventory for all solid, liquid and gaseous toxic products for the components shall be limited to the maximum extent possible in the design, and their impact maintained As Low As Reasonable Achievable (ALARA) during operation.

The French Labour Code art. R.4226-1 is applicable to any design activities of components to be delivered to ITER site. This relates to the control of a new electrical installation (NFC 15-100 & NFC 13-200 Standard).

##### **6.6.2 Safety limits**

The RF exposure for workers expressed as Equivalent Power density for plane waves shall be:  $< 1.0 \text{ mW/cm}^2$  measured at 10 cm from the RF source enclosure. European directive 2013/35/UE referring to 1999/519/CE relating to workers' exposure to electromagnetic risks are applicable.

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### **6.6.3 Safety monitoring requirements**

Safety monitoring requirements shall be generated & submitted by Bidder for the approval of ITER-India. Bidder shall monitor the same during factory acceptance test.

Monitoring shall be provided by ITER-India and/or IO during site acceptance tests to indicate the status in all operational states and accident conditions to indicate whether the above safety functions and requirements are being met.

### **6.6.4 On-site Work Regulations/ Assembly-Integration-commissioning at ITER-India lab and Purchaser's site**

In the frame of work described under this tender, Bidder shall follow specific rules concerning e.g. safety regulations applicable to works of third parties at ITER-India lab as well as at Purchaser's site [26], access to and activities on the site, occupational health and safety on the site and special health and safety matters. In particular, the standard n° ISO14122 - "Safety of machinery - Permanent means of access to machinery" shall be applied. For Electrical Safety, as per the French Labour Code art. R.4226-14 (relates to the control of a new electrical installation NFC 15-100 & NFC 13-200 Standard) a regulatory initial inspection of the delivered components will be conducted before getting energizing clearance. All the relevant documents will be accessible to the Bidder after placing of contract.

### **6.7 Control and Instrumentation Requirements**

The Instrumentation & Control equipment (I&C) for example LCU, supplied by Bidder shall conform to standards, specifications and interfaces as specified in the document "Plant Control Design Handbook" [11].


### **6.8 Manufacturing Requirements**

Detailed Quality Plans, Manufacturing Inspection Plans (MIP) as per template [6], work plans and procedures shall be developed by the Bidder and Subcontractors for each step of fabrication as defined in **Annexure-A (Section 10)**. They shall be submitted to ITER-INDIA for review and approval/acceptance.

### **6.9 CE Markings, Legal Inspection & other certifications**

CE Markings shall be implemented in accordance with European directives requirements. The list of European directives concerning CE marking is available on the following web site [https://ec.europa.eu/growth/single-market/ce-marking/manufacturers\\_en](https://ec.europa.eu/growth/single-market/ce-marking/manufacturers_en). Other useful information can be found in the "Guide of implementation of directives based on the New Approach and the Global Approach": [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C\\_.2022.247.01.0001.01.ENG](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2022.247.01.0001.01.ENG).

Applicability of CE marking & other certifications on Components/sub-systems etc. shall be listed by the Bidder. Bidder is responsible to get certification on the components/sub-systems

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to be supplied by the Bidder and shall be submitted to ITER-INDIA for review and approval/acceptance. The detail process of getting certifications and time duration shall be submitted to ITER-INDIA for review/approval within 6 months from the contract signature.

There is a requirement at Purchaser's site to have a legal inspection (NFC 15-100 & NFC 13-200) of any electrical equipment before it is energized for the first time. Bidder shall depute third party consultant to imply all the requirement of such legal inspection during production of items in factory and conduct legal inspection at factory before transportation to ITER-India lab / delivery to Purchaser's site. Bidder is also responsible for the clearance for Legal inspection of their supplied components at Purchaser's site.

### **6.10 Reliability and Maintainability Requirements**

ITER-India will provide necessary inputs for HP components to bidder. Bidder need to generate necessary parameter for RAMI analysis for their components & subsystems and perform RAMI analysis for full RF source.

## **7 Delivery requirements at Purchaser's Site**

### **7.1 Labelling, Cleaning, Packaging, Handling, delivery-and Storage**

#### **7.1.1 Scope of application**

The following generic requirements apply for the transportation and/or delivery of components/sub-systems from the manufacture/assembly to the ITER-India lab and/or Purchaser's Site.


Suitable precautions shall be taken to avoid damage to the components/sub-systems. Therefore, components/sub-systems shall be fitted with the required sensors, if applicable and shall be packed as defined in **section 7.1.4**.

The components/sub-systems shall be subject to control and inspection, as defined below.

#### **7.1.2 Labelling and Traceability**

All components and the main sub-systems shall be clearly marked in a permanent way and in a visible place with the IO official numbering system according to the document "ITER Numbering System for Components and Parts" [8] and [9]. A detailed 'IO component identification standard' together with printed label templates and tagging standards will be provided by ITER-India [10].

The components/sub-systems included in the scope of supply shall be fitted with a rating plate & CE marking/any other conformity marking in accordance with the applicable standards. The name plate with ratings shall bear the identification of the corresponding components/sub-systems in the project.

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In addition, identification of the components/sub-systems and components shall comply with the labelling requirements defined in EDH Guide A [13].

### **7.1.3 Cleaning**

During cleaning, particular attention shall be given to the removal of weld spatter, debris and other foreign matter. Bidder shall ensure effective cleaning without damage to the surface finish, material properties or metallurgical structure of the materials.

### **7.1.4 Packaging and Handling**

Any special ITER-India or/and purchaser's site or regulatory transportation requirements shall be documented and provided to the Bidder prior to transportation/delivery.

Subsequent to the Factory Acceptance Test, the components shall be partially disassembled to the optimum size that can be shipped. All components requiring re-assembly at the ITER-India lab and/or Purchaser's Site shall be clearly labelled and tagged.


The Bidder shall design and supply appropriate packaging, adequate to prevent damage during shipping lifting and handling operations. Where appropriate, required sensors shall be fitted to ensure that limits have not been exceeded. In case, accelerometers are used, these shall be fixed onto the box and shall be capable of recording the acceleration along three perpendicular directions [28].

Shock absorbing material shall be used.

Each transportation/delivery shall be accompanied by a transportation/Delivery Report shall be prepared by the Bidder, stating as a minimum:

- The packing date;
- The full address of the place of delivery and the name of the person responsible to receive the package, as well as of the Bidder's name and full address;
- Bill of Materials;
- Security Measures;
- Release Note [7];
- Packing List;
- Material Safety Sheet;
- The declaration of integrity of the package;
- The declaration of integrity of the components;
- Any additional relevant information on the status of the components.

The Delivery Report shall be signed by a representative of the ITER-India/IO and the Bidder. The signature by the ITER-India and/or IO of the Delivery Report prior to delivery represents a Hold Point (HP).

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### **7.1.5 Transportation and Delivery**

Before the delivery, a Release Note shall be prepared in accordance with the “Contractor Release Note” [7] and approved by the ITER-India and/or IO.

Upon receipt of the package, the ITER-India and/or IO shall prepare an Inspection Report;

The following points will be checked:

- The integrity of the package, including identifying visible damage;
- The reading of the accelerometers or other sensors;
- The enclosed documentation;
- The number and type of components contained in the delivery from the documentation.

In the case of anomalies, the ITER-India and/or IO shall make any additional relevant remark on the inspection report.

The ITER-India and/or IO will inspect the accelerometers or other sensors mounted on the boxes. If these accelerometers record shocks above 5g, a thorough inspection of the components shall be performed. A decision on acceptance of the delivery of the components will be made by the ITER-India and/or IO.

The boxes will be opened in presence of Bidder’s representative, once moved to the final assembly place. The integrity of the components, including identifying visible damage will be checked by ITER-India/IO.


If the components are in an acceptable condition, the ITER-India and/or IO will sign the Inspection Report. The signature of the Inspection Reports is an ITER-India and/or IO Hold Point.

The original of the Inspection Report shall be kept by the ITER-India and/or IO and a copy of it shall be kept by the Bidder.

## **8 Conditions for integrated performance demonstration and Site acceptance**

Components/sub-systems supplied by Bidder under this tender will be integrated with HPAs for demonstrating the overall performance of RF source at ITER-India lab & Purchaser’s site.

The condition for integrated performance demonstration and site acceptance in integrated mode in this section is for components/sub-systems supplied by Bidder and HPAs supplied by ITER-India. Bidder shall confirm that the supplied components/sub-systems will meet the functional requirements as integrated mode with the RF chains and RF sources. Bidder will be responsible to conduct the validation tests of supplied components/sub-system in presence of ITER-

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India/HPA contractor representative during integrated performance demonstration at ITER-India lab and SAT at Purchaser's site. ITER-India will extend the support to the Bidder during these activities.

The following sections describe the Integrated performance demonstration and SAT processes of RF chains & RF sources. Additional details and responsibility sharing matrix for Integrated performance demonstration and SAT process are given in **Table 1**.

## **8.1 Conditions for Acceptance**

### **8.1.1 Integrated performance demonstration at ITER-India lab**

Assembly, integration and integrated performance demonstration activities will be carried out at ITER-India Lab as per the responsibility sharing described in **Table 1**.

All the components/sub-systems provided by Bidder shall be ready for integration before the initiation of integrated performance demonstration of RF source.

#### **8.1.1.1 Functional and interfaces tests**

Following tests to be conducted and recorded in the validation reports as per **Annexure-G (Section 16)**.

##### **Geometry:**

- Overall dimensional check of components/sub-systems supplied by Bidder.
- Overall weight check of components/sub-systems supplied by Bidder (estimation by summing the different component's weight)

##### **Interface (components/sub-systems provided by Bidder) check:**

- Various power supplies and their electrical connections;
- Connections with LCU;
- Connections with low power section and SSPA;
- Grounding connections;
- Key safety system and protection circuits;
- Water connections;
- Air flow connections;
- Transmission line connections;
- Combiner connections;
- Enclosure, service platform etc.


##### **Electrical:**

- Fuse tests on Aux. PS as given in technical specification of aux power supplies.
- Threshold setting for over voltage, over current etc. for Aux PS

##### **Control and instrumentation (LCU will be provided by Bidder):**

The tender document is to provide technical content and scope related to ITER deliverables and shall not be disclosed or used for any other purpose without written permission from ITER-India.



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- Monitoring of parameters, protection and controls of HPA2 & HPA3 through LCU will be checked including healthiness of arc detection system and interlocks with HVPS
- Calibration of directional couplers (Coupling, directivity etc.) for power measurement and other measuring instrument will be checked
- Test set up for RF & electrical measurement will be checked
- Local operation of the source via its controller (LCU) will be checked. The validation of the LCU design includes not only the validation of monitoring, controls, interlocks and data acquisition but also the validation of the performance of the control loops.

#### ***Cooling:***

- Water cooling will be tested under operational conditions at rated inlet pressure, flow rate, measurement of pressure drop, inlet-outlet temperature etc.
- Air cooling will be checked under operational conditions at rated inlet flow rate.

The validation reports for the following components/sub-systems are required to be generated by Bidder:

- LP section and SSPA;
- Directional couplers and transmission line components;
- 3dB Hybrid combiner with dummy load at isolation port;
- LCU;
- LT Panel;
- Auxiliary power supplies;
- Grounding;
- Water and air cooling;
- RF power measurement test set up;
- Key management system;
- RF enclosure integrity check;

#### **8.1.1.2 Integrated performance test with RF chain**


The overall integrated performance test of RF chain will be checked on Matched as well on Mis-matched load at ITER-India lab. Bidder will be responsible for the performance of supplied components/sub-systems during testing.

#### **Tests of HPA2 on matched load: (for the information to Bidder)**

##### ***(a) Low power test (Static tests):***

- Hi-Pot test of tube, capacitors etc. will be conducted, if needed
- Frequency: to be swept at specified range (35 MHz to 65 MHz) within 360s from lower to higher frequency or vice versa;
- Tuning configuration are tested at 35, 36, 40, 42, 45, 50, 53, 55, 60 & 65 MHz on VNA;



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- Suppression of Higher Order Mode & Parasitic Oscillation test: to ensure stable operation by standard factory test method for 35, 36, 40, 42, 45, 50, 53, 55, 60 & 65 MHz

**(b) High Power tests:**

- VF, IF, VG1, IG1, VG2, IG2, VA, IA will be measured;
- Frequencies: 36, 40, 42, 53, 55, 60 MHz;
- 120 kW, 2000/3600 s duration at each frequency;
- 1dB BW will be checked at 120kW output power, keeping all other parameters constant;
- Harmonic/spurious signal will be checked;
- Electrical Efficiency & gain will be checked.

**HPA2 test report shall include:**

Following tests are not under the scope of this tender. However, during these tests Bidder will participate and responsible only for the performance of supplied components/sub-systems.

- Static curves (S11 & S21);
- Hi-Pot test results;
- Measured parameters during operation with test setup diagram;
- Tuning positions for respective frequencies;
- Water & air-cooling parameters.

**Tests of HPA2+HPA3 on matched load: (for the information to Bidder)**


Following tests are not under the scope of this tender. However, during these tests Bidder will participate and responsible only for the performance of supplied components/sub-system.

**(a) Low power test (Static tests):**

- Hi-Pot test of tube, capacitors etc. will be conducted;
- Frequency: to be swept at specified range (35 MHz to 65 MHz) within 360 s from lower to higher frequency or vice versa;
- Tuning configuration: for 35, 36, 40, 42, 45, 50, 53, 55, 60 & 65 MHz on VNA;
- Suppression of Higher Order Mode & Parasitic Oscillation test: To ensure stable operation by standard factory test method for 35, 36, 40, 42, 45, 50, 53, 55, 60 & 65 MHz.

**(b) High Power tests for HPA3:**

- VF, IF, VG1, IG1, VG2, IG2, VA, IA will be measured for HPA2 & HPA3;
- Tests will be performed on 4 frequencies: 36, 40, 42, 53, 55, 60 MHz;
- Output RF power: 1.6MW, 3600 s duration at each frequency;
- 1dB bandwidth at  $\pm 1$  MHz shall be checked in 0.25 MHz steps at four central frequencies i.e. 36 MHz, 40MHz, 42MHz, 53 MHz, 55MHz & 60 MHz, with 1.6 MW output power, keeping all other parameters constant;
- Harmonic/spurious signal will be checked;
- Burn in test at 60 MHz, 1.6MW/3600s, 5 successive pulses with 25% duty cycle;
- Electrical Efficiency & gain will be checked.

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**Note:**

Response time for changing amplitude, frequency and phase of RF output (modulation) will be checked through LCU on matched load.

**HPA3 test report shall include:**

- Static curves (S11 & S21);
- Hi-Pot test results;
- Measured parameters during operation with test setup diagram;
- Tuning positions for respective frequencies;
- Water- & air-cooling parameters.

**High power tests of HPA2+HPA3 on mis-matched load: (for the information to Bidder)**

Following tests are not under the scope of this tender. However, during these tests Bidder shall participate and responsible only for the performance of supplied components/sub-system.

Cavity tuning shall be kept at the same position as set during matched load test.

- VF, IF, VG1, IG1, VG2, IG2, VA, IA will be measured for HPA2 & HPA3;
- Tests will be performed on 6 frequencies: 36, 40, 42, 53, 55 & 60 MHz with VSWR 2:1, at rated power 1.5MW/2000s **AND/OR** VSWR 1.75/1.6MW/3600s, at phase angles 0°, 45°, 90°, 135°, 180°, for each frequency;
- Burn-in test on mismatch load for 1.6MW/3600s/VSWR 1.75 for five consecutive pulses with 25% duty cycle (without any break) will be demonstrated at specified constant output power, for 42MHz & 53 MHz with 5 different phase angles of reflection coefficient between 0 to 180 degree.
- Harmonic/spurious signal will be checked;
- Electrical Efficiency & gain will be checked.

**HPA3 test report shall include:**


- Measured parameters during operation with test setup diagram.
- Tuning positions for respective frequencies.
- Water- & air-cooling parameters.

**8.1.1.3 High power test of prototype & Unit-1 RF source**

Tests shall be performed by combining two RF chains of 1.6MW along with 3dB Hybrid combiner.

Performance tests of 3MW RF sources shall be conducted by:

- ITER-India at ITER-India lab for prototype RF source
- Bidder at ITER-India lab for Unit-1 RF source

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### ***On matched load***

- VF, IF, VG1, IG1, VG2, IG2, VA, IA will be measured
- Tests will be performed on 4 frequencies: 40, 42, 53, 55 MHz
- Output RF power: 3.0 MW for 3600s duration at each frequency
- 1dB bandwidth ( $\pm 1$  MHz) shall be checked in 0.25 MHz steps at four central frequencies i.e. 40 MHz, 42MHz, 53 MHz & 55 MHz at 3.0 MW output power keeping, all other parameters constant
- Harmonic/spurious signal will be checked
- Burn-in test at 55 MHz/3.0 MW/3600s for 5 successive pulses with 25% duty cycle
- X-ray and RF Exposure will be checked as defined in **section 6.6.2**
- Electrical Efficiency & gain will be checked

**Note:** Response time for changing amplitude, frequency and phase of RF output (modulation) will be checked through LCU on matched load.

### **Test report shall include:**

- Measured parameters during operation with test setup diagram.
- Tuning positions for respective frequencies.
- Water- & air-cooling parameters.

### ***On mis-matched load***

Cavity tuning shall be kept at the same position as set during matched load tests.

- VF, IF, VG1, IG1, VG2, IG2, VA, IA will be measured;
- Tests will be performed on 4 frequencies: 40,42, 53, 55 MHz with VSWR 1.5:1, at rated power 3.0MW/3600s, at phase angles 0°, 45°, 90°, 135°, 180°, for each frequency;
- Harmonic/spurious signal will be checked;
- X-ray and RF Exposure will be checked as defined in section 6.6.2.
- Electrical Efficiency & gain will be checked.


### **Test report shall include:**

- Measured parameters during operation with test setup diagram
- Tuning positions for respective frequencies
- Water- & air-cooling parameters

### ***8.1.2 Site acceptance tests (SAT) at Purchaser's site***

All the components/sub-systems provided by Bidder shall be ready for integration before the initiation of SAT of RF sources (Prototype + Unit-1).

Performance tests of 3MW RF sources shall be conducted under supervision of bidder at Purchaser's site for prototype and Unit-1 RF source.

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Performance of HPA-2, HPA-3 & trombone integrated with each RF chain will be demonstrated by ITER-India for 1.6 MW power. Bidder is responsible for demonstrating performance of their supplied components and integrated performance of 3 MW power from prototype and Unit-1 RF source, using 2 chains and combiner.

Following test will be conducted:

- Prototype RF source will be tested on matched load only as given in **section 8.1.1**
- Unit-1 RF source will be tested on matched & mis-match load as given in **section 8.1.1**


## 9 Reference Documents

Version of these documents are referenced in the tender document as per their applicability context as on date of tender publication, however, during execution of the contract the latest version of documents shall be applicable. For a better understanding, they are grouped below with some explanation. Further details could be exchanged during the pre-bid meeting.

These reference documents shall be implemented for the components supplied by Bidder, wherever applicable.

**Table 9: List of reference documents for this tender**

Ref.	Title	No.	Version
These documents describe the quality management in ITER Organization. They are helpful to understand the general context of ITER organization but as well the detailed requirements linked to the quality classification of the IC RF sources. Specific documents on the delivery processes or the ITER numbering system are provided.			
[1]	Order dated 7 February 2012 relating to the general technical regulations applicable to BNI - FR (7GJHSE) translated for guidance in:	ITER_D_7GJHSE &	1.3
	Order dated 7 February 2012 relating to the general technical regulations applicable to BNI - EN (7M2YKF) and the subsequent ASN decisions linked to this Order	ITER_D_7M2YKF	1.7
[2]	Quality Requirements for IO Performers & ITER Quality Assurance Program (QAP)	ITER_D_22MFG4 & ITER_D_22K4QX	6.3 & 8.5
[3]	Quality Classification Determination	ITER_D_24VQES	6.0
[4]	Quality Requirements for IO Performers	ITER_D_22MFG4	6.3
[5]	Procedure for Management of Deviations & Nonconformities	ITER_D_2LZJHB	9.1
		ITER_D_22F53X	9.1
[6]	Manufacturing Inspection Plan (MIP) Template	ITER_D_QV7GQF	1.3
[7]	Requirements for Producing a Contractors Release Note	ITER_D_22F52F	Obsolete

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Ref.	Title	No.	Version
[8]	ITER function category and type for ITER numbering system	ITER_D_2FJMPY	1.7
[9]	ITER numbering system (for parts/components)	ITER_D_28QDBS	5.1
[10]	Specification for Labelling of Components/sub-systems on ITER Project	ITER_D_VYJ7U2	1.4

The following documents provide technical information. Some of them are quite general as the ITER Plant Control Design Handbook and only part of it will be applicable within the Bidder's scope: for instance, the cable catalogue is mandatory to be used by the Bidder while choosing their components. The list of applicable standards shall be adapted as per the Bidder component characteristics. Some other documents specify the interface requirements.


[11]	Plant Control Design Handbook	ITER_D_27LH2V	7.1
[12]	Electrical Design Handbook Part 3: Codes and standards	ITER_D_2E8DLM	1.3
[13]	Electrical Design Handbook Guide A: Electrical Installations for SSEN Client Systems	ITER_D_2EB9VT	2.7
[14]	IO cabling rules	ITER_D_335VF9	3.3
[15]	Earthing/grounding at ITER-India lab & IO lab	ITER_D_3V2CUG	1.1
[16]	IO Cable catalogue	ITER_D_355QX2	6.13
[17]	3 1/8 inch EIA Transmission line flange	ITER_D_4FHCF3	1.3
[18]	6 1/8 inch EIA Transmission line flange	ITER_D_4FHGF2	1.3
[19]	12 inch Transmission line flange: fix and swivel	ITER_D_4FJGBX ITER_D_3QT2B6	1.3 1.1

The floor response spectrum needed to carry out the seismic simulation will be provided by ITER-India. The following documents provide guidelines for seismic analysis.

[20]	Instructions for Seismic Analyses	ITER_D_VT29D6	2.0
[21]	EU-DA Report – PA 6.2.P2.EU.02 - Methodology to be Used to Generate the Seismic Floor Response Spectra for Ancillary Buildings at ITER	ITER_D_PN36V6	3.1
[22]	IO Building 15 FRS Data	ITER_D_QPBST4	1.2
[23]	Procedure for the CAD management plan Procedure for the Usage of the ITER CAD Manual	ITER_D_2DWU2M ITER_D_2F6FTX	2.2 1.1
[24]	ITER Document Breakdown Structure Overview	ITER_D_43327Q	1.1
[25]	Risk and Opportunity Management Procedure	ITER_D_22F4LE	6.4

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Ref.	Title	No.	Version
[26]	Health Protection and Safety General Coordination Plan ITER Construction Site - Volume 0 - General Safety Rules	ITER_D_2NUEYG	6.0
	Internal Regulations	ITER_D_27WDZW	3.1
	Environmental requirements	ITER_D_97WRFP	2.2
	Contractor Safety Management Procedure	ITER_D_Q2GBJF	1.4
	Procedure for Occupational Health and Safety Hazard Identification and Assessment	ITER_D_AJLQRF	6.0
	Vehicle Access and Traffic Circulation and Parking on the ITER Site	ITER_D_N3MG3V	3.2
	ITER Site access Procedure	ITER_D_S3893D	3.1
	General Management Specification for Executing Entities at the ITER Site	ITER_D_YX55YY	2.3
[27]	Working Instruction for the Delivery Readiness Review (DRR)	ITER_D_X3NEGB	3.0
[28]	Procedure for Transportation of Components to ITER Site	ITER_D_RY5C6Q	3.1
[29]	Design Review Procedure	ITER_D_2832CF	7.0
[30]	Working Instruction for Manufacturing Readiness Review	ITER_D_44SZYP	5.1
[31]	Codes and Standards for ITER Mechanical Components	ITER_D_25EW4K	5.0
[32]	BOM templates-		
	a) BOM Electrical Discipline	a) ITER_D_5EEL63	1.3
	b) BOM Mechanical Discipline	b) ITER_D_YH3HJR	1.7
	c) BOM Template-piping discipline	c) ITER_D_WKRHM5	2.1
	d) Cable Tagged Item List	d) ITER_D_2AC6RA	3.1
	e) Equipment Tagged Item List	e) ITER_D_2ABW98	3.1
	f) Instrumentation Tagged Item List	f) ITER_D_2AC7MG	3.1
	g) Lines Tagged Item List	g) ITER_D_28NSHN	3.2
	h) Support Tagged Item List	h) ITER_D_2CSXHN	3.1
	i) Valve Tagged Item List	i) ITER_D_2AC3GV	3.1
[33]	Agreement on the Establishment of the ITER organisation	ITER_D_2EW6RK	1.1
[34]	ICH System Concept of Operation	ITER_D_3MBC4P	4.0
[35]	Working Instruction for Reliability, Availability, Maintainability and Inspectability (RAMI) Analysis	ITER_D_C8U8V8	1.2

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**Note:**

Reference documents may be downloaded and referred from the following link:

[https://www.iterindia.in/indus/admin/doc\\_detail.php?FolderId=202401270](https://www.iterindia.in/indus/admin/doc_detail.php?FolderId=202401270)

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## 10 Annexure-A: Management Specifications

### 10.1 Quality requirements

Quality Requirements shall be in accordance with the “ITER Procurement Quality Requirements” [2]. The ITER Quality Assurance Program shall be applied to all the work under this Tender. The ITER QA Program is based on IAEA Safety Standard GS-R-3 and on conventional QA principles and integrates the requirements of the INB Order dated 7 February 2012 [1] on the quality of design, construction and operation in Basic Nuclear Installation. For this purpose, the Bidder and Subcontractors carrying out contracts placed under this Tender shall comply to QA requirements under the relevant ITER QA classifications, the requirements of the INB Order and shall have an IO approved QA Program or an ISO 9001 accredited quality system, complemented with the above-mentioned requirements.

Prior to commencement of any work under this Tender, a “Quality Plan” (QP) [4] shall be produced by the Bidder and Subcontractors and submitted to the ITER-INDIA/IO for approval, describing how they will implement the ITER Procurement Quality Requirements.


Prior to the commencement of any manufacturing, a “Manufacturing and Inspection Plan” (MIP) [6] shall be produced by the Bidder and Subcontractors and approved by the ITER-INDIA/IO, who will mark up any intended intervention point. MIPs are used to monitor Quality Control and acceptance tests during the execution of the Contract. It should be noted that interventions additional to those required in this Technical Specification may be included on the MIP by the ITER-INDIA/IO. The right of the ITER-INDIA/IO listed above shall apply in relation to any Subcontractor and in this case the ITER-INDIA/IO will operate through the Bidder. The overseeing of the quality control operation by the ITER-INDIA/IO shall not release the Bidder from his responsibility in meeting any aspect of this Technical Specification.

Documentation developed as the result of this Contract shall be retained by the Bidder for a minimum of 5 years after date of closure of the contract in digital form and then may be discarded at the direction of the ITER-INDIA/IO. The use of computer software to perform a safety basis task activity such as analysis and/or modelling, etc. shall be reviewed and approved by the ITER-INDIA/IO prior to its use. Bidder and Subcontractors carrying out contracts placed under the Tender shall comply to QA requirements under the relevant QA classifications as defined in “Quality Classification Determination” [3].

The components/sub-systems included in the scope of supply shall follow the quality standards corresponding to a quality class 2.

### 10.2 Monitoring, evaluation & verification

ITER-India shall have a close monitoring of the production scheme with Bidder. This monitoring shall include Notification Points, Authorization-To-Proceed Points and Hold Points at critical steps in the Bidder’s Manufacturing and Inspection Plans. The control points shall be integrated into the agreed schedule which will be finalized during kick of meeting.


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A Notification Point (NP) is a milestone where the Bidder is required to notify the ITER-India, who informs the IO, 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 and IO personal to follow the progress of the contract and possibly to witness a critical manufacturing step at the Bidder's premises. The Notification shall be sent by the Bidder to the ITER-India at least 10 working days prior to the scheduled manufacturing step. ITER-India (and IO) shall decide whether or not they want to attend. A NP shall not affect the production flow of the Bidder that shall continue the work even without a reply from ITER-India (and/or IO).

An Authorization-To-Proceed Point (ATPP) is a milestone where the Bidder is required to notify ITER-India, who informs the IO, that it has completed a specific task or a specific deliverable. The Bidder must wait for an authorization from ITER-India before proceeding to the next task or to the next action on the specific deliverable. ITER-India shall grant the Authorization to Proceed on the basis of clearly identified Quality Control data and of Acceptance test results to be provided by the Bidder. The ITER-India (and IO jointly) shall have 8 working days to review the Bidder's data and to notify the Bidder of its decision. In case of authorization, the Bidder shall proceed to the next task or to the next action on the specific deliverable. In case of rejection, the Bidder shall develop a recovery plan that shall be submitted and reviewed by the ITER-India and IO within 5 working days of submission. An ATPP shall only affect the specific task or the specific deliverable it is associated with and shall not interfere with the execution of other tasks of the production or other deliverables of the same kind.

A Hold Point (HP) is a milestone where the Bidder is required to notify ITER-India, who informs the IO, 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 ITER-India and the IO at the time of the request. ITER-India (along with IO) shall have a maximum of 11 working days to review the Bidder's data and to notify the Bidder on the assessment and to confirm or reject it. In case of clearance, the Bidder shall resume its activity. In case of rejection, the Bidder shall develop a recovery plan that shall be submitted to ITER-India and reviewed by the ITER-India (IO, through ITER-India) within 10 working days of submission. In case of ITER-India/IO objection, the ITER-India (& IO, through ITER-India) shall detail its reasons in writing and the Bidder shall have 10 working days to answer the ITER-India's objection and, whenever suitable, develop a recovery plan.

NPs, ATPPs and HPs to be implemented during the various phases of execution of this project and will be finalized mutually between Bidder and ITER-India/IO in the updated manufacturing and inspection plan (MIP) during the kick-off meeting; however, part of these hold points are already defined in the **Table A1** for implementation.

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**Table A1: Preliminary hold points (HP)**

Sr. No.	Description	Deliverable requirements
1.	QA document for components/sub-systems supplied by Bidder and approved by ITER-India & IO	QA Documents
2.	FDR & Safety related documents of components/sub-systems supplied by Bidder for RF Sources	Final design/Safety documents
3.	Submittal of Material Procurement Document for components / sub-systems supplied by Bidder to ITER-India	Material test certificate
4.	CE certification & legal inspection validation at bidder's site	Reports/certificates
5.	FAT to get delivery clearance for components/sub-systems supplied by Bidder	FAT report
6.	FRR & updated safety & QA documents of components/sub-systems supplied by Bidder for RF Sources	Fabrication readiness review report
7.	Acceptance of components/sub-systems supplied by Bidder for ITER-India Test Facility	Test report
8.	MRR, updated safety & QA documents of components/sub-systems supplied by Bidder for RF Sources	Final Design/Manufacturing Readiness Review report
9.	DRR: CRN, Delivery Report, the native-file Packing List, the Storage & Preservation requirements, customs documents, and/or any other technical or logistical information that is needed so that the material can be adequately managed through transportation, reception, storage, and integration & assembly at Purchaser's Site.	DRR documents
10.	Legal inspection validation at Purchaser's site before energising any components/sub-systems supplied by Bidder for RF Source	Legal inspection validation report
11.	Final acceptance of components/sub-systems supplied by Bidder for RF Sources at ITER site	Test report

### 10.3 Periodic reports & Meetings

#### Reporting

The Bidder shall submit periodic reports to ITER-India and agree on periodic review meetings with ITER-India in order to monitor contract execution. The Bidder maintains data and documents and makes them available upon ITER-India's request to verify that the Project requirements are satisfied.

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### ***Progress meeting***

Progress meetings shall be conducted as required by ITER-India upon mutual agreement. The frequency of such meetings shall vary throughout the progress of the project, typically from once per month during the initial phases to once per 3 (three) months at the end, assuming no qualification or production problems arise. The meetings shall be held by video conference, teleconference or physically on the ITER-India premises or on the Bidder's premises.

Final meeting minutes shall be prepared by the Bidder and submitted to ITER-India not later than 5 (five) calendar days after the meeting.

The ITER-India shall forward to the Bidder 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.

IO will be involved in progress meetings and review process of minutes of meetings.

### **Reviews & Inspection**

ITER-India and Bidder will organize Updated Design Reviews and Status / Quality Control Reviews by mutual agreement. They may be focused on the different updated design stages and particular areas of production.


Bidder shall designate a Programme Manager who will:

- Lead the Programme efficiently,
- Have cognisance and full responsibility for overall performance of the Contract,
- Act as primary point of contact with the Purchaser.

A Programme Team, under the responsibility of the Programme Manager, will be created to provide effective management and control of all aspects of the Programme.

Bidder will maintain a Work Breakdown Structure (WBS) that fully captures and defines the scope of the responsibilities as defined in **section 3**. The process of generating the WBS shall be in accordance with established internal procedures and processes as identified within Bidder's plans. The development of the WBS shall comply with ITER-India WBS and shall be finalized mutually within 1 month after placing of the contract. The major elements of WBS shall have:

- System Engineering,
- Manufacturing, factory testing and delivery of components supplied by Bidder,
- Assembly, integration and Site Acceptance,
- Programme management and Quality assurance,
- Data Acquisition, Monitoring & Controls,
- Required AC/DC power supplies.

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The following formal meetings shall be organized between Bidder and the ITER-India throughout the contract period:

- Kick-off meeting,
- Finalisation of overall Layout of RF source and controls through LCU
- Discussion on outcome of Factory Acceptance Tests
- Discussion on outcome of integrated performance demonstration at ITER-India lab
- Final Design/Manufacturing readiness Review meeting with IO
- Discussion on outcome of Site Acceptance Tests at Purchaser's site

Meetings will normally be held at Bidder's premises/remotely (except SAT) and minutes will be written by the Bidder. Actions including responsible person and date for resolution will be agreed during the meeting. The minutes, including the agreed action list, will be distributed for comment no later than 2 working days after the meeting. Representatives of both parties will subsequently sign the formal minutes to validate the decisions and actions agreed during the meeting.


The topics to be covered for each formal meeting, assessment and closure criteria for the action/issues shall be mutually agreed during kick-off meeting.

The main Reviews and Inspections are listed in the following table:

**Table A2: Reviews and Inspections lists**

Sr. No.	Reviews & Inspection	Objectives
1.	Review of Technical report (FDR/FRR/MRR/DRR) accompanied with Bill of Material, Safety/QA documents and layout of components/sub-systems supplied by Bidder	Approval of the report by ITER-India/IO
2.	Applicable material test certificate for the fabrication of components/ sub-systems.	Approval by ITER-India/IO
3.	Validation of CE certification & legal inspection at bidder's site	Reports/certificates issued by authorised organisation
4.	Factory Acceptance Test of components/ sub-systems supplied by Bidder.	Technical approval of product by ITER-India/IO
5.	Inspection of integrated assembly of components/ sub-systems supplied by Bidder at ITER-India lab.	Approval of assembled components supplied by Bidder by ITER-India/IO
6.	Inspection of integrated assembly of component/system other than components/ sub-systems supplied by Bidder at ITER-India lab.	Validation of assembled component/ system by Bidder
7.	Assembly, integration & performance demonstration of components/ sub-systems supplied by Bidder at ITER-India lab.	Verification of Commissioning by ITER-India/IO



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Sr. No.	Reviews & Inspection	Objectives
8.	Inspection of inward goods (components/sub-systems supplied by Bidder) at ITER site.	Visual inspection of system/component by ITER-India/IO, to identify any damage occurs during transit
9.	Inspection of integrated assembly of components/sub-systems supplied by Bidder at ITER site.	Approval of assembled components supplied by Bidder by ITER-India/IO
10.	Legal inspection conformity at Purchaser's site before energising components/sub-systems supplied by Bidder	Reports/certificates
11.	Validation of all interfaces which will be integrated with components/sub-systems supplied by Bidder at ITER site.	Validation of assembled component/ system by Bidder
12.	Site Acceptance Test of components/sub-systems supplied by Bidder at Purchaser's Site.	Verification of Commissioning and technical approval of product by ITER-India/IO


In case of concerns regarding the quality of production, it may be required to carry out on-the-spot checks (with prior request by ITER-India), in addition to the checks foreseen in the technical specifications by ITER-India/IO). In such a case, ITER-India will provide a description of its concerns and the rationale behind such request. The actual date(s) of the on-the-spot checks shall be determined by agreement between the Parties.

#### **10.4 Right of access**

The Bidder shall inform ITER-India of all locations where sub-contracts are implemented. It shall further ensure that sub-contracts include the rights of on-the-spot access subject to the requirement, as stated above (in **Review & Inspection section**). The material which is already procured by Bidder will be inspected at Bidder's site. The new procurement contracts will be monitored by II/IO under such access.

ITER-India's representative shall have access to the premises of the Bidder (and sub-Bidders of Bidder) in order to witness on-site tests and critical fabrication operations, carry out on-the-spot checks in addition to the tests foreseen in the technical specifications and to participate in periodic review meetings. The COTS items which are procured by Bidder will be witnessed at Bidder's site. The new procurement contracts will be monitored by II/IO under such activities.

In case of marked up interventions in the Manufacturing and Inspection Plan, IO representative will visit the manufacturing site. The appointed IO representatives will always be accompanied by ITER-India's representatives on their visits to the Bidder's premises (or sub-Bidders' premises). The IO representatives shall be bound by appropriate confidentiality obligations to be agreed in advance.

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### 10.5 Quality assurance


- The Bidder shall ensure the quality of all materials, components and services to meet all the requirements of this tender.
- Should any question whatsoever arise with respect to the requirements defined in this tender, the Bidder shall ask ITER-India for clarification prior to proceeding with the work.
- The Bidder Quality Assurance (hereinafter referred to as “QA”) Programme subject to approval by ITER-India shall be applied to all the work under the tender. Under QA program Bidder shall declare the items under old & new contracts and prepare & shall follow the QA plan accordingly.
- A list of the general documentation associated with ITER-India’s Quality Requirements is given in table below:

**Table A3: ITER-India’s Quality Requirements**

<b>ITER-India’s Quality Requirements</b>
<b>Prior to contract implementation:</b> <ul style="list-style-type: none"> <li>Obtain ITER-India acceptance of a dedicated “Quality Plan”.</li> </ul>
<b>Prior to start of manufacturing:</b> <ul style="list-style-type: none"> <li>Obtain ITER-India acceptance and mark up of a “Manufacturing and Inspection Plan (MIP)”.</li> </ul>
<b>During manufacture:</b> <ul style="list-style-type: none"> <li>Notify ITER-India representatives of any Inspection Points as marked up on the “MIP”.</li> <li>Complete the relevant entries in the “MIP” as work progresses.</li> </ul>
<b>During contract implementation:</b> <ul style="list-style-type: none"> <li>Issue “Deviation Request” and “Non-Conformance Reports” as necessary.</li> </ul>
<b>Prior to delivery:</b> <ul style="list-style-type: none"> <li>Complete the “<b>Bidder Release Note</b>”.</li> <li>Delivery readiness review documents: <ul style="list-style-type: none"> <li>Contractor release note (CRN)</li> <li>Delivery report</li> <li>Packaging list</li> <li>Components/sub-systems storage &amp; preservation requirement</li> </ul> </li> </ul>

- Quality Plans are produced by the Bidder and its Bidder(s) to describe how they will implement the ITER-India’s Quality Requirements. The Bidder’s and its Bidder Quality Plans will be approved by ITER-India. This will be submitted to IO for acceptance, if required.
- MIP is used to monitor Quality Control and acceptance tests and must be produced by the Bidder and its Bidders and sent to ITER-India for approval and mark-up of interventions. This will be submitted to IO for acceptance, if required.
- The Bidder shall ensure that its Bidder(s) shall only start implementing any contract with a Quality Plan in place that has been approved by ITER-India. This will be submitted to IO for acceptance, if required.



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- iv. ITER-India shall designate appropriate inspector/s to perform inspections of the Bidder and its Bidder(s) to verify compliance with quality related activities. These inspections will be performed in accordance with the MIPs and Quality Plan. The inspector/s may be ITER-India personnel or specialized inspectors contracted for that purpose.

### **10.6 Change Management**


- i. All requirements of this tender and subsequent changes and deviations proposed by either ITER-India or the Bidder during the course of execution of the contract will be controlled with ITER-India's Configuration Change Management System.
- ii. Proposed changes and deviations will be jointly assessed by the ITER-India, IO and the Bidder.
- iii. Proposed changes and deviations will be implemented by the Bidder after getting approval by ITER-India and IO through Deviation Request process described in "Contractors Deviations and Non-conformities Procedure"[5].

### **10.7 Risk Management**

- The Bidder shall, within 60 (sixty) calendar days of the entry into force of the contract, draw up and submit to the ITER-India, for information, a plan [25] for managing risks associated with implementing the contract (hereinafter referred to as the "Risk Plan").
- The Risk Plan shall set out a register of the risks which may impinge on the successful execution of the contract following the applicable ITER-India Risk Management system and, for each identified risk, shall provide:
  - a summary assessment of likelihood of the risk materializing and of the potential consequences for the successful execution of the contract,
  - possible measures for risk reduction or mitigation and conditions for triggering such measures,
  - an attribution of responsibility in the structure of the Bidder for managing the risk,
  - a plan, consistent with the Schedule, and arrangements for regular monitoring and review of the risk.
- The Bidder shall implement possible measures for risk reduction and mitigation following a graded approach and shall provide to the ITER-India progress reports on a quarterly basis in accordance with the standard template to be agreed between ITER-India and Bidder.
- If and when conditions to trigger specific risk reduction and mitigation measures occur, the Bidder shall inform the ITER-India promptly. The Parties shall consult on the appropriate actions to be taken and on their consequences for the execution of this contract.

### **10.8 Quality Records**

Quality Control and Acceptance Test records shall be maintained according to the procedures defined below as Data Management process. Availability to the ITER-India of the required data is a pre-requisite for granting Authorizations to proceed and Hold Point clearances.


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### ***10.9 Data Management Process***

The large amount of data generated during the execution of this contract shall be handled electronically and entered into a Database. The structure of this Database shall be defined by the ITER-India in consultation with the Bidder protecting Intellectual Property Right as per **Annexure-B (section 11)** and the same will be communicated to IO for agreement. The Bidder and ITER-India shall use this Database to store information related to this contract. All data entered in the Database shall be kept strictly confidential by the IO, and, in no circumstances, shall be communicated or made accessible to other Bidders or other ITER Domestic Agencies.

Documents and data delivered by bidder in the frame of the contract will be uploaded on a document platform defined by ITER-India (INDUS or IDM). No documentation database will be implemented by bidder for this contract.

Data flow from the Bidder to ITER-India: relevant data shall be made available to the ITER-India through the Database each time a NP, ATPP and HP is issued or a Deviation Request and Non-Conformity Report is filed by the Bidder.

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## 11 Annexure-B: Intellectual Property Rights Provisions

### 1. General terms & definitions:

**1.1** As defined in Article 1.2 & 1.3 of Annex on Information and Intellectual Property (IIP Annex) [33] of the Establishment Agreement on the of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project (ITER Agreement), the following definition applies to information and intellectual property:

#### 1.1.1 Information:

“Information” shall mean published data, drawings, designs, computations, reports and other documents, documented data or methods of research and development, as well as the description of inventions and discoveries, whether or not protectable, which are not covered by the term Intellectual Property as defined in 1.1.2.

“Information” shall also include confidential information like specifications, 3-D models, samples and prototypes.

#### 1.1.2 Intellectual property (IP):

“Intellectual Property” shall have the meaning defined in Article 2 of the Convention Establishing the World Intellectual Property Organization, done at Stockholm on July 14, 1967. It may include confidential information such as know-how or trade secrets provided that they are unpublished, and in written or otherwise documented form, and


- a) have been held in confidence by their owner,
  - b) are not generally known or available to the public from other sources, and/or are not generally available to the public in printed publications and/or other readable documents and any form of electronic records,
  - c) have not been made available by their owner to other parties without an obligation concerning confidentiality, and
  - d) are not available to the receiving party without an obligation concerning confidentiality.
- Nothing under these provisions would override the National Laws related to Information and Intellectual Property.

#### 1.1.3 Background Intellectual property:

“Background Intellectual Property” shall mean Intellectual Property that has been or is acquired, developed or produced, before the entry into force of the Contract, or outside of the scope of this Contract. (Entry into force shall be the date of Letter of Intent (LoI), in case the actual contract is signed after the LoI).

#### 1.1.4 Generated Intellectual Property:

“Generated Intellectual Property” shall mean Intellectual Property that is generated or acquired with full ownership by ITER-India or by the Bidder and its subcontractors, pursuant to and in the course execution of this Contract.

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## 2. Provisions under background Intellectual Property:

### 2.1 Declaration of background:

**2.1.1** The Bidder shall declare all Intellectual Property and Information which is held by the Bidder prior to the signature of the Contract or outside its scope and which is needed for carrying out the Contract – this information & Intellectual Property shall be subsequently be referred to as “the background”. The declaration shall provide detailed information on the origin and ownership of the background as well as any legal restrictions relating to its use of which the Bidder is aware. The declaration of the background forms part of the Contract.

**2.1.2** The Bidder may identify additional background information after the signature of the contract. However, in such a situation, the Bidder needs to justify why such a background was not invoked originally into the contract. The use of this Background information shall be authorized only after discussion with ITER-India.

**2.1.3** The Bidder must clearly identify the use background information that belongs to a third party for which the Bidder has a license agreement. Further, he must obtain the rights form third party to allow him to use the background in conformity with 2.1.1 and 2.1.2.


**2.1.4** The Bidder must clearly identify the Background information that is confidential. ITER-India shall preserve (in a manner agreed mutually with the Bidder) the confidentiality of the same. On transfer of component to IO, the Background confidential information so provided shall be communicated to IO and shall be protected by IO in a manner described in clause 2.2.2.

**2.1.5** The background information provided by the Bidder shall be owned exclusively by the Bidder.

### 2.2 Access to Background information:

**2.2.1** The Bidder who has incorporated Background Intellectual Property, except confidential information such as know-how and trade secrets, into the items supplied to the ITER-India and the background information so provided is required:

- to construct, operate, use or integrate technology for research and development in relation to the IO facilities,
- to maintain or repair the item provided, or
- when deemed necessary by ITER-India, in advance of any public procurement, shall grant on an equal and non-discriminatory basis an irrevocable, non-exclusive, royalty free license to use such Background Intellectual Property to ITER-India, other Members (of IO) and to the IO either directly or through ITER-India, with the right of the IO to sub-license and the right of the ITER-India and other Members (of IO) to sub-license to their research institutes and institutes of higher education within their respective territory for the strict purposes of publicly sponsored fusion research and development programmes.

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**2.2.2** The Bidder who has incorporated background confidential information into the items provided to ITER-India and the background confidential information is required:

- to construct, operate, use or integrate technology for research and development in relation to the IO facilities,
- to maintain or repair the item,
- when deemed necessary by ITER-India in advance of any public procurement, or for safety, for quality assurance and quality control reasons as required by regulatory authorities, shall ensure that ITER-India and the IO have an irrevocable, non-exclusive, non-transferable, royalty-free license available to use for their own needs and to the exclusion of rights to disclose, publish or sublicense, such background confidential information including manuals or instructional training materials for the strict purposes of construction, operation, maintenance and repair of the IO facilities.

The confidential information shall be transmitted maintaining the protection for confidentiality in accordance with section 2.1.4. The recipient for such information shall use it only for the provisions identified above. IO guarantees this protection and compensation for damages arising from the misuse of the background confidential information shall be the responsibility of IO.

**2.2.3** The Bidder's attention is drawn to Article 4.2.4 and 4.2.5 of the IIP Annex of ITER Agreement, whereby the Bidder shall use its best efforts to either grant licenses to the background incorporated into the goods supplied under the Contract or to supply such goods to IO Members under the conditions established in Article 4.2.4 and 4.2.5 of the IIP Annex of JIA.


**2.2.4** The Bidder is encouraged to make its background incorporated into the goods supplied under the Contract available for commercial purposes under the conditions established in Article 4.2.6 of the IIP Annex of ITER Agreement.

**2.2.5** The Bidder shall grant on fair and reasonable conditions a license to use the background information & Intellectual Property, applicable to this contract to any third party nominated by ITER-India for the purpose of fulfilling the contract with ITER-India in case of Bidder's default.

### **3 Provisions under Generated Intellectual Property:**

**3.1** All Information (defined in 1.1.1 above) provided by or on behalf of ITER-India to the Bidder shall remain the property of ITER-India. These shall not be shared without permission from ITER-India.

**3.2** The background intellectual property provided by ITER-India will continue to be the property of the ITER-India. Any further extension of the IP during the course of execution of the contract will also belong to the ITER-India.

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**3.3** If, during the process of execution of the contract, any improvement, refinement or technical changes and modifications are affected by the Bidder to the background Information and IP owned by ITER-India and given to the Bidder for execution, such changes shall not affect the title to the property of the ITER-India and it shall continue to own the modified Information and IP. ITER-India shall have absolute rights to assign, transfer, sublet, use and transmit all such Information and IP to its consultants, agents and Bidder. Bidder shall not have any claim or right whatsoever in respect of the above Information and IP.

**3.4** Any information and Intellectual property generated during the course of execution of the contract including those generated at the sub-Bidders end working for this contract shall be communicated to ITER-India immediately and ITER-India shall have the first right to protect such generated intellectual property on its name. The Bidder shall take the appropriate legal and administrative measures to enable ITER-India protect it in its own name.

**3.5** In specific cases ITER-India may waive its right to take protection. In such a situation, the Bidder can take the protection of IP in its name and solely at its cost after reimbursing costs incurred by ITER-India (if any) on such a protection. At all times ITER-India shall be entitled to a royalty-free, non-exclusive, worldwide, irrevocable license with the royalty-free right to grant sublicenses on the resulting registered right.

**3.6** If the Bidder or its employee desires to claim rights on the generated intellectual property, it shall be ensured that the same is possible, subject to compatibility with the Bidder's obligations under the contract and also ensuring that the rights of ITER- India remain unaffected.

**3.7** The Bidder shall be permitted to use the generated Intellectual Property for his own needs. For this, he needs to obtain license from ITER-India. The terms shall be mutually agreed.


**3.8** The Bidder is made aware of the fact that ITER-India may at its discretion, decide to seek protection of a generated intellectual Property, outside India.

**3.9** For generated IP where ITER-India, decides to seek protection, the inventors will assign their rights to ITER-India.

**3.10** ITER-India will seek protection through DAE-IPR Cell.

**3.11** Should the Bidder wish to seek protection of IP generated on the subject matter on the contract within a period of 24 months after conclusion of the contract, the same shall be conveyed to ITER-India. It may be noted that the subject of these IPs shall be considered to be a part of the Generated Intellectual Property (and subject to provision 3.3 above), unless the Bidder demonstrates that these have been created outside the scope of the contract.



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#### **4 Indemnities, repair rights and copyrights:**

**4.1** In case the Bidder needs to use the intellectual property belonging to a third party, the Bidder shall indemnify ITER-India from any action for infringement associated with the third-party intellectual property.


**4.2** The Bidder shall have the first right to attend to repairs for proprietary supplies which incorporate background intellectual property owned by him. However, should the contract not be successful in effecting repairs for such supplies in the first instance, ITER-India shall have the right to effect repairs by whomsoever it may think fit.

**4.3** The Bidder shall be responsible for obtaining all permits, license and copyrights required for the implementation of the contract, as per laws applicable to the place where the contract is executed. In case of inability to seek the necessary permits, licenses and copyrights, the contract shall inform the same to ITER-India and ITER- India shall decide whether to acquire the rights at costs payable by the Bidder or effect a decision to discontinue all or some part of the work.

Project Director Bidder  
ITER-India, Institute for Plasma Research  
Block A, Sangath SKYZ,  
Bhat-Motera Road, Koteswar,  
Ahmedabad - 380 005, Gujarat, India

(Official Seal)(Official Seal)




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## 12 Annexure-C: Delivery Schedule

**Table C: Tentative Delivery Schedule**

Sr. No.	Activity	Completion (month)	Month WRT T0	Probable Hold Points (HP)
<b>C1: Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources (Supply Part)</b>				
1.	Signature of the contract.	T0	T0	
2.	Kick of meeting	T1 =T0+1	T0+1	
3.	Submission of FDR documents & participation	T2 =T1+6	T0+7	Hold Point
4.	FDR closure	T3 =T2 +2	T0+9	Hold Point
5.	FAT and report submission of 1st unit of components/subsystems of prototype RF source	T4 =T3 +10	T0+19	
6.	Transport 1st unit of components/subsystems of prototype RF source	T5 =T4 +2	T0+21	
7.	Delivery of measuring instrument (Annex-H13) at ITER-India Lab.	T5' =T0 +21		
8.	Validation test & reports generation of 1st unit components/subsystems of prototype RF source	T6 =T5 +6	T0+27	Hold Point
9.	Integrated performance demonstration of supplied components with chain-1 of prototype RF source and submit the report.	T7 =T6 +9	T0+36	Hold Point
10.	FAT and report submission of balance components/subsystems of prototype RF source	T8=T4 +8	T0+27	
11.	Transport balance components & sub-systems of <b>prototype</b> RF source at ITER-India lab.	T9=T8+1	T0+28	

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Sr. No.	Activity	Completion (month)	Month WRT T0	Probable Hold Points (HP)
12.	Validation test & reports generation of balance components/subsystems of prototype RF source	T10=T9+7	T0+35	
13.	Integrated performance demonstration of supplied components with chain-2 of prototype RF source and submit the report.	T11 =T10 +6	T0+41	
14.	Integrated performance demonstration of set-1 components with Prototype RF source	T12 =T11 +6	T0+47	Hold Point
15.	Conduction of Manufacturing Readiness Review (MRR)	T13 =T12 +1	T0+48	Hold Point
16.	DRR closure and Dis-assembly & handover of supplied components/sub-system of prototype RF source as per FCA Incoterms at Contactor's Site	T14 = T13 + 2	T0+50	
17.	FAT and report submission of 2nd set of components/subsystems for unit-1 RF source	T15=T7+9	T0+45	Hold Point
18.	Transport 2nd set of component & subsystems for Unit-1 RF source at ITER-India Lab.	T16=T15+1	T0+46	
19.	Delivery of software packages (Annex-H13) at ITER-India Lab.	T16'=T0+46	T0+46	
20.	Validation test & reports generation of 2nd set of component & subsystems for Unit-1 RF source	T17=T16+4	T0+50	
21.	Integrated performance demonstration of supplied components with individual chains of Unit-1 RF source and submit the report.	T18=T17+10	T0+60	
22.	Integrated performance demonstration of set-2 components with Unit-1 RF source	T19=T18+6	T0+66	Hold Point
23.	DRR closure & Dis-assemble & handover supplied components/sub-system of Unit-1 RF source as per FCA Incoterms at Contactor's Site	T20=T19+1	T0+67	


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Sr. No.	Activity	Completion (month)	Month WRT T0	Probable Hold Points (HP)
<b>Total Duration</b>		<b><math>T_{total} = T0 + 67</math></b>		
<b>C2: Assembly, integration &amp; commissioning of Components and sub-systems for high power RF Sources at Purchaser's site (Supervision Part)</b>				
Sr. No.	Activity	Completion (month)	Month WRT T0	Probable Hold Points (HP)
1	Delivery of prototype RF source at Purchaser's Site (Under ITER-India's Scope)	$T21 = T17 + 2$	$T0 + 52$	
2	Supervise preparatory activities for readiness of supplied components & sub-systems (Set-1) for testing of Prototype RF source	$T22 = T21 + 2$	$T0 + 54$	Hold Point
3	Integrated performance demonstration of supplied components with individual chains of prototype RF source and submit the report.	$T23 = T22 + 5$	$T0 + 59$	
4	Integrated performance demonstration of set-1 components with Prototype RF source	$T24 = T23 + 3$	$T0 + 62$	Hold point
5	Delivery of Unit-1 RF source at Purchaser's Site (Under ITER-India's Scope)	$T25 = T20 + 1$	$T0 + 68$	
6	Supervise preparatory activities for readiness of supplied components & sub-systems (Set-2) for testing of Unit-1 RF source	$T26 = T25 + 1$	$T0 + 69$	Hold point
7	Integrated performance demonstration of supplied components with individual chains of Unit-1 RF source and submit the report.	$T27 = T26 + 5$	$T0 + 74$	
8	Integrated performance demonstration of set-2 components with Unit-1 RF source	$T28 = T27 + 5$	$T0 + 79$	Hold point
9	Final documentation & closure of contract	$T29 = T28 + 3$	$T0 + 82$	
<b>Total Duration</b>		<b><math>T_{total} = T0 + 82</math></b>		

### 13 Annexure-D: Reference for seismic analysis

The RF sources (including components supplied by the Bidder) are classified Non-seismic Components but have to be compliant with the following;

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The seismic analyses process for ITER components and the corresponding spectrum to be used for the analysis are defined in the [20], [21] & [22].

The purpose of the analysis is to check the behaviour of the components under the loads corresponding to 3 types of earthquake: SL 1, SL 2 and EC8-ULS (defined in Eurocode 8)

Depending on the seismic classification, the Bidder has to demonstrate different or common conditions under the different earthquake events:

**For SL 2:**


- The RF sources shall not jeopardize the building stability.
  - In particular, the manufacturer shall provide the component response under SL-2.
  - It is part of ITER-India tasks to check for compliance as regard to building stability.

**For SL 1:**

In compliance with the requirements for Investment Protection, the RF sources shall be designed to be reasonably expected to restart and operate in normal situation after an SL-1 event, without special maintenance or tests. Only analytical calculation for SL1 will be conducted without testing the system on the shake table.

**For EC8-ULS**

The RF source stability shall be maintained. This guaranties that occupational safety is ensured as per Eurocode 8 criteria. This applied to the area occupied by people.


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#### 14 Annexure-E: List of Suppliers

List of supplier/fabricator/ sub-contractor/consultants for fabrication of components /CE/LI/French regulation certification:


**Table E1: List of items and reference of supplier**

Sr. No.	Item Description	Reference
1.	RF Analog Signal Generator, 9 kHz to 1 GHz.  Suggested make & model number: Keysight, N5171B EXG X-Series	Annex- H2: RF Signal Generator, Table No-1
2.	Siemens make PLC compatible with PCDH catalogue  Suggested Model No:  1. Digital Input: 6ES7221-1BH32-0XB0 2. Digital Output: 6ES7222-1BH32-1XB0 3. Analog Input: 6ES7231-4HF32-0XB0 4. CPU: SIMATIC S7-1200, CPU 1214C, compact CPU	Annexure-H3: HPA1- 8kW Solid State Power Amplifier-SSPA, Table No-14
3.	48 V/200 A DC SMPS.  Suggested make & model number: Meanwell RST-10000-48	Annexure-H3: HPA1- 8kW Solid State Power Amplifier-SSPA, Table No-15
4.	48 V/10 A DC SMPS.  Suggested make & model number: Mean well NDR-480-48	Annexure-H3: HPA1- 8kW Solid State Power Amplifier-SSPA, Table No-16
5.	8x1 power combiner.  Suggested make & model number: Welratone D9793R-80 or equivalent	Annexure-H3: HPA1- 8kW Solid State Power Amplifier-SSPA, Table No-24
6.	HPA-2 filament power supply  Suggested make & model number: Magna Power XR 10-375/380+LXI	Annexure-H5: Auxiliary Power Supplies, Table No-5

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7.	HPA-3 filament power supply  Suggested make & model number: Magna Power TSD 20-1000/380+LXI	Annexure-H5: Auxiliary Power Supplies, Table No-6
8.	HPA-2 Control Grid power supply  Suggested make & model number: Magna Power SL500-3/UI +HS+LXI	Annexure-H5: Auxiliary Power Supplies, Table No-7
9.	HPA-3 Control Grid power supply  Suggested make & model number: Magna Power SL500-12/380 +HS+LXI	Annexure-H5: Auxiliary Power Supplies, Table No-8
10.	HPA-2 Screen Grid power supply  Suggested make & model number: Magna Power TSD1500-3.3/380+HS+LXI	Annexure-H5: Auxiliary Power Supplies, Table No-9
11.	HPA-3 Screen Grid power supply  Suggested make & model number: Magna Power TSD2000-10/380+HS+LXI	Annexure-H5: Auxiliary Power Supplies, Table No-10
12.	Suggested make & model number for cRIO system: 1. NI cRIO-9049, 1.6GHz Quad-core, 325T FPGA, 8-Slot, RT, Non-XT with Linux RT OS 2. NI 9401 8-Channel, 100 ns, TTL Digital Input/Output Module 3. NI 9924 Front-mount terminal block for 25-pin D-Sub Modules 4. NI 9403 with DSUB 32 Ch, TTL Digital Input/Output Module 5. NI 9220 DSUB, +/-10 V, 16-Bit, 100 kS/s, 16-Ch, SSH AI Module 6. NI 9264 w/ DSUB 16-Ch ±10V, 25 kS/s, 16-Bit, Analog Output Module	Annexure-H7: LCU tender specifications, Table No-1
13.	1. Siemens SIMATIC PM 1507 24 V/8A 2. Siemens SIMATIC S7-1500, CPU 1516-3 PN/DP or 1518-4 PN/DP 3. Siemens SIMATIC ET 200MP, IM155-5 PN HF Profinet interface module 4. Siemens SIMATIC S7-1500, Digital input module 5. Siemens SIMATIC S7-1500, Digital output module	Annexure-H7: LCU tender specifications, Table No-2



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	6. Siemens SIMATIC S7-1500, Analog input module 7. Siemens SIMATIC S7-1500, Analog output module 8. Siemens SIMATIC S7-1500, Front connector 9. Siemens PSU100S, 1Φ, 24VDC/20A	
14.	Suggested make & model number for RF Signal Generator:  Keysight N5171B EXG X-Series	Annexure-H2: RF signal generator, Table No-1
15.	Reference of suppliers for Transmission line components (Tx-line):  M/s Raut Electromech Industries, Shiv-Shakti Industrial Estate, 2, Main Rd, Vadkun, Dahanu, Maharashtra 401602  M/s. Aditya High Vacuum Private Limited  Plot No. 218 & 219, Kathwada GIDC, Odhav, Ahmedabad, Kathwada, Gujarat 382430	Annexure-H9: Transmission line components, Table No-12
16.	Suggested make & model number for 200kW Dummy Load:  - Co-axial Dynamic, USA - Altronic Research INC USA	Annexure-H10: RF Accessories, Table No-1
17.	Suggested make & model number for Key-Management System:  HALMA INDIA PVT. LTD, Bengaluru	Annexure-H11: Safety Key management System, Table No-1
18.	Suggested agency for Legal Inspection consultation:  - Bureau Veritas - Apave, France	-
19.	Suggested agency for CE certification consultation:  - TUV Nord - Apave, France	-

## 15 Annexure-F: List of HPA hardware to be interfaced with LCU

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Following components/sensors will be provided by ITER-India. Bidder need to interface these components/sensors with LCU which is under responsibility of bidder (refer **Annexure-H7, section 17**).


### 15.1 Sensor/transmitter

Sensor/transmitter for water-cooling and air-cooling distribution system are tabulated below based on existing RF chain.


**Table F2: Sensor/transmitter**

Component	Quantity per RF chain	Signal name/Status	Make/Reference
<b>Water cooling system:</b>			
Isolation Valve	HPA2: 2 No.	Manual valve1 High	EBRO Z011 A GGG40 MSK 03 A
		Manual valve1 Low	
		Manual valve2 High	
		Manual valve2 Low	
Motorized Valve	Inlet & outlet of main water-cooling line: 2 No.	Motorized valve1 High	EBRO Z011 A GGG40 E65 24VDC
		Motorized valve1 Low	
		Motorized valve2 High	
		Motorized valve2 Low	
Pressure Indicator with switch	HPA2-2 No.	HPA2 PSL1 low	WIKA 2 contacts NC/NO
		HPA2 PSH1 High	
		HPA2 PSL2 low	WIKA 2 contacts NC/NO
		HPA2 PSH2 High	
	HPA3- 2 No.	HPA3 PSL1 low	WIKA 2 contacts NC/NO 0-10 bar ½’’G
		HPA3 PSH1 High	
		HPA3 PSL2 low	WIKA 2 contacts NC/NO 0-10 bar ½’’G
		HPA3 PSH2 High	
Flow switch	HPA-2: 2 No.	HPA2 Flow alarm1 Low	ELETTA low flow switch PN16 SST
		HPA2 Flow alarm2 Low	ELETTA flow switch low V15GSS25C
	HPA-3: 9 No.	HPA3 Flow alarm1 Low	ELETTA flow switch low DN80 PN16
		HPA3 Flow alarm2 Low	ELETTA low flow switch ½’’ PN16 SST DN15 2
		HPA3 Flow alarm3 Low	ELETTA flow switch low DN80 PN16
		HPA3 Flow alarm4 Low	ELETTA flow switch low DN80 PN16
		HPA3 Flow alarm5 Low	ELETTA flow switch low DN80 PN16
		HPA3 Flow alarm6 Low	ELETTA flow switch low

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Component	Quantity per RF chain	Signal name/Status	Make/Reference
			DN80 PN16
		HPA3 Flow alarm7 Low	ELETTA flow switch low DN80 PN16
		HPA3 Flow alarm8 Low	ELETTA flow switch low DN80 PN16
		HPA3 Flow alarm9 Low	ELETTA low flow switch ½” PN16 SST DN15 2
Temperature switch	HPA2: 2 No.	HPA2 Temp inlet high	THERMOEST
		HPA2 Temp outlet high	THERMOEST
	HPA3: 2 No.	HPA3 Temp inlet high	THERMOEST
		HPA3 Temp outlet high	THERMOEST
Temp sensor & transmitter	HPA-2: 2 No.	HPA2 inlet Temperature Transmitter 1	THERMOEST SI600-0 à 120°
		HPA2 outlet Temperature Transmitter 2	THERMOEST SI600-0 à 120°
	HPA-3: 2 No.	HPA3 inlet Temperature Transmitter 3	THERMOEST SI600-0 à 120°
		HPA3 outlet Temperature Transmitter 4	THERMOEST SI600-0 à 120°
Flow sensor & transmitter	HPA-2: 1 No.	HPA2 Flow Transmitter1	ELETTA flow meter D5GSS25B 24-120 l/min
	HPA-3: 1No.	HPA3 Flow Transmitter1	ELETTA D5FSS80F 240-1200 l/min
<b>Air cooling system</b>			
Differential pressure switch	HPA2: 3 No.	HPA2 DPSL1	HUBA 6049500001W
		HPA2 DPSL2	HUBA 6049500001W
		HPA2 DPSL3	HUBA 6049500001W
	HPA3: 9 No.	HPA3 DPSL1	HUBA 6049500001W
		HPA3 DPSL2	HUBA 6049500001W
		HPA3 DPSL3	HUBA 6049500001W
		HPA3 DPSL4	HUBA 6049500001W
		HPA3 DPSL5	HUBA 6049500001W
		HPA3 DPSL6	HUBA 6049500001W
		HPA3 DPSL7	HUBA 6049500001W
		HPA3 DPSL8	HUBA 6049500001W
		HPA3 DPSL9	HUBA 6049500001W
Blower		HPA2 blower# run	

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Component	Quantity per RF chain	Signal name/Status	Make/Reference
		HPA2 blower# fault	
		HPA3 blower# run	
		HPA3 blower# fault	
		HPA2 Blower# start command	
		HPA3 Blower# start command	

### 15.2 Arc detector, Motor & Driver/controller requirement

following components are provided by ITER-India and required to interface with LCU by Bidder.

**Table F3: Arc detector, Motor & Driver/controller**

Component	Quantity per RF chain	Description	Make/Comments
Arc detector	HPA2: 2 Arc detectors	<ul style="list-style-type: none"> <li>– FOC for Arc simulator &amp; light transmitting from Arc detector header</li> <li>– Arc detector module: ARC-4</li> </ul>	
	HPA3: 6 Arc detectors		
Motor & driver/controller	HPA2: 8 sets of motor & driver/controller and 1 set of motor & driver/controller for trombone (phase shifter)	<ul style="list-style-type: none"> <li>– Moving mechanism with motor</li> <li>– Motor's driver/controller having Profinet connectivity</li> <li>– Cables &amp; connectors required to connect motor with motor driver/controller</li> </ul>	
	HPA3: 9 sets of motor & driver/controller		

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## 16 Annexure-G: Preliminary validation report formats for interfaces at ITER-India lab/ Purchaser's site


Before start of assembly, integration and integrated performance demonstration /SAT of RF chain/ RF Source, at ITER-India lab/ Purchaser's site. Bidder shall be responsible to conduct validation tests as per following formats for the supplied components/sub-systems by the Bidder. The final version of these reports and contents will be defined at the FDR.

### 16.1 Interface Title: Water cooling

ITER-India contract no.	
Contract title	
Bidder	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<b>Water Cooling Facility</b>	


Description	Requirements	Observations	Remark
Type of water			
Main line inlet water conductivity			
Main line inlet water temperature			
Main line inlet pressure			
Main line flow			
HPA-3; Inlet pressure			
HPA-3; Outlet pressure			
HPA-3; Flow rate			
HPA-2; Inlet pressure			
HPA-2; Outlet pressure			
HPA-2; Flow rate			

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone
	Accepted [ ] Rejected [ ] with HPA3 Interface
	Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
Filled by Bidder's Representative	Filled by ITER-India's/IO's Representative
Name:	Name:
Date:	Date:
Signature	Signature:

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## 16.2 Interface Title: Air cooling

ITER-India contract no.	NA
Contract title	NA
Contractor	NA
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<i>Air Cooling Facility</i>	

Description	Requirements	Observations at ITER-India lab	Remark
<b>HPA-2</b>			
Input circuit			
Primary output circuit			
Secondary output circuit			
<b>HPA-3</b>			
Filament circuit			
Input RF circuit			
Input RF transformer			
Output RF transformer: (back wall side)			
Output RF transformer: (front side)			
Bottom anode (back wall side):			
Bottom anode (front side)			
Top anode (back side)			
Top anode front side			

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA3 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
Filled by Bidder's Representative	Filled by ITER-India's/IO's Representative
Name:	Name:
Date:	Date:
Signature	Signature:


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### 16.3 Interface Title: LP section and SSPA

ITER-India contract no.	PO:
Interface Title	<b>LP section and SSPA</b>
Supplied by	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<b>Pre-driver (HPA-I): Solid State Power Amplifier (SSPA)</b>	

Parameters	Requirements	Observations	Remark
Frequency (MHz)	36, 40, 42, 53,55 and 60MHz		
Output power	8kW on matched load		
Pulse duration	3600 s		
Harmonic and spurious (on matched load)	≤-20dBc		
Gain Flatness (±4MHz)	1dB		
Interface for remote control	Analog mode		
Cooling water parameters (pressure/flow/Inlet temperature)	5bar/ 30 LPM/21°C		
Control & protection	RF power, over drive, over VSWR, water cooling		

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
	Accepted [ ] Rejected [ ]
	Accepted [ ] Rejected [ ]
Test for performance evaluation	Accepted [ ] Rejected [ ]
Comments (if any)	
Attachments (if any)	
Filled by Bidder's Representative	Filled by ITER-India's/IO's Representative
Name:	Name:
Date:	Date:
Signature:	Signature:

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#### 16.4 Interface Title: Directional coupler


ITER-India contract no.	
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<i>Calibration of directional coupler</i>	

Frequency (MHz)	FWD Coupling (dB)	RFL Coupling (dB)	Directivity (dB)	Remark
36				
40				
42				
53				
55				
60				

#### Calibration for harmonics

Frequency (MHz)	Fundamental (dB)	H1 (dB)	H2 (dB)	H3 (dB)
36				
40				
42				
53				
55				
60				

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA3 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
<b>Filled by Bidder's Representative</b>	<b>Filled by ITER-India's/IO's Representative</b>
Name:	Name:
Date:	Date:
Signature	Signature:

	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
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### 16.5 Interface Title: RF power measurement test setup for HPA2 & HPA3


ITER-India contract no.	
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<i>Calibration of RF power measurement test setup with cable, filter and attenuator</i>	

Frequency (MHz)	Offset Value for forward power measurement (dB)		Offset Value for Reflected power measurement (dB)		Remark
	HPA2	HPA3	HPA2	HPA3	
36					Total offset: DC coupling+Attenuator loss +Filter loss +Cable loss
40					
42					
53					
55					
60					

### Measurement of harmonics

Frequency (MHz)	Fundamental (dB)	H1 (dB)	H2 (dB)	H3 (dB)
36				
40				
42				
53				
55				
60				

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA3 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
<b>Filled by Bidder's Representative</b>	<b>Filled by ITER-India's/IO's Representative</b>
Name:	Name:
Date:	Date:
Signature	Signature:


	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
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### 16.6 Interface Title: Transmission line components

ITER-India contract no.	
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	

Frequency (MHz)	Insertion loss (dB)	Return loss (dB)
36		
40		
42		
53		
55		
60		

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA3 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
Filled by Bidder's Representative	Filled by ITER-India's/IO's Representative
Name:	Name:
Date:	Date:
Signature	Signature:

	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
		H6GLB2Q


### 16.7 Interface Title: 3dB Hybrid Combiner with dummy load at isolation port

ITER-India contract no.	
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications on matched load</b>	

Frequency (MHz)	Insertion loss (better than 0.15 dB)	Return loss (better than 22 dB)	Isolation (better than 22 dB)
36			
40			
42			
53			
55			
60			

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA3 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
Filled by Bidder's Representative	Filled by ITER-India's/IO's Representative
Name:	Name:
Date:	Date:
Signature	Signature:



	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
		H6GLB2Q

### 16.8 Interface Title: 3MW Dummy load


ITER-India contract no.	
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<i>Calibration of dummy load</i>	

Temp. (°C)	S11@ 40MHz	S11@ 42MHz	S11@ 53MHz	S11@ 55MHz	S11@ 100MHz
66					
71					
72					

Temp. (°C)	VSWR @ 40MHz	VSWR @ 42MHz	VSWR @ 53MHz	VSWR @ 55MHz	VSWR @ 100MHz
66					
71					
72					

Temp. (°C)	Impedance @ 40MHz	Impedance @ 42MHz	Impedance @ 53MHz	Impedance @ 55MHz	Impedance @ 100MHz
72					


Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA3 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
Filled by Bidder's Representative	Filled by ITER-India's/IO's Representative
Name:	Name:
Date:	Date:
Signature	Signature:

	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q

### 16.9 Interface Title: Filament Power Supply for HPA2

ITER-India contract no.	PO No.		
Contract title			
Contractor			
Person Involved in Validation:		Date:	
Major Technical Specifications			
Filament Power Supply for HPA2			
Description	Major Specifications	Observations	Remarks
Rated DC output Voltage			
Operational DC voltage			
Rated DC output Current			
Filament Voltage at the cavity terminal Vf (V)			
Filament current If (A)			
Ramp up and Ramp down rate			Through LCU
Line Regulation			Available equipment will be used
Load Regulation			Available equipment will be used
Output voltage ripple			
Over Voltage Threshold			Through LCU
Over Current Threshold			Through LCU
Fault protections: Over load Over voltage			
Heat run test			
Monitoring of Voltage & Current			Through LCU
Cable type			

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA2 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
Filled by Bidder's Representative	Filled by ITER-India's/IO's Representative
Name:	Name:
Date:	Date:
Signature	Signature:


	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q

### 16.10 Interface Title: Filament Power Supply for HPA3

ITER-India contract no.	PO No.
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<b>Filament Power Supply for HPA3</b>	

Description	Major Specifications	Observations	Remarks
Rated DC output Voltage			
Operational DC voltage			
Rated DC output Current			
Filament Voltage at the cavity terminal Vf (V)			
Filament current If (A)			
Ramp up and Ramp down rate			Through LCU
Line Regulation			Available equipment will be used
Load Regulation			Available equipment will be used
Output voltage ripple			
Over Voltage Threshold			Through LCU
Over Current Threshold			Through LCU
Fault protections: Over load and Over voltage			
Heat run test			
Monitoring of Voltage & Current			Through LCU
Cable type			

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA3 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
<b>Filled by Bidder's Representative</b>	<b>Filled by ITER-India's/IO's Representative</b>
Name:	Name:
Date:	Date:
Signature	Signature:


	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q

### 16.11 Interface Title: Control Grid Power Supply for HPA2

ITER-India contract no.	PO No.
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<b>Control Grid Power Supply for HPA2</b>	

Description	Major Specifications	Observations	Remarks
Rated DC output voltage			
Operational DC voltage			
Rated DC current			
Current in the bleeder			
Fuse test (0.5A)			Fuse test will be conducted with Bleeder & external protection circuit
Line regulation			Available equipment will be used
Load regulation			Available equipment will be used
Output voltage ripple			
Over Voltage Threshold			Through LCU
Over Current Threshold			Through LCU
Heat run test			
Monitoring of Voltage & Current			Through LCU
Cable type			
Cooling water parameters for water cooled bleeder assembly	50 LPM @ 5bar		

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA2 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
<b>Filled by Bidder's Representative</b>	<b>Filled by ITER-India's/IO's Representative</b>
Name:	Name:
Date:	Date:
Signature:	Signature:


	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q

### 16.12 Interface Title: Control Grid Power Supply for HPA3

ITER-India contract no.	PO No.
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<b>Control Grid Power Supply for HPA3</b>	

Description	Major Specifications	Observations	Remarks
Rated DC output voltage			
Operational DC voltage			
Rated DC current			
Current in the bleeder			
Fuse test (0.5A)			Fuse test will be conducted with Bleeder & external protection circuit
Line regulation			Available equipment will be used
Load regulation			Available equipment will be used
Output voltage ripple			
Over Voltage Threshold			Through LCU
Over Current Threshold			Through LCU
Heat run test			
Monitoring of Voltage & Current			Through LCU
Cable type			
Cooling water parameters for water cooled bleeder assembly	50 LPM @ 5bar		

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA3 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
<b>Filled by Bidder's Representative</b>	<b>Filled by ITER-India's/IO's Representative</b>
Name:	Name:
Date:	Date:
Signature	Signature:


	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q

### 16.13 Interface Title: Screen Grid Power Supply for HPA2

ITER-India contract no.	PO No.
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<b>Screen Grid Power Supply for HPA2</b>	

Description	Major Specifications	Observations	Remarks
Rated DC output voltage			
Operational DC voltage			
Rated DC current			
Current in the bleeder			
Fuse test (1.0A)			Fuse test will be conducted with Bleeder & external protection circuit
Line regulation			Available equipment will be used
Load regulation			Available equipment will be used
Output voltage ripple			
Over Voltage Threshold			Through LCU
Over Current Threshold			Through LCU
Heat run test			
Monitoring of Voltage & Current			Through LCU
Cable type			
Cooling water parameters for water cooled bleeder assembly (pressure/flow/Inlet temperature)	50 LPM @ 5bar (Inlet 21°C)		

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA2 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
<b>Filled by Bidder's Representative</b>	<b>Filled by ITER-India's/IO's Representative</b>
Name:	Name:
Date:	Date:
Signature	Signature:

	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
		H6GLB2Q


### 16.14 Interface Title: Screen Grid Power Supply for HPA3

ITER-India contract no.	PO No.
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<i>Screen Grid Power Supply for HPA3</i>	

Description	Major Specifications	Observations	Remarks
Rated DC output voltage			
Operational DC voltage			
Rated DC current			
Current in the bleeder			
Fuse test (1.0A)			Fuse test will be conducted with Bleeder & external protection circuit
Line regulation			Available equipment will be used
Load regulation			Available equipment will be used
Output voltage ripple			
Over Voltage Threshold			Through LCU
Over Current Threshold			Through LCU
Heat run test			
Monitoring of Voltage & Current			Through LCU
Cable type			
Cooling water parameters for water cooled bleeder assembly	50 LPM @ 5bar		

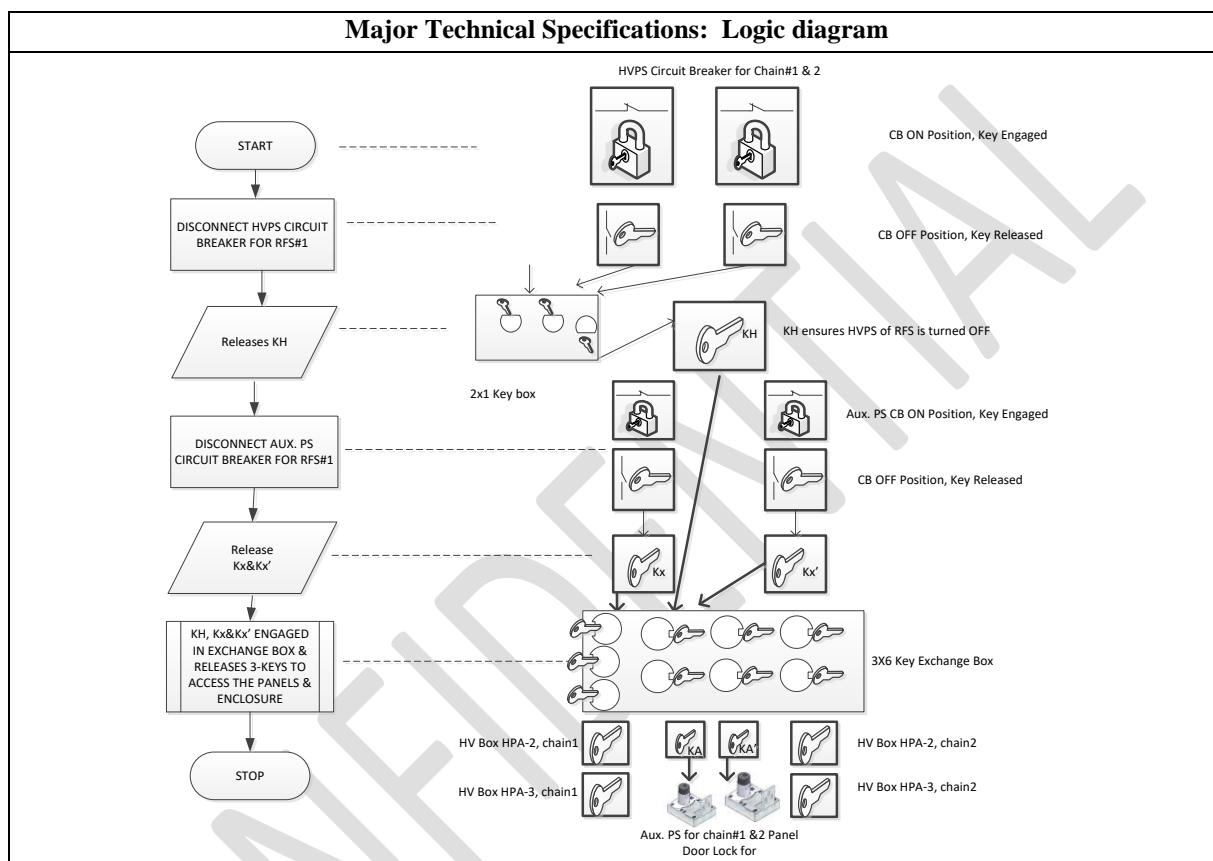
Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA3 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
<b>Filled by Bidder's Representative</b>	<b>Filled by ITER-India's/IO's Representative</b>
Name:	Name:
Date:	Date:
Signature	Signature:




	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q

### 16.15 Interface Title: Safety Key Management

ITER-India contract no.	
Interface Title	<b>Safety Key Management System</b>
Supplied by	
Person Involved in Validation:	Date:



Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
	Accepted [ ] Rejected [ ]
	Accepted [ ] Rejected [ ]
	Accepted [ ] Rejected [ ]
Comments (if any)	
Attachments (if any)	
<b>Filled by Bidder's Representative</b>	<b>Filled by ITER-India's/IO's Representative</b>
Name:	Name:
Date:	Date:
Signature:	Signature:


	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
		H6GLB2Q

### 16.16 Interface Title: RF enclosure & Support Structure

ITER-India contract no.	
Interface Title	<b>RF enclosure</b>
Supplied by	
Person Involved in Validation:	Date:

Major Technical Specifications
Checking as per Layout diagram
<div style="text-align: center; font-size: 2em; opacity: 0.1; transform: rotate(-30deg); pointer-events: none;">CONFIDENTIAL</div>


Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
	Accepted [ ] Rejected [ ]
	Accepted [ ] Rejected [ ]
	Accepted [ ] Rejected [ ]
Comments (if any)	
Attachments (if any)	
Filled by Bidder's Representative	Filled by ITER-India's/IO's Representative
Name:	Name:
Date:	Date:
Signature:	Signature:

	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
		H6GLB2Q

**16.17 Interface Title: Grounding Scheme at ITER-INDIA lab/Purchaser's site**

ITER-India contract no.	
Contract title	
Contractor	
Person Involved in Validation:	Date:
<b>Major Technical Specifications</b>	
<i>Grounding Scheme at ITER-INDIA lab/IO Site Purchaser's site</i>	

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA3 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	
Filled by Bidder's Representative	Filled by ITER-India's/IO's Representative
Name:	Name:
Date:	Date:
Signature	Signature:


	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q

### 16.18 Interface Title: Local Control Unit (LCU)

ITER-India contract no.			
Contract title			
Contractor			
Person Involved in Validation:		Date:	
<b>Major Technical Specifications</b>			
<b>Local Control Unit (LCU)</b>			

Description (Preliminary)	Observations	Remarks
Sequential control system		
Interfacing and health monitoring system of different sub system		
Data Acquisition system: Acquisition with Normal speed & acquisition with 1 $\mu$ s with pre & post data for 100ms w.r.t. fault initiated RF muting		
Fast Protection system		
Offline analysis module		

Performance evaluation criteria	
Visual evaluation	Accepted [ ] Rejected [ ]
Technical evaluation	Accepted [ ] Rejected [ ] with standalone Accepted [ ] Rejected [ ] with HPA2 Interface Accepted [ ] Rejected [ ] with power test
Comments (if any)	
Attachments (if any)	<b>LCU: Annex-1</b> (see in next page)
Filled by Bidder's Representative	Filled by ITER-India's/IO's Representative
Name:	Name:
Date:	Date:
Signature	Signature:


	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
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### LCU: Annex-1

Interlock	Interlock Simulation	Desired Actions	Results	Remarks
Water Cooling	By creating a fault in HPA2 Water Cooling System			
Air Cooling	By creating a fault in HPA2 Air Cooling System			
Temp & Pressure Security	By creating a fault in HPA2 Temp & Press Security System			
Dummy Load Fault	By creating a fault in Dummy Load System			
Tuning System	By changing Frequency of the system at all Power supply on state			
Filament Trip	By creating Filament Over Voltage condition			
CG Trip	By creating CG Over Voltage condition			
HVPS Trip	By creating HVPS Over Voltage condition			
SG Trip	By creating SG Over Voltage condition			
CG Reverse Current	By creating CG Reverse current condition			
CG Over Current	By creating CG Over current condition			
SG Over Current	By creating SG Over current condition			
APD max	By changing APD Max limit			
Over Reflection	By changing Max over reflection limit			
Emergency OFF	By pushing Emm OFF button			

**Note:**

Monitoring & Interlocks will be tested as per Logic required during RF power operation.

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## 17 Annexure-H: Detailed Description for scope of works

The password protected documents of main tender for technical scope of work, all the associated Annexures, acceptance criteria and design review detail for each components/sub-system will be shared with bidder after getting signed non-discloser agreement (NDA) from the eligible bidder.

Bidder is responsible for the scope of works as described in respective section of components/sub-systems.

The fabrication/procurement of the items will be carried out by Bidder. ITER-India will provide reference design with all the technical details with drawings, layout, name of supplier/fabricator etc.

Bidder is suggested to go through all the document thoroughly before final submission of offer.

### 17.1 Mechanical system

Mechanical system as per lay out: Grounding materials as per grounding scheme, Cable trays, Complete water-air cooling headers, water & air-cooling accessories along with instrumentation and cables for monitoring & control purpose of the components supplied, specific jigs, fixtures & lifting arrangement etc. RF source enclosure, support frame, Base frame, service platform with ladder to accommodate components supplied by the Bidder and component supplied by ITER-India for RF source. Refer **Annexure-H1** ([ITER D 96RYDS](#)) for detail information.

### 17.2 RF signal generators during

Refer **Annexure-H2** ([ITER D A7572E](#)) for detail information.

### 17.3 HPA1 ~8 kW Solid State Power Amplifier-SSPA

Refer **Annexure-H3** ([ITER D A75D6V](#)) for detail information.


### 17.4 Low Power RF Components

Low Power RF Section: Power Divider (s), RF Switch, Voltage Controlled Attenuator, Voltage Controlled Phase Shifter, Directional Coupler etc. Refer **Annexure-H4** ([ITER D CY87XX](#)) for detail information.

### 17.5 Auxiliary Power Supplies:

Auxiliary Power supplies (Aux.PS) with required cables, DC loads & Grounding strips/cables with connecting accessories etc. Refer **Annexure-H5** ([ITER D DRQHJL](#)) for detail information.

### 17.6 LT Panels:

	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
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LT Panels (one for Class IV and one for Class II AC systems) with required output cables to connect with different load points. Refer **Annexure-H6** ([ITER\\_D\\_DUFCK8](#)) for detail information.

### ***17.7 Local Control Unit***

Local Control Unit (LCU) with required fibre optic and copper cables to connect with different load points. Refer **Annexure-H7** ([ITER\\_D\\_94WW8T](#)) for detail information.

### ***17.8 Arc Detection System***

Arc detection system with required fibre optic and copper cables to connect with different detection points. Refer **Annexure-H8** ([ITER\\_D\\_DUFD7A](#)) for detail information.

### ***17.9 Transmission Line Components***

Transmission line components (Tx-line): For inter-connecting transmission line components including all directional couplers & Gas Barriers and Gas Inlet Tees etc. Refer **Annexure-H9** ([ITER\\_D\\_9MQFVK](#)) for detail information.

### ***17.10 RF Accessories***

Accessories (Fixed attenuators of various values & power ratings, RF cable assemblies, 50 ohms terminations of various power ratings, 200kW Dummy Load (DL) for the isolation port of 3dB combiner, adaptors (BNC-N, BNC-BNC, N-N) are required for assembly, integration and commissioning of all components/Sub-systems in RF source. Refer **Annexure-H10** ([ITER\\_D\\_DRR5WK](#)) for detail information.

### ***17.11 Safety key management system***


The Key Management Safety System (KMSS) is designed to ensure personnel & system safety during maintenance along with their related systems & sub-systems like Auxiliary power supplies cubicle, Circuit breakers in LT panel, or other electric system must be incorporated with key lock unit. Refer **Annexure-H11** ([ITER\\_D\\_DUFC4X](#)) for detail information.

### ***17.12 Preliminary list of Test & Measuring Instruments***


Test & measuring instruments will be required during assembly, integration and integrated performance demonstration at ITER-India lab and SAT at Purchaser's site. One set will be deliverable to IO. Refer **Annexure-H12** ([ITER\\_D\\_DRRURW](#)) for detail information.

### ***17.13 Preliminary list of Measuring Instruments and Software***



	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
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Measuring Instruments and Software will be required during assembly, integration and integrated performance demonstration at ITER-India lab. One set will be deliverable to ITER-India lab. Refer **Annexure-H13** **(ITER D DRRURW)** for detail information.

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	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q

## 18 Annexure-I: Proposed RF source Layout

In this section, a proposed RF source layout is described. This layout will be finalized mutually between ITER-India, IO, supplier of HPA and Bidder complying RF building interface requirements during FDR phase.

Each RF source consists of two chains and a 3dB hybrid combiner; each chain comprising of a low power RF section, an SSPA, two high power tube-based amplifiers (HPA2 & HPA3), Inter-connecting Tx-lines, electrical power supplies, control & monitoring system (LCU) and the water- & air-cooling distribution system.

Different sub-systems/components of the RF source are mounted on a base frame, a support frame and a service platform. The HPA2, HPA3 and Trombone have their own independent support structures, connected to the base frame.

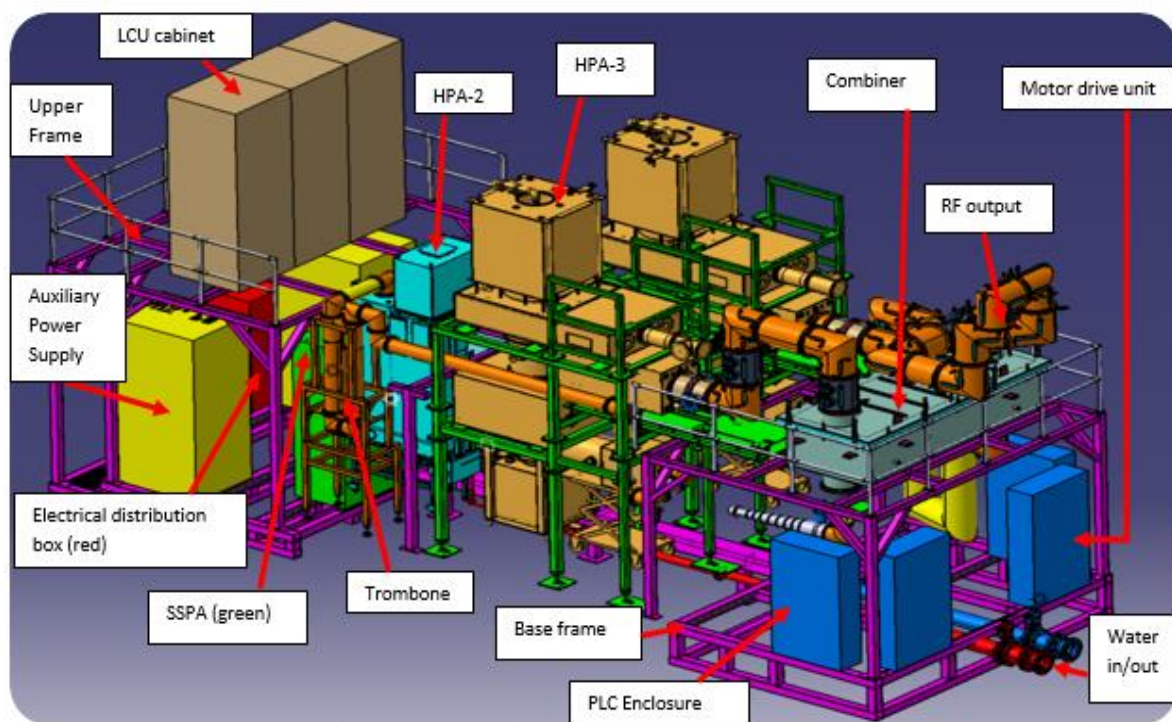



Fig. 2: Layout of overall RF source

	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q

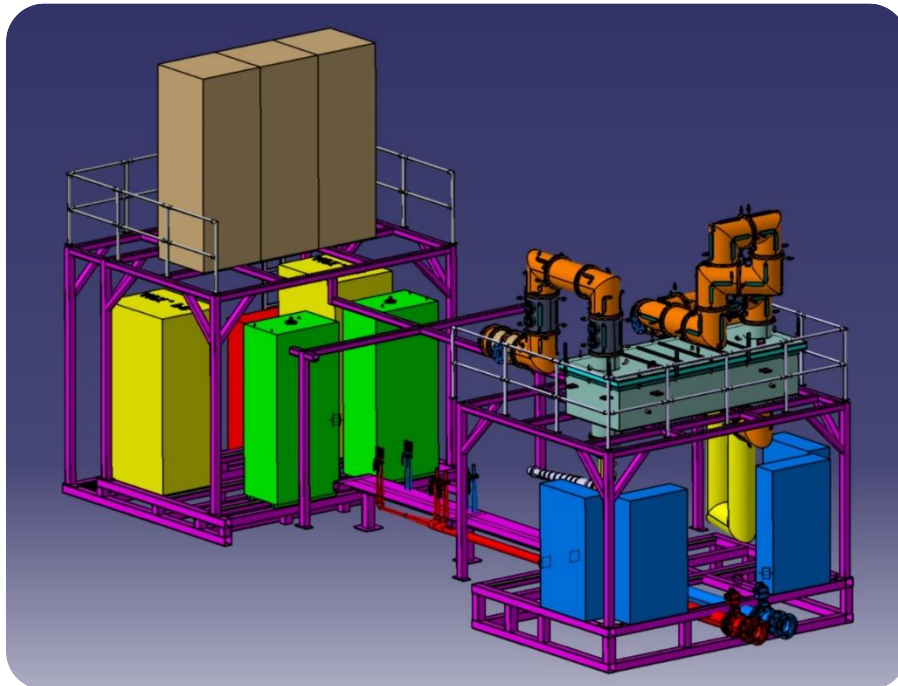


Fig. 3: Layout of components/ sub-systems supplied by Bidder

**Fig. 3** and **Fig. 4** show all the components / sub-systems which are under the Bidder's scope for installation on base frame along with support structures. The total weight of components under Bidder's scope shall not be more than **9 tons**.

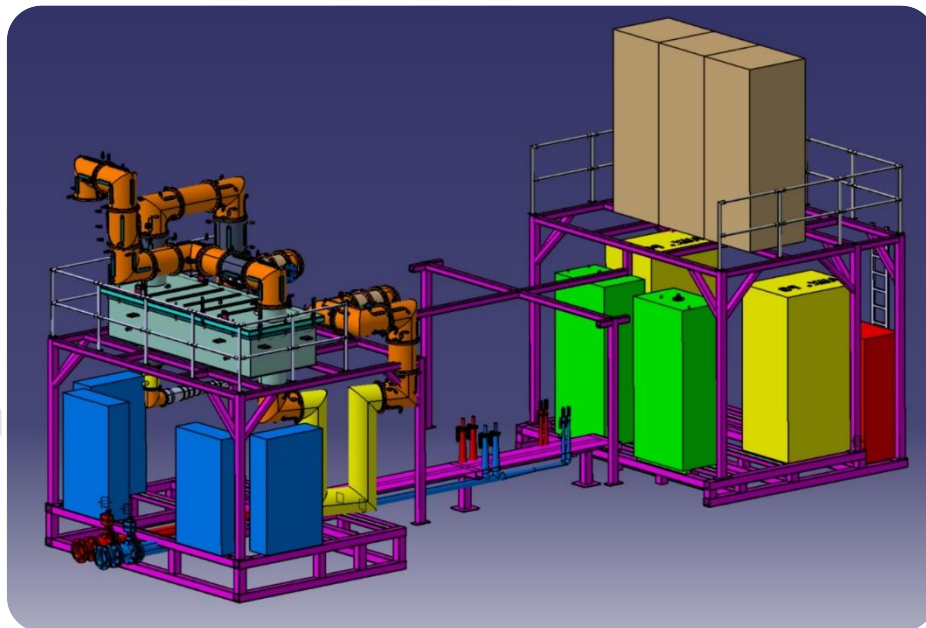



Fig. 4: Layout of components/ sub-systems supplied by Bidder

	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
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**Fig. 5** shows the details of the base frame, the support frame, the service platform, the main water-cooling headers (inlet & outlet) and the interface flanges between water distribution of HPA2 & HPA3.

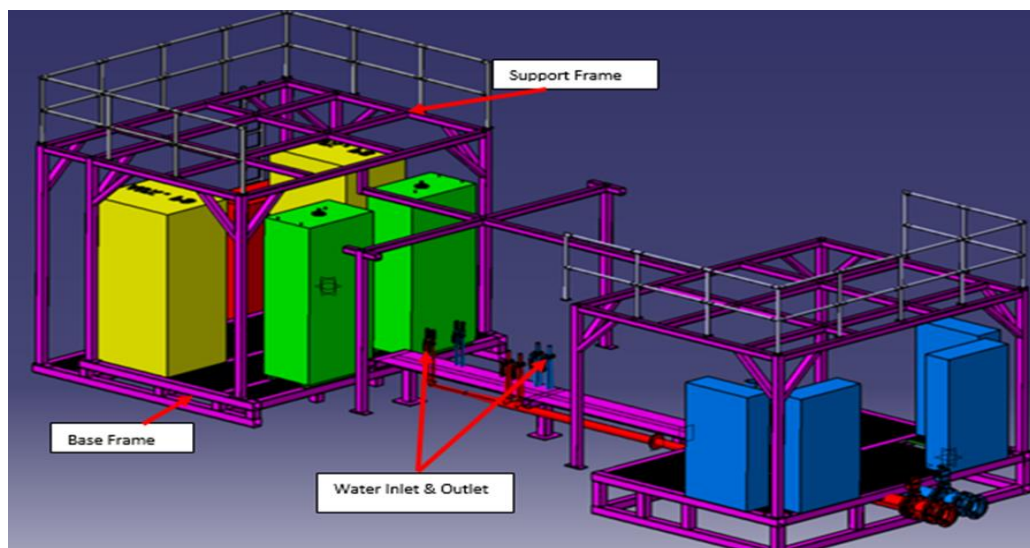


Fig. 5: Support & base frame, service platform and main water-cooling header

The overall dimensions of base & support frame are shown in **Fig. 6**. It is to be noted that the support frame, base frame and main water-cooling header up to the interface flanges of water distribution for HPA2 & HPA3 are under Bidder's scope. The base frame is considered to accommodate the main water-cooling lines up-to interface point, as well as electrical and control cables. Ladder and cable tray are not shown but, it is under the scope of bidder.

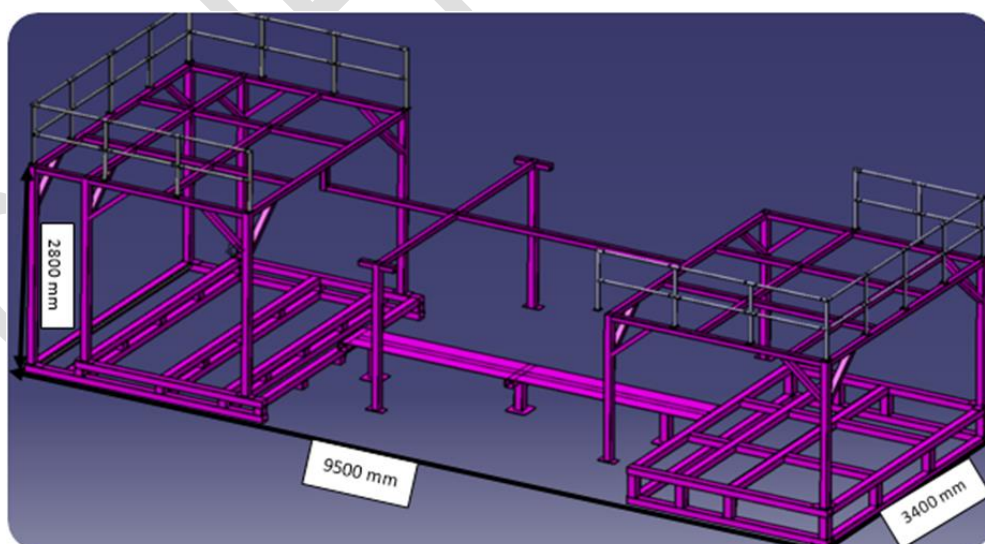



Fig. 6: Overall dimensions of base & support frame



	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources	INDUS Ref.
	PART A(ii) Scope of Supply, work and Technical Specifications	H6GLB2Q

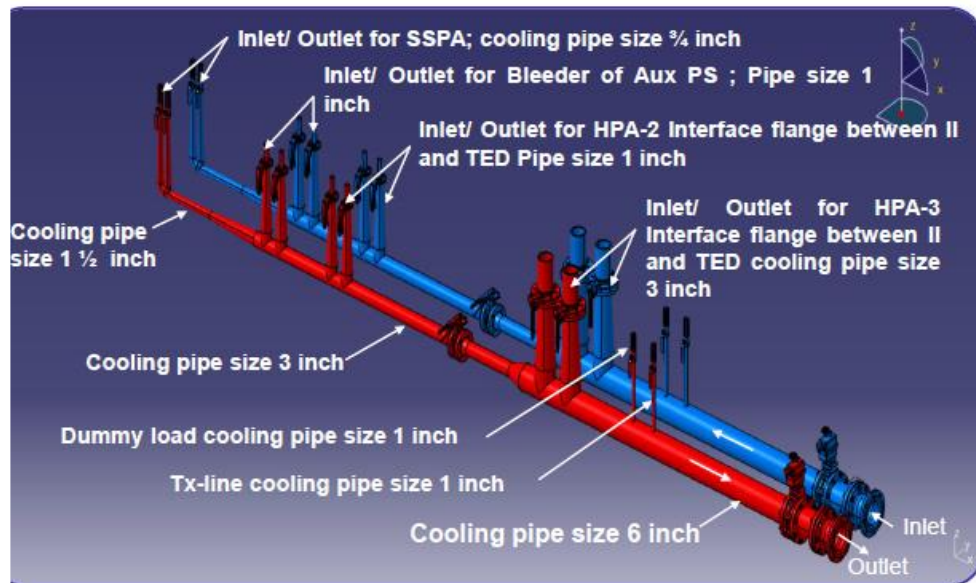


Fig. 7: Layout of main water-cooling header

The details of inlet & outlet water cooling flanges for SSPA, Aux PS Bleeder assembly, HPA2, HPA3, dummy load and Tx-line is shown in **Fig. 7**.

The connection details for 3dB hybrid combiner are shown in **Fig. 8**, which is under Bidder's responsibility.

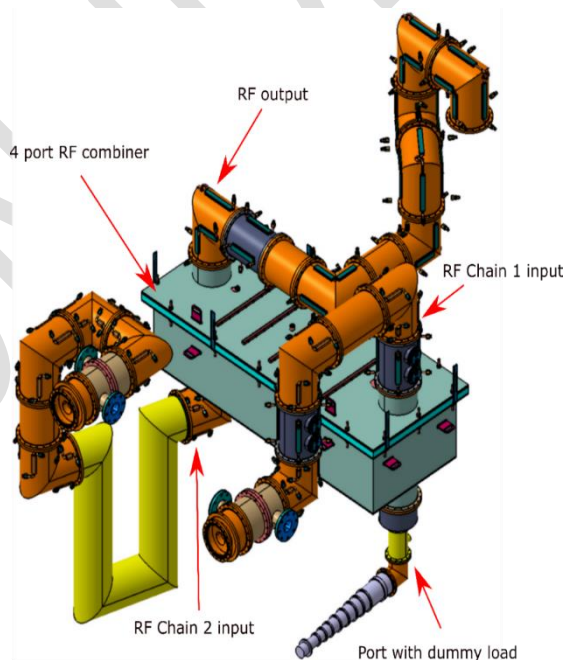




Fig. 8: 3dB hybrid combiner with Tx. Line components

	GeM bid No. GEM/2026/B/7159931 dated 28.01.2026 for Design, Manufacturing and Supply of Components and sub-systems for high power RF Sources  PART A(ii) Scope of Supply, work and Technical Specifications	INDUS Ref.
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The following table shows the approximate dimensions and quantities of sub-systems /components for one RF source.

**Table I1: Approximate dimensions and quantities**

Sr. No.	Components	Dimensions (W x L) in mm per unit	Quantity
1	Aux. Power Supplies	1000x 800	2Nos.
2	PLC enclosure	300x800	2Nos.
3	SSPA	600x900	2Nos.
4	LCU	800x800	3 Nos.
5	Motor's driver enclosure	300x800	2 Nos.
6	Combiner + Tx. Line	2700x2140	1set
7	Electrical distribution box	1000x500	1No.

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## 19 Annexure-J: PFD diagram for water and air cooling circuits

The proposed RF source water- and air-cooling details are described in this section. However, this will be finalized mutually by discussion between ITER-India, IO, Supplier of HPA and Bidder within one-month time after placing the contract. Bidder is responsible to provide PFD diagrams and main header as per **Annexure-I: Proposed RF source Layout**.

### 19.1 Proposed PFD diagram for water cooling

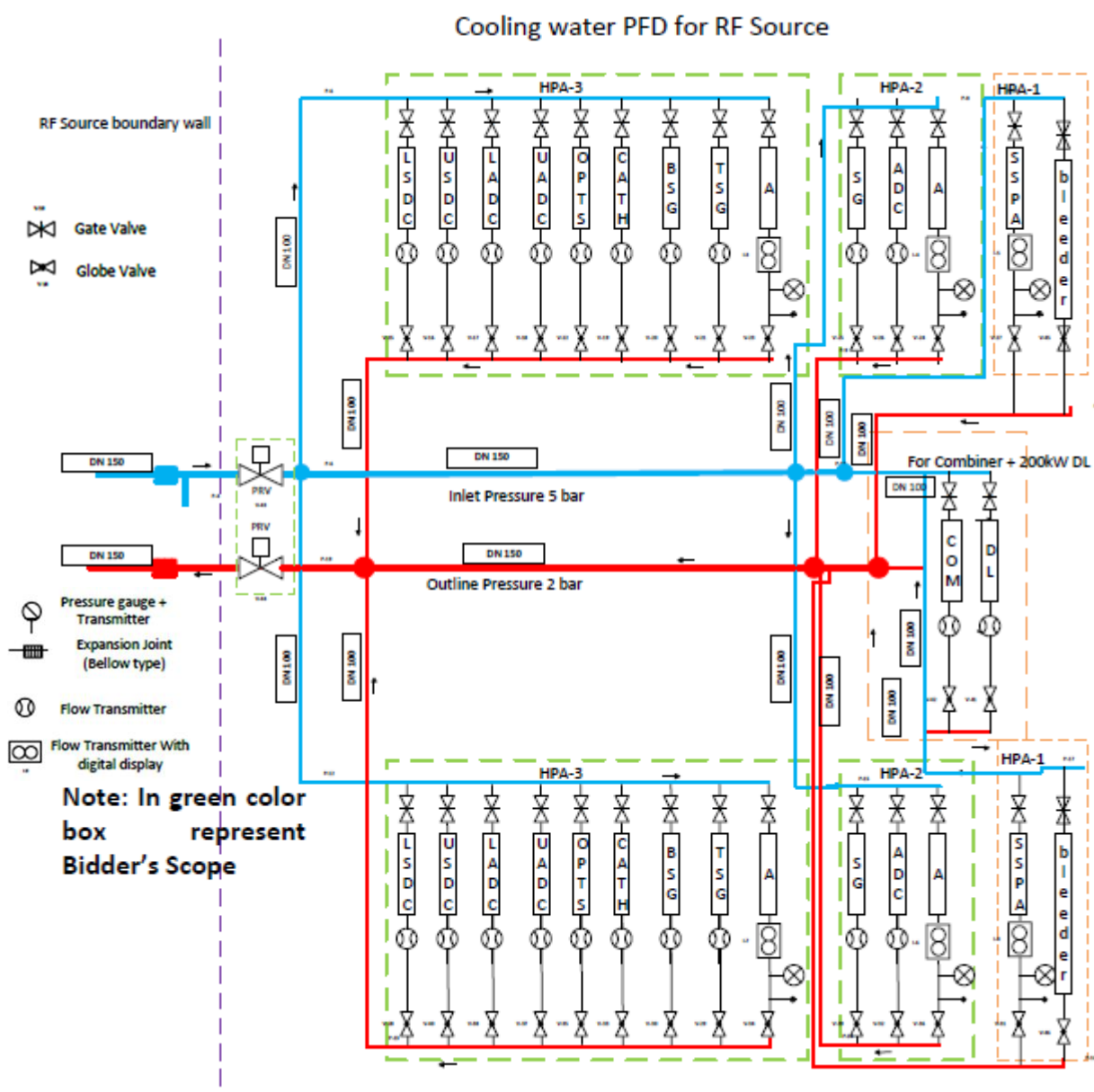




Fig. 9: Water cooling PFD diagram for one RF source



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**Table J1: Flow Requirement for one RF Source**

Description		Flow (LPM)	Flow (LPM)	Flow (kg/s)
		Single RF Chain	Single RF Source	Single RF Source
HPA-3	Anode (A)	775	1550	25.83
	Top Screen grid (TSG)	4	8	0.13
	Bottom Screen grid (BSG)	4	8	0.13
	Cathode (CATH)	4	8	0.13
	Output Transformer (OPTS)	6	12	0.20
	Upper Anode decoupling capacitor (UADC)	6	12	0.20
	Lower Anode decoupling capacitor (LADC)	6	12	0.20
	Upper screen decoupling capacitor (USDC)	4	8	0.13
	Lower screen decoupling capacitor (LSDC)	4	8	0.13
HPA-2	Anode (A)	75	150	2.50
	Anode decoupling capacitor (ADC)	6	12	0.20
	Screen Grid (SG)	6	12	0.20
Auxiliary Power supplied	Bleeder assembly	40	80	1.33
SSPA (HPA-1)	Solid state power amplifier (SSPA) + 200kW Dummy Load for 3dB hybrid combiner (In series with SSPA)	35	70	1.17
<b>Total Requirement</b>		<b>975</b>	<b>1950</b>	<b>32.48</b>

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### 19.2 Proposed PFD diagram for Air cooling

The blowers are being used to cool transmission lines and 4 port RF combiner. Airflow sensors & blowers are the part of bidder's supply, PFD and P&ID will be finalised during design phase. The air flow diagram for two chains are shown below:

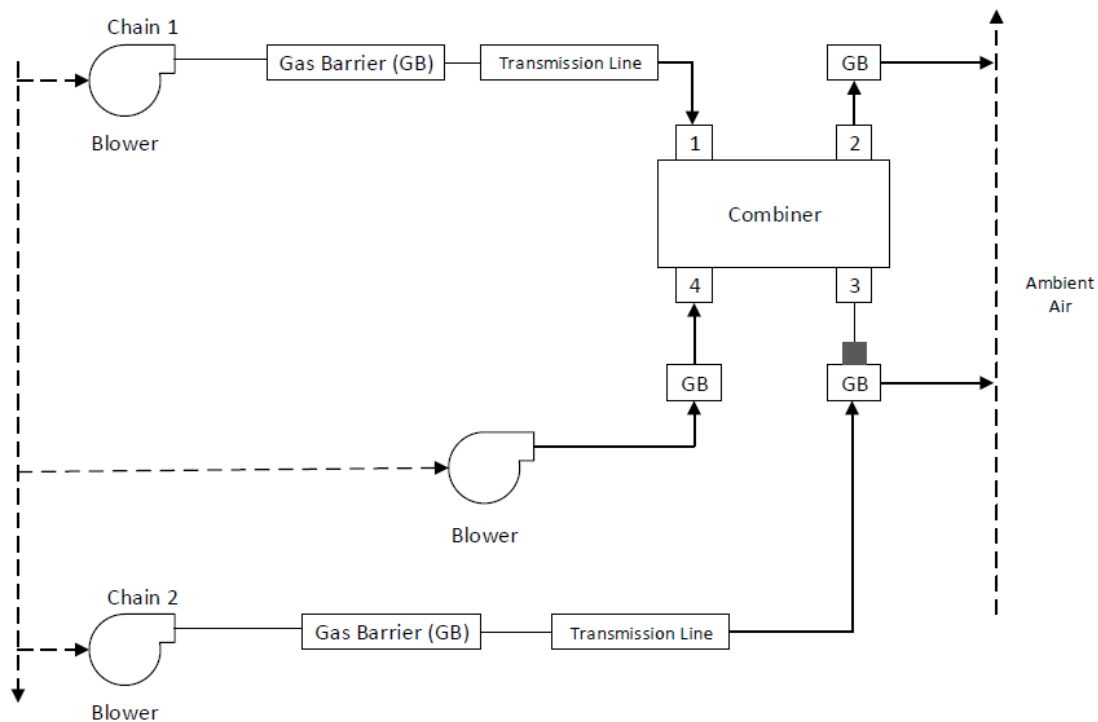



Fig. 10: Air cooling PFD for Tx-line and combiner


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## 20 Annexure-K: Compliance matrix


The bidder has to provide Compliance matrix with their comment with the bid.

**Table K2: Compliance matrix**


Sr. No.	ITER-INDIA's Specifications / requirement	Comply Yes/No	Comments
1.	Contract execution as per <b>section 2</b>		
2.	Main responsibility sharing as per <b>section 3</b>		
3.	Scope of work and scope of supply as per <b>section 4</b>		
4.	Understanding of Technical specification for single RF chain (1.6MW) as per <b>section 6.1</b> and Technical requirement for RF Source (3.0MW) as per <b>section 6.2</b>		
5.	Interface requirement as per <b>section 6.3</b>		
6.	Structural & Seismic requirements as per <b>section 6.4</b>		
7.	Understanding of codes and standards as per <b>section 6.5</b>		
8.	Understanding of safety requirement as per <b>section 6.6</b>		
9.	Control and instrumentation requirement as per <b>section 6.7</b>		
10.	Manufacturing requirements as per <b>section 6.8</b>		
11.	CE Markings, Legal Inspection & other certifications as per <b>section 6.9</b>		
12.	Reliability and Maintainability Requirements as per <b>section 6.10</b>		
13.	Delivery requirement as per Purchaser's Site as per <b>section 7</b>		
14.	Conditions for integrated performance demonstration and Site acceptance as per <b>section 8</b>		

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15.	Management specifications as per Annexure-A <b>section 10</b>		
16.	Intellectual Property Rights Provisions as per Annexure-B <b>Section 11</b>		
17.	Delivery schedule as per Annexure-C <b>Section 12</b>		
18.	Understanding for Seismic analysis as per Annexure-D <b>Section 13</b>		
19.	List of HPA hardware to be interfaced with LCU as per Annexure-F <b>Section 15</b>		
20.	Preliminary validation report formats for interfaces at ITER-India lab/ Purchaser's site as per Annexure-G <b>Section 16</b>		
21.	Detailed Description for scope of works as per Annexure-H <b>Section 17</b>		
22.	Understanding of proposed RF source layout as per Annexure-I <b>Section 18</b>		
23.	Understanding of PFD diagram for water- and air-cooling circuits as per Annexure-J <b>Section 19</b>		
24.	Supply of 'Mechanical System' as per Annexure-H1		
24 (a).	Scope of work for Support Structure and Enclosure of RF source as per section 4.1, Annexure-H1		
24 (b).	Scope of work for complete cooling water header as per section 4.2, Annexure-H1		
24 (c).	Scope of work for cable tray as per section 4.3, Annexure-H1		
25.	Supply of 'RF Signal Generator' as per Annexure-H2		
25 (a).	Technical Specifications of RF signal Generator as per section 4, Annexure-H2		

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26.	Supply of '8 kW Solid State Power Amplifier-SSPA' as per Annexure-H3		
26 (a).	Scope of work and Technical Specifications of 8 kW Solid State Power Amplifier (SSPA) as per section 4, Annexure-H3		
26 (b).	Technical Specifications of different PCB as per section 2, Annexure-H3		
26 (c).	Procurement of Components as per section 3, Annexure-H3		
26 (d).	Technical Specifications of low power RF boards as per section 4-1, Annexure-H3		
26 (e).	Technical Specifications of PLC & display module as per section 4-2, Annexure-H3		
26 (f).	Procurement of DC power supplies as per section 5, Annexure-H3		
26 (g).	Specifications for a water cooled heatsink for high power application as per table no 20, section 6, Annexure-H3		
26 (h).	Technical specifications for cooling components as per Table No 21, section 6, Annexure-H3		
26 (i).	Fabrication & procurement of power combiner as per section 7, Annexure-H3		
26 (j).	Reference specifications of 19" instrument rack as per Table No 25, section 8, Annexure-H3		
26 (k).	Specifications of components for electrical distribution as per Table No 27, Annexure-H3		
27.	Supply of 'Low Power RF Components' as per Annexure-H4		
27 (a).	Scope of work as per details mentioned in 3.0, Annexure-H4		


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27 (b).	Technical specifications for Low power components as per Table No 1, section 1, Annexure-H4		
27 (c).	Specifications for 3.3 V/1A DC power supply as per Table No 2, Annexure-H4		
27 (d).	Specifications for triple output power supply +5V, +15 V, -15 V as per Table No 3, Annexure-H4		
27 (e).	Assembly & mounting of a Low Power System as per section 2, Annexure-H4		
28.	Supply of 'Auxiliary Power Supply's per Annexure-H5		
28 (a).	Scope of supply as per section 2, Annexure-H5		
28 (b).	Scope of work as per section 3, Annexure-H5		
28 (c).	Specifications for HPA-2 filament power supply as per Table No 5, Annexure-H5		
28 (d).	Specifications for HPA-3 filament power supply as per Table No 6, Annexure-H5		
28 (e).	Specifications for HPA-2 Control Grid power supply as per Table No 7, Annexure-H5		
28 (f).	Specifications for HPA-3 Control Grid power supply as per Table No 8, Annexure-H5		
28 (g).	Specifications for HPA-2 Screen Grid power supply as per Table No 9, Annexure-H5		
28 (h).	Specifications for HPA-3 Screen Grid power supply as per Table No 9, Annexure-H5		
28 (i).	Specifications for the cubicle as per Table No 11, Annexure-H5		
28 (j).	Specifications for HPA-2 CGPS Bleeder as per Table No 14, Annexure-H5		


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28 (k).	Specifications for HPA-3 CGPS Bleeder as per Table No 15, Annexure-H5		
28 (l).	Specifications for HPA-2 SGPS Bleeder as per Table No 16, Annexure-H5		
28 (m).	Specifications for HPA-3 SGPS Bleeder as per Table No 17, Annexure-H5		
28 (n).	Specifications for heatsink as per Table No 18, Annexure-H5		
28 (o).	Specifications for Resistor as per Table No 19, Annexure-H5		
28 (p).	Specifications for control Grid protection circuit as per Table No 22, Annexure-H5		
28 (q).	Specifications for HPA-2 Screen Grid fast protection circuit as per Table No 24, Annexure-H5		
28 (r).	Specifications for HPA-3 Screen Grid fast protection circuit as per Table No 25, Annexure-H5		
28(s).	Specifications for Electrical distribution as per Table No 41, Annexure-H5		
29.	Supply of 'LV Electrical Distribution Board for RF Source' as per Annexure-H6		
29 (a).	Scope of work as per section 3, Annexure-H6		
29 (b).	Specifications for incomer load points with cable as per section 4, Annexure-H6		
29 (c).	Specifications for electrical distributor panel as per section 6.2, Annexure-H6		
30.	Supply of 'Local Control Unit (LCU)' as per Annexure-H7		
30 (a).	Scope of work as per section, Annexure-H7		




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30 (b).	Specifications of hardware for cRIO modules as per section 4.1, Annexure-H7		
30 (c).	Technical specifications of PLC hardware as per section 4.2, Annexure-H7		
30 (c).	Technical specifications of signal conditioning modules as per section 4.3, Annexure-H7		
30 (d).	Technical specifications of RF Measurement & Control module technical specification as per section 4.4, Annexure-H7		
30 (e).	Technical specifications of I&C rack as per section 4.5, Annexure-H7		
30 (f).	List of deliverables as per section 4.6, Annexure-H7		
30 (g).	Technical specifications of cables as per section 4.8, Annexure-H7		
31.	Supply of 'Arc Detector System' as per Annexure-H8		
31 (a).	Scope of work as per Section 3, Annexure-H8		
31 (b).	Technical specifications of Arc detector Module as per Section 6.1.1, Annexure-H8		
31 (c).	Technical specifications of LCU interface card as per Section 6.1.2, Annexure-H8		
31 (d).	Technical specifications of back panel PCB as per Section 6.1.3, Annexure-H8		
31 (e).	Technical specifications of fiber optic cable as per Section 6.1.6, Annexure-H8		
31(f).	Technical specifications of PCB fabrication as per Section 6.2, Annexure-H8		
32.	Supply of 'Transmission line components' as per Annexure-H9		
32 (a).	Scope of work as per section 4, Annexure-H9		

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32 (b).	Technical specifications of 3-1/8 inch Tx line as per Table No 1, Annexure-H9		
32 (c).	Technical specifications of 3-1/8 inch directional coupler as per Table No 2, Annexure-H9		
32 (d).	Technical specifications of 6-1/8 inch Tx line as per Table No 3, Annexure-H9		
32 (e).	Technical specifications of 6-1/8 inch directional coupler as per Table No 4, Annexure-H9		
32 (f).	Technical specifications of 12 inch Tx line as per Table No 5, Annexure-H9		
32 (g).	Technical specifications of 12 inch directional coupler as per Table No 6, Annexure-H9		
32(h).	Technical specifications of 12 inch gas barrier as per Table No 7, Annexure-H9		
32(i).	Technical specifications of 12-inch to 6-1/8-inch reducer as per Table No 8, Annexure-H9		
32(j).	Technical specifications of 12-inch assembly bellow as per Table No 9, Annexure-H9		
32(k).	Technical specifications of 12-inch elbow with interface flange as per Table No 10, Annexure-H9		
32(l).	Technical specifications of 12-inch Hybrid Combiner as per Table No 11, Annexure-H9		
32(m).	Bill of Material as per Table No 12, Annexure-H9		
33.	Supply of 'RF Accessories' as per Annexure-H10		
33 (a).	Technical specifications of RF accessories required for single RF source as per Table No 1, Annexure-H10		
34.	Supply of 'Key Management Safety System Hardware' as per Annexure-H11		

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34 (a).	Supplier scope of work as per section 4, Annexure-H11		
35.	Supply of ‘Test and measuring instruments’ as per Annexure-H12		
35 (a).	List of test and measurement instrument as per Table No 1, Annexure-H12		
36.	Supply of ‘Measuring Instruments and Software’ as per Annexure-H13		
36 (a).	List of test and measurement instrument as per Table No 1, Annexure-H13		
36 (b).	List of Computer Software & hardware as per Table No 2, Annexure-H13		