

TECHNICAL DESCRIPTION

Spectral Calibration System

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1 Preamble

This Technical Specification is to be read in combination with the General Management Specification for Service and Supply (GM3S) – Ref [1] that constitutes a full part of the technical requirements.

In case of conflict, the content of the Technical Specification supersedes the content of Ref [1].

2 Purpose

This Technical Specification describes all technical performances, verification requirements for the manufacturing and delivery of the ‘Calibration System Tunable Source’ for the ITER Visible Spectroscopy Diagnostic System (internally referred to as the 55.E6 VSRS).

It is expected that the contractor will provide a Commercial-Off-The-Shelf (COTS) meeting the specifications (requirements) described in this document.

The scope of this document includes:

- Functional and technical specifications
- Environmental constraints
- Interfacing specifications
- Factory acceptance Tests
- Site Acceptance Test

3 Acronyms & Definitions

3.1 Acronyms

The following acronyms are the main one relevant to this document.

Abbreviation	Description
CRO	Contract Responsible Officer
COTS	Commercial Off the Shelf
GM3S	General Management Specification for Service and Supply
HW	HardWare
IO	ITER Organization
PRO	Procurement Responsible Officer
SCS	Spectral Calibration System
Vm	Verification method
VSRS	Visible Spectroscopy Reference System

3.2 Definitions

Contractor: shall mean an economic operator who have signed the Contract in which this document is referenced.

In subsequent sections, requirements/specifications to be met by the equipment will be listed. The contractor is expected to propose a verification methods (Vm) for each requirement that is to be coded as follows:

- I** Inspection: Requirement can be demonstrated by a visual inspection of Hardware and/or the relevant documentation
- R** Review of Design: by presenting the design, implementation of the requirement can and must be demonstrated
- A** Analysis: by presenting a documented analytical result the implementation of the requirement can be demonstrated
- T** Test: Results of a (set of) test(s) will demonstrate verification of the requirement

A and **T** type verification methods may be replaced by **R** if they can be proven by similarity of-design with existing, tested systems.

4 Applicable Documents & Codes and standards

4.1 Applicable Documents

This is the responsibility of the Contractor to identify and request for any documents that would not have been transmitted by IO, including the below list of reference documents.

This Technical Specification takes precedence over the referenced documents. In case of conflicting information, this is the responsibility of the Contractor to seek clarification from IO. Upon notification of any revision of the applicable document transmitted officially to the Contractor, the Contractor shall advise within 4 weeks of any impact on the execution of the contract. Without any response after this period, no impact will be considered.

Ref	Title	IDM Doc ID	Version
1	General Management Specification for Service and Supply (GM3S)	82MXQK	1.4
2	ITER numbering system for components and parts	28QDBS	5.0
3	Working Instruction for the Delivery Readiness Review (DRR)	X3NEGB	2.0
4	Requirements for Producing a Quality Plan	22MFMW	4.0

4.2 Applicable Codes and Standards

This is the responsibility of the Contractor to procure the relevant Codes and Standards applicable to that scope of work.

5 Scope of Work

This section defines the specific scope of work, in addition to the contract execution requirement as defined in Ref [1].

5.1 Supply of Tuneable Light Source

5.1.1 Description

The tuneable light source main function will be to enable characterization and comparison of the various spectral instruments of the VSRS diagnostic system. The Spectral Calibration System (SCS) is located in the diagnostic room on an optical table where a laboratory environment is applicable, and it is controlled remotely for periodic operation.

The following hardware shall be delivered:

- 1 tuneable spectral light source
- Power supply (if required)
- Container (transport & long-term storage)
- Data and power cables

In the sections below the technical requirements of the system are detailed. However, the supplier is invited to propose in first instance their most compliant, existing calibration source type and indicate any non-compliances this system would have.

5.1.2 Design requirements

- [Req-01] The spectral range of the calibration system shall cover uninterruptedly:
- 400nm to 700nm (threshold);
 - 350nm to 820nm (goal).
- [Req-02] The FWHM spectral line width shall be:
- ≤ 1.5 nm (threshold);
 - ≤ 0.5 nm (goal).
- [Req-03] The wavelength accuracy of the selected line shall be better than 0.5 nm.
- [Req-04] The spectral line position shall be adjustable in steps ≤ 0.1 nm.
- [Req-05] The emission of the spectral calibration source shall not be coherent. In case a coherent source (Laser etc.) is proposed, then methods of reducing spectral coherence shall be implemented.
- [Req-06] The spectral line position shall be adjustable with an adjustment speed of ≥ 10 nm/s.
- [Req-07] The spectral line emission shall be available continuously. Pulsed operation can be allowed provided intensity within targeted integration time remains within the stability requirement.
- [Req-08] The spectral brightness of the calibration source shall be larger than 0.5 mW/nm.
- [Req-09] The intensity of the spectral line emission shall be stable within:
- 0.1% within any 0.1 sec;
 - 1% within 1 hour;
 - 10% over life.
- [Req-10] The instrument volume shall be less than 600 mm x 300 mm x 300 mm.
- [Req-11] The mass of the calibration source shall be ≤ 16 kg (goal), ≤ 50 kg threshold.
- [Req-12] The power consumption shall be less ≤ 500 W.

- [Req-13] The time required between start-up of the instrument and performing stable measurements shall be less than 10 minutes.
- [Req-14] The calibration system operating lifetime shall be > 2000 Hrs between maintenance actions.

5.1.3 *Operating requirements*

- [Req-15] The spectral calibration system will be operated in a laboratory environment under ambient conditions and shall work within its specifications for the environmental conditions detailed below.
- [Req-16] The operational temperature range lies within 17 to 27 °C.
- [Req-17] The operational temperature stability lies within:
±0.1 °C hourly variation;
±1 °C variation over the year.
- [Req-18] The operational pressure range lies within 970 to 1040 mbar.
- [Req-19] The relative humidity lies within 30 and 65%.

5.1.4 *Performance requirements*

See Section 5.1.2 Design requirements

5.1.5 *Interface requirements*

- [Req-20] The optical fibers used to supply the measurement light have the following properties:
- Fibre core diameter $\leq 1.5\text{mm}$;
- NA ≤ 0.39 .
- [Req-21] The optical fiber output connection shall be SMA type.
- [Req-22] The instrument shall have provisions for mechanical mounting on an optical table by bolting or clamping.
- [Req-23] The communication connection shall be RJ-45 ideally but can also be RS-232, RS-485 or RS-422.
- [Req-24] The communication protocol shall be Ethernet ideally but can also be serial communication.
- [Req-25] The power supply shall run on 240 VAC.

5.1.6 *Mechanical Requirements*

See Section 5.1.2 Design requirements and 5.1.5 Interface requirements

5.1.7 *Electrical Requirements*

See Section 5.1.2 Design requirements and 5.1.5 Interface requirements

5.1.8 *Software requirements*

- [Req-26] The Device software support should include native Linux kernel driver/module, user space API libraries and/or native protocol specification (serial etc.) along with the device operation manual (state cycles etc.). If no native Linux support is available, the vendor should allow and provide support for developing ITER Linux Driver.

- [Req-27]** It shall be possible to remotely control (read and set) at least the following instrument parameters:
- Emission on/off;
 - Wavelength;
- Control over more instrument parameters is preferred.

5.1.9 Material, welding and fabrication requirements

- [Req-28]** Metallic and non-metallic materials shall be listed and provided to ITER before the completion of the first deliverable. When material certificates exist, they shall be provided to the ITER Organization.
- [Req-29]** Non-metallic materials shall be in accordance with the following international standards:
- Reduced flame propagation/spread (according to IEC 60332-3);
 - Low smoke (according to IEC 61034);
 - Non-toxicity (according to IEC 60754-2);
 - Zero Halogen (according to IEC 60754-1).

5.1.10 Quality Control Provisions

- [Req-30]** A Manufacturing control report including material certificates, datasheets, results of factory acceptance test, etc., as well as a listing of Non-Conformance Records (if any) shall be provided by the contractor after the manufacturing and prior to the shipment.
- [Req-31]** Factory acceptance tests shall provide evidence of the compliance with respect to the requirements that can be verified by test. This includes but not limited to Req-01, 02, 03, 08 and 09.
- [Req-32]** The contractor shall provide the user manual including installation and maintenance instructions if any.

5.1.11 Spare Parts

Not applicable

5.1.12 Packing, preservation & shipping

- [Req-33]** CE Markings shall be implemented in accordance with European directives requirements.
- [Req-34]** All main components of the equipment 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" [2]. The IO numbering for this equipment will be provided by IO.
- [Req-35]** The calibration system shall be packed in a box or shipping container that provides adequate protection during handling, shipment and storage as well as accelerometers or other sensors if needed. Each packaging and shipping container shall be marked on the outside showing all relevant information (e.g. company, contents, destination). Also, the warnings "DELICATE OPTICAL COMPONENTS REQUIRING SPECIAL HANDLING" and "TOP" or "OPEN THIS SIDE" shall be clearly marked on the shipping container or box. The supplier is invited to propose container/packaging applicable.

Prior to shipment, a Delivery Readiness Review shall be carried out according to the “Working Instruction for the Delivery Readiness Review (DRR)” [3]

[Req-36] The contractor shall prepare a DRR with support from the IO.

Reference [3] describes the 3 documents that need to be prepared for the DRR by the contractor and provides links to templates of them.

[Req-37] In preparation of the DRR, the contractor shall provide a Contractor-Release Note.

[Req-38] In preparation of the DRR, the contractor shall provide a Packing List.

[Req-39] In preparation of the DRR, the contractor shall provide a Delivery Report.

After successful DRR, shipment by contractor can proceed.

[Req-40] Each shipment shall be accompanied by the shipping documentation **[Req 37, 38 & 39]**.

For information, upon receipt of the package, the IO logistics team shall open the package and make a visual inspection of its content to check:

- The integrity of the package, including identifying visible damage;
- The number and type of components contained in the shipment;
- The enclosed documentation;
- The reading of the shock indicator labels, accelerometers or other sensors if any;
- The integrity of the components.

In the case of anomalies, the IO shall make any additional relevant remark on the inspection.

A decision on acceptance of the delivery of the components will be made by the IO.

If the components are in an acceptable condition, the IO will sign the Delivery Report.

[Req-41] The Contractor shall bear the risk of loss or damages to the components during the execution of this Contract up to delivery, after inspection against any failure of the components during transport.

[Req-42] Any risk of loss or damage shall be transferred from the Contractor to the IO upon delivery.

5.1.13 Acceptance post delivery

Site Acceptance Testing shall be done by IO at the ITER site or ITER integration site, providing evidence of the instrument integrity and functionality after transport. This comprises as a minimum:

- Photograph of packaged and unpacked device;
- Power on/off;
- Performing a full spectrum scan demonstrating:
 - Spectral line shape at least 5 different wavelengths spread over the spectrum;
 - Spectral intensity over the full spectrum.

The supplier is invited to propose alternative or additional tests in a Site Acceptance Test plan. Support during testing and verification of the acceptance criteria by the supplier is not requested in the scope of this contract, but can be proposed by the supplier if deemed useful. As such, there is no firm requirement presently expressed in those Technical Specifications.

[Req-43] The equipment shall be handed over to the IO when they have been delivered in accordance with this Technical Specification and all related documentation have been accepted by the IO, have satisfactorily passed the tests (Factory Acceptance Testing, Delivery Inspection and Site Acceptance Testing).

At that point a Certificate of Final Acceptance shall be issued (Final Acceptance) by IO.

[Req-44] Ownership of the components shall be transferred from the Contractor to the IO upon Final Acceptance at the ITER instrument testing and assembly Site.

[Req-45] The transfer of ownership to the IO shall not relieve the Contractor of its obligations under this Contract in case of non-conformities of the components for the duration of the warranty period.

[Req-46] The Contractor shall provide a standard commercial warranty covering repair or replacement of the components for which the procurement is in the scope of this contract up to 2 years after the Final Acceptance of the components.

5.1.14 Delivery Time

The maximum expected duration from the contract signature to the supply of the scope of work is 6 months.

6 Location for Scope of Work Execution

The Contractor can perform the work at their own location.

7 IO Documents & IO Free issue items

No input nor free issue item is expected from IO.

8 List of deliverables

The Supplier shall provide IO with the documents and data required in the application of this technical specification, the GM3S Ref [1] and any other requirement derived from the application of the contract.

As a reminder, prior any work commencement, it is expected to have an approved quality plan (more details see Req-47).

You can find here below a minimum list of documents, but not limited to, that are required within the expected timing:

Technical Design Family (TDF)	Generic Document Title (GTD)	Further Description	Expected Timing (T0+x) *
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Review or Decision or Recommendations Report	Progress Report	D1 - Progress Report on manufacturing activities. Manufacturing Control Report required.	T0 + 5
Review or Decision or Recommendations Report	Progress Report	D2 - Progress Report on Delivery phase including delivery and final acceptance. Manual, Contractor Release Note, Packing List and Delivery Report required.	T0 + 6

(*) T0 = Commencement Date of the contract ; X in months.

Supplier shall prepare their document schedule based on the above and using the template available in the GM3S Ref [1] appendix II ([click here to download](#)).

9 Quality Assurance requirements

The Quality class under this contract is QC-3, [Ref 1] GM3S section 7 applies in line with the defined Quality Class.

[Req-47] Prior to commencement of any work under this Contract, a “Quality Plan” (QP) shall be produced by the Supplier and submitted to the IO for approval, describing how they will implement the ITER Procurement Quality Requirements [4].

10 Safety requirements

Note that the 55.E6 Spectral Calibration System (SCS) is not PIC and has no PIA related to it. No specific safety requirement related to PIC and/or PIA and/or PE/NPE components apply.

11 Specific General Management requirements

Requirement for [Ref 1] GM3S section 6 applies completed/amended with the below specific requirements.

11.1 Meeting Schedule

Because the component to be supplied is a COTS, no regular progress meetings are needed but just on demand.

11.2 CAD design requirements

This contract does not imply CAD activities.