

Technical Specifications (In-Cash Procurement)

**55.GG - Technical specification - Engineering support for
FDR-level system development**

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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 specification is for engineering support in the design and development of 55.GG Calorimetry up to FDR level, and support in organisation and closure of the FDR.

The activities include creation and update of documentation, coding, and analysis work.

These activities are relevant for pre-FDR and FDR-level work.

3 Acronyms & Definitions

3.1 Acronyms

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

Abbreviation	Description
CODAC	Control, Data Access and Communication
CRO	Contract Responsible Officer
FDR	Final Design Review
GM3S	General Management Specification for Service and Supply
HMI	Human-Machine Interface
IDP	Input Document Package
IO	ITER Organization
KoM	Kick off Meeting
MoM	Minutes of Meeting
PDR	Preliminary Design Review
PRO	Procurement Responsible Officer
SoW	Scope of Work

3.2 Definitions

55.GG Calorimetry is a software-based system for the measurement of a fusion energy pulse, described in more detail at [2]

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

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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	System Design Description (DDD) 55.GG Calorimetry	UVM7XN	1.1
3	55.GT - System Design Specification (SDS)	7W5HGK	2.3
4	Design Review Procedure	2832CF	7.0

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.

Ref	Title	Doc Ref.	Version
CS1	ISO/IEC 5055	N/A	2021

5 Scope of Work

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

Four scopes of work are expected to be realised under this contract:

1. Creation of FDR level documentation
2. Creation and update of the system code
3. Support to FDR organisation
4. Support to chits closure and post-FDR documentation update

The scopes are intertwined, and some activities from different scopes are mutually dependent. An order of the tasks execution is given at the deliverables table.

5.1 Scope of work #1: Creation of FDR level documentation

5.1.1 Description

The Contractor shall update or create the documentation necessary to successfully launch and complete the FDR of 55.GG. This includes also development of inputs for an update of 55.GT documentation relevant for the interface with 55.GG.

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The expected documentation to be processed is listed in the table below. The Contractor shall consider in their offer the expected workload according to the approximate complexity categories A (simple – 1 working day), B (medium – 3 working days), C (complex – 5 working days), as indicated in the table.

Document	IDM link	Category	Deliverable
55.GG Calorimetry ConOps	https://user.iter.org/default.aspx?uid=G2NFJ6	C	D1
55.GG - Algorithm description	https://user.iter.org/default.aspx?uid=G2NECZ	B	
System Design Description (DDD) 55.GG Calorimetry	https://user.iter.org/default.aspx?uid=UVM7XN	B	
55.GT - System Design Specification (SDS)	https://user.iter.org/default.aspx?uid=7W5HGK	B	
55.GG - Selection of scenarios for the system testing	https://user.iter.org/default.aspx?uid=9D8N2K	A	D2
55.GG - List of the sensors used by 55.GG Calorimetry	https://user.iter.org/default.aspx?uid=BXQ7YM	C	
55.GG - Instrumentation and Control - List of Signals	https://user.iter.org/default.aspx?uid=G9RD8E	B	
55.GG - Estimation of energy fluxes analysed by calorimetry	https://user.iter.org/default.aspx?uid=EWWGJ4	B	
55.GG - Assessment of the expected system accuracy	https://user.iter.org/default.aspx?uid=8MG9EE	B	D3
55.GT - Functional Analysis Report	https://user.iter.org/default.aspx?uid=VCLZEW	A	
55.GG - System Detailed Performance Definition-SDPD	https://user.iter.org/default.aspx?uid=G9RMFT	A	
55.GG - Qualification Plan	https://user.iter.org/default.aspx?uid=G9RMM2	B	
55.GG - Acceptance Plan	https://user.iter.org/default.aspx?uid=G9RNWU	A	
55.GG - System Commissioning Plan	https://user.iter.org/default.aspx?uid=G9S332	B	D4

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55.GG - Commissioning Test Procedure	https://user.iter.org/default.aspx?uid=G9SGNZ	B	
55.GG - Concept of HMI	https://user.iter.org/default.aspx?uid=G9UBNJ	B	
55.GG - Operation and Maintenance Manual	https://user.iter.org/default.aspx?uid=G9UCYV	B	
55.GG - Human and Organisational Factor Analysis (HOF)	https://user.iter.org/default.aspx?uid=G9ULA2	A	

The Contractor shall update the existing documents to reflect the current status of the project (including revision of the list of sensors belonging to the interacting systems) and the development level of 55.GG.

For the documents which do not exist following the PDR stage, the Contract shall develop these documents according to the FDR level maturity requirements, or produce justifications for not including them in the DR.

All the documentation developed under this, and other SoWs shall follow the relevant IO templates.

5.1.2 Service Duration

The maximum expected duration for this activity is 8 months.

5.2 Scope of work #2 Creation and update of the system code

5.2.1 Description

The Contractor shall develop the system code to the level allowing for its operation using a rudimentary HMI, with the real data transferred from 55.GT. The developed code shall be compatible with 55.GT requirements expressed at 55.GT design requirements document [3].

The deliverables shall include the source code and a short report describing the obtained progress (in the form to be agreed at KoM – PowerPoint presentation or text report). The following code development milestones are to be reported at each deliverable:

Milestone	Deliverable
Operational adapter to 55.GT data	D1
Operation of the code with real data from the existing sensors	D2
Implementation of error handling and data clearing scripts with the real data	D3
<ul style="list-style-type: none"> - Rudimentary HMI developed - Preliminary self-calibration algorithm developed 	D4
Presentation-ready system	D5
Consolidation of requirements for the final algorithm development, final description of the code	D6

The code shall be developed based on the PDR-level code, preferably in Python. During the code development the contractor shall in parallel write a thorough description and report, which will

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serve as the final deliverable along with the consolidated requirements for the final code development.

5.2.2 *Service Duration*

The maximum expected duration for this activity is 12 months.

5.3 **Scope of work #3 Support to FDR organisation**

5.3.1 *Description*

The Contractor shall support update and creation of the documents listed in the table below, using the relevant IO templates, with complexity categories defined as in 5.1.

Document	Category	IDM link
ICD-55-55 Interface Control Document for Diagnostics	A	https://user.iter.org/default.aspx?uid=UYR KVV
IS-55.GT-55-003 Functional interface between Tokamak Systems Monitor (TSM) (PBS-55.GT) and Calorimetry (PBS-55.GG)	B	https://user.iter.org/default.aspx?uid=BKD QVN
55.GG - Interface Compliance Matrix	A	https://user.iter.org/default.aspx?uid=G9U LBJ
55.GG - Design Compliance Matrix	B	https://user.iter.org/default.aspx?uid=9EL L6A

Based on the documents in this SoW and SoW 1, the Contractor shall create FDR level IDP and adjust the document types to match the FDR requirements and current sign-off authorities. In the case of the need to produce new versions of some of the documents, the Contract shall support the IO TRO in obtaining their approval.

The Contractor shall also provide support in production of other documentation necessary for the FDR (notification, agenda etc.), as well as the creation of FDR presentations. The Contractor shall participate at the FDR and present the scope relevant to the SoWs in this specification. On-site presence may be requested for the FDR.

5.3.2 *Service Duration*

The maximum expected duration for this activity is 2 months.

5.4 **Scope of work #4 Support to chits closure and post-FDR documentation update**

5.4.1 *Description*

Following the FDR, the contract shall perform the update of documentation mentioned in SoW 1 and SoW 3 as needed according to the chits and feedback received during the DR. While the actual complexity of chits may vary, the Contractor shall anticipate the resolution of 1 category 1 chit, 4 category 2 chits and 2 category 3 chits, resulting in a minor of update of 8 documents. Description of chit categories is provided at 7.7.2 of Design Review Procedure [4].

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5.4.2 Service Duration

The maximum expected duration for this activity is 2 months.

6 Location for Scope of Work Execution

Contractor can perform the work at their own location, however an on-site participation at the FDR meeting may be requested.

7 IO Documents

The IO shall deliver all the documents from section 4.1 and the relevant source codes developed so far by 55.GG.

8 List of deliverables and due dates

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.

A minimum, but not limited to, list of documents is available hereafter with associated due dates:

Deliverable number	Further Description	Expected date
D1	Report on performed activities: Documentation development as per 5.1, Code development as per 5.2	T0 + 2 months
D2	Report on performed activities: Documentation development as per 5.1, Code development as per 5.2	T0 + 4 months
D3	Report on performed activities: Documentation development as per 5.1, Code development as per 5.2	T0 + 6 months
D4	Report on performed activities: Documentation development as per 5.1, Code development as per 5.2	T0 + 8 months
D5	Report on performed activities: Code development as per 5.2, Support in organisation and participation at the FDR as per 5.3	T0 + 10 months
D6	Report on performed activities: Code development as per 5.2, Support in closure of the FDR as per 5.4	T0 + 12 months

(*) T0 = Commencement Date of the contract

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Supplier is requested to 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 QC3, [Ref 1] GM3S section 8 applies in line with the defined Quality Class.

The Contractor shall develop the code to adhere to the quality standards outlined at [CS1].

10 Safety requirements

No specific safety requirement related to PIC and/or PIA and/or PE/NPE components apply.

11 Special Management requirements

Requirement for [Ref 1] GM3S section 6 applies in full.

11.1 Work Monitoring

The work will be monitored by regular weekly progress meetings and ad-hoc technical meetings if needed. The Contractor shall produce the MoMs if necessary.

The quality of delivered work will be assessed through the review and approval of deliverables.

11.2 CAD design requirements

This contract does not imply CAD activities.

11.3 Other specificities

The Contractor shall deploy resources with the following skills:

- Proven experience in energy data analysis using Python:
 - o knowledge of CoolProp library (<https://coolprop.org/coolprop/Tabular.html>),
 - o familiarity with thermal circuit modelling,
 - o experience in transient analysis of thermal systems
- Good knowledge of principles of thermodynamics and heat transfer, in particular understanding of control volume selection and thermal balancing
- Knowledge of electrical circuits and electrical energy transfer
- Knowledge of cryogenics and heat losses in the cryostats
- Skills in reading P&IDs, CBDs, wiring diagrams
- Understanding of technical aspects and physical principles underlying 55.GG operation:
 - o Energy flows in fusion reactions
 - o Energy transfers and conversion in tokamak systems (heating, cooling)
 - o Nuclear reactions in neutron-irradiated materials, especially secondary gamma emissions