



ITER-India
(Institute For Plasma Research)



Title	Tender No. I-I/TN/ET-TPT/22003/22-23 dated 18-08-2022 for Soft X-ray calibration source
Sub Title	PART-A (II): Scope of Supply & Work, Technical Specifications

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**Background**

This is a proposal for procuring soft X-ray light source which is to be used at ITER-India, IPR, India. This document describes the complete technical and application details to the manufacturers or suppliers. This is to enable the vendors to quote all relevant products with complete details, complying ITER-India requirements

I. Application details

Institute for Plasma Research is a premiere research institute pursuing research on plasma science and technology in India. ITER-India is an Indian domestic agency (IN-DA, a center of IPR, carries out research and development to deliver the in-kind components/systems to the International Thermonuclear Experimental Reactor (ITER). As a part of IN-DA deliverable, ITER-India needs design, develop and deliver a broad band X-Ray crystal spectrometer (XRCS) and a high-resolution X-Ray Crystal Spectrometer to ITER. These spectrometers will be used to monitor impurities, measure impurity concentration and ion temperature of the ITER plasma, respectively.

These XRCS spectrometers have set of crystals and detector assemblies and operated in high vacuum. The radiations emitted from ITER-Plasma are dispersed using set of crystals and detected on a large area photon counting detectors. For the XRCS-Survey, the measurable energy range is 124eV-13keV and the XRCS-Edge, the measurable energy is ~ 3 – 6keV.

The integrated intensity of X-Ray characteristic line emission will be measured and postprocess to determine the plasma and impurity parameters required to fulfil measurement goals of this diagnostics. Therefore, an absolute calibration both (intensity and wavelength) is required to be carried out for both the spectrometer in the soft X-ray range to test their performances. The proposed soft X-ray calibration source is intended to be used in the prototype developmental activities carried out at ITER-India laboratory.

II. Technical specifications Soft X-ray source

ITER-India intends to procure one integrated X-ray source system comprising of source head, source power supply, source electronics and controller and other required accessories. The required technical specifications are given below.

Sr. No.	Parameter	Unit	ITER-India specification
A. Source Emission			
1.	Source Type	-	Accelerated electrons from filament impinging on solid metal targets of different Z, selectable
2.	Energy Range	-	Characteristics line emission in energy range from 100 eV to 10.00keV band
3.	Power output	W	0.25 and up to 30 watts max, continuous operation
B. Source head			
4.	Vacuum chamber		<ul style="list-style-type: none"> - Stainless steel (such as 304, 316) - multiple anode selectable in-vacuum - Two output ports of DN40CF: one for X-ray out and other for monitoring
5.	Operating Pressure	Torr	10 ⁻⁵ or better
C. Electron Beam			
6.	Beam Current (tube current)	mA	0.1 to ≥ 3mA, variable
7.	Beam Energy (Maximum anode potential)	kV	≥ 10 kV, variable
D. Target/Anode			
8.	Anode Assembly, Anodes on single assembly	-	Multiple anode selectable in vacuum 6 or more.
9.	Target element purity		All elements should be pure ≥ 99 %
10.	Target elements list	Abbreviation, Name	Al, Aluminum Si, Silicon Fe, Iron

			Mn, Manganese Ni, Nickel Ti, Titanium Au, Gold Mg, Magnesium Mo, Molybdenum B, Boron Y, Yttrium, Ru, Ruthenium Rh, Rhodium Sc, Scandium Zr, Zirconium
11.	Target shape, size	mm	Circular or other, ~ 4±1 nominal diameter
12.	Target quantity	#	2 of each
E. Filter wheel			
13.	Operation	-	In-vacuum, motorized/manual for selection filter
14.	Filter shape, size	mm	Circular, diameter
F. Power supply and controller			
15.	HV power supply	-	Including voltage and current set point and monitor supplied along with the source
16.	Filament power supply	-	To be supplied along with the source
17.	Cables and connectors	-	All cables and connectors to be supplied for operation
18.	Standard accessories	-	All standard accessories including mounting hardware, vacuum feedthrough, electrical feedthrough, DN40CF gate valve and cables, – details to be provided by supplier

Additional requirements:

- Include all standard accessories required for the operation of the source.
- 230 V AC, 50 Hz power
- Operation manuals
- One-year warranty

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III. A) Acceptance test criterion

The final acceptance of the integrated Source system will be given after the following two tests:

1. Pre-dispatch test at factory site by the vendor (ITER-India reserves the right to carryout Pre-dispatch Inspection (PDI) of the ordered item/s by ITER-India personnel at factory site)
2. Final acceptance test at ITER-India.

Part I: Pre-dispatch tests/Factory acceptance tests

1. Before dispatching the Source system, the supplier needs to send a complete test report (details of the tests are attached in Appendix-1).
2. ITER-India reserves the option to be present at supplier site during testing and inspection of Soft X-ray source.

Part II: Acceptance tests at ITER-India laboratory/Site acceptance tests

At ITER-India lab, installation, testing and demonstration of system's performance has to be carried out either physically or remotely by the principal or by their Indian representative. After successful commissioning at ITER-India, a final acceptance will be given only when it complies with all the technical specifications.

Appendix-1

Proposed Acceptance tests

Tests to be carried out for confirming the following functionalities of the X-ray source and test results (wherever applicable) need to be supplied before pre-dispatch. These tests need to be demonstrated during commissioning of the source at ITER-India site. For this the supplier should inform the equipment required for testing on site prior to the dispatch of items.

Acceptance test report/certificate containing the following information:

1. Source function for continuous operation (burn-in test)
2. Vacuum test (to duplicate it requires buyer also has access to He mass spec leak detector capable to detect leak rate $< 1 \times 10^{-9}$ Pa m³/s) for leak tightness
3. The source must be shown to be producing X-rays from targets mentioned in (parameters #10) at maximum power within (safety margin) using an energy dispersive detector (Silicon drift detector or equivalent detector which is not the scope of supply). The test report along with measured data file from SDD should be supplied for shipment clearance.



Appendix-2
Technical Compliance Matrix

Sr. No.	Parameter	Unit	ITER-India specification	Offered Specifications by Bidder	Compliance Yes/No
A. Source Emission					
1.	Source Type	-	Accelerated electrons from filament impinging on solid metal targets of different Z, selectable	To be filled by Supplier	To be filled by Supplier
2.	Energy Range	-	Characteristics line emission in energy range from 100 eV to 10.00keV band	To be filled by Supplier	To be filled by Supplier
3.	Power output	W	0.25 and up to 30 watts max, continuous operation	To be filled by Supplier	To be filled by Supplier
B. Source head					
4.	Vacuum chamber		<ul style="list-style-type: none">- Stainless steel (such as 304, 316)- multiple anode selectable in-vacuum- Two output ports of DN40CF: one for X-ray out and other for monitoring	To be filled by Supplier	To be filled by Supplier
5.	Operating Pressure	Torr	10^{-5} or better	To be filled by Supplier	To be filled by Supplier
C. Electron Beam					
6.	Beam Current (tube current)	mA	0.1 to ≥ 3 mA, variable	To be filled by Supplier	To be filled by Supplier
7.	Beam Energy (Maximum anode potential)	kV	≥ 10 kV, variable	To be filled by Supplier	To be filled by Supplier
D. Target/Anode					

8.	Anode Assembly, Anodes on single assembly	-	Multiple anode selectable in vacuum 6 or more.	To be filled by Supplier	To be filled by Supplier
9.	Target element purity		All elements should be pure $\geq 99\%$	To be filled by Supplier	To be filled by Supplier
10.	Target elements list	Abbreviation, Name	Al, Aluminum Si, Silicon Fe, Iron Mn, Manganese Ni, Nickel Ti, Titanium Au, Gold Mg, Magnesium Mo, Molybdenum B, Boron Y, Yttrium, Ru, Ruthenium Rh, Rhodium Sc, Scandium Zr, Zirconium	To be filled by Supplier	To be filled by Supplier
11.	Target shape, size	mm	Circular or other, $\sim 4 \pm 1$ nominal diameter	To be filled by Supplier	To be filled by Supplier
12.	Target quantity	#	2 of each	To be filled by Supplier	To be filled by Supplier
E. Filter wheel					
13.	Operation	-	In-vacuum, motorized/manual for selection filter	To be filled by Supplier	To be filled by Supplier
14.	Filter shape, size	mm	Circular, diameter	To be filled by Supplier	To be filled by Supplier
F. Power supply and controller					
15.	HV power supply	-	Including voltage and current set point and monitor supplied along with the source	To be filled by Supplier	To be filled by Supplier
16.	Filament power supply	-	To be supplied along with the source	To be filled by Supplier	To be filled by Supplier
17.	Cables and connectors	-	All cables and connectors to be supplied for operation	To be filled by Supplier	To be filled by Supplier

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18.	Standard accessories	-	All standard accessories including mounting hardware, vacuum feedthrough, electrical feedthrough, DN40CF gate valve and cables, – details to be provided by supplier	To be filled by Supplier	To be filled by Supplier
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