外部委託業者の募集

References: IO/24/CFT/10029880/VML

"Design, manufacturing, testing, installation and commissioning of the ELM-PS "

（ELM-PS の設計、製造、試験、据付と試運転）

IO 締め切り 2024 年 11 月 12 日(火)

〇目的

この文書は、ITER 機構（IO）が調達する必要のあるエッジ局所モード電源（ELM-PS）システムの技術要件の概要を示しています。このシステムは、最大 15 kA の電流または最大 300 V の電圧を生成するために必要な 27 台の電源で構成されています（DC および/または AC、0-50 Hz）。

このシステムは、IO によって調達され、27 台の電源とその補助システム（中・低圧電気配電、計装および制御システム、冷却水配分、機械構造、ダミーロードなど）の設計、製造、試験、設置、試運転を含む完全なターンキー契約となります。

この文書の目的は、この入札およびその後の契約に参加を希望する企業やコンソーシアムに対して、予備情報を提供することです。最終的な技術仕様書は後日発行され、入札に考慮される唯一の技術文書となります。

〇背景

ITER 機構（IO）は、初期の建設活動が進行中の国際共同研究開発プロジェクトです。IO の 7 つのメンバーは、欧州連合（F4E が代表）、日本、中華人民共和国、インド、大韓民国、ロシア連邦、アメリカ合衆国です。

このプロジェクトの目的は、平和的目的のための核融合発電の科学的および技術的な実現可能性を示し、初の電力を生産する核融合プラントの設計、建設、運用に必要なデータを得ることです。また、フルスケールの核融合発電所に必要な加熱、制御、診断、および遠隔メンテナンスなどの重要技術のいくつかをテストします。

ITER のサイトはフランスのブーシュ＝デュ＝ローヌ地区に位置し、IO の本部と建設現場が含まれています。施設の建設は進行中です。さらなる情報は IO のウェブサイト（http://www.iter.org）で入手できます。

機械内部では、核融合反応を制御および安定化するためにいくつかの磁石とコイルが実装されています。その中には 27 個のエッジ局所モードコイルがあり、それぞれが 1 つの ELM 電源に接続されています。これらのコイルは水冷銅導体に基づいており、抵抗/インダクタンス値は 2.5 mΩ/250 μH の範囲にあります。

この指名依頼を開始する前に、IO は概念的研究を行い、インターフェースを特定・仕様化し、建物に考慮すべきサイズや質量を予測し、システムのアーキテクチャを選定しました。これらの研究は、この文書において供給者に影響を与える情報を提供するために考慮されています。しかし、入札段階では、入札者は必須要件を満たす限り、自身のソリューションを提案することができます。

〇技術要件と作業範囲

1 システムの電気的な要件

各インバータは、15 kAの電流または300 Vの電圧を生成できるように設計される必要があります。最大電流と最大電圧は同時に生成される必要はなく、電流は負荷のインピーダンスによって制限されます。これに基づいて、各インバータの推定出力は約800 kVAの範囲となります。

各グループレベルでは、特定の制御モードが使用され、すべてのインバータが同時に最高の電圧/電流を生成する必要はありません。この機能によりシステムを最適化でき、各整流器が供給する電力は5 MVAに削減されます。

2 制御システム

特定のサブシステム（インバータ、整流器など）に必要なローカルコントローラーに加えて、各9台の電源グループごとに2種類の制御システムを実装する必要があります：

ELM-PSシステムの状態を監視し、システムのアクチュエーター（またはローカルコントローラー）に制御信号を提供し、ELM-PSシステムの各グループをITERの中央制御システムとインターフェースする、従来型の制御システム。

ELM-PSシステムレベルでの保護機能を実装・監視し、ELM-PSシステムの各グループをITERの中央インターロック制御システムとインターフェースする、インターロック制御システム。ただし、保護機能は、ローカルコントローラー（インバータ、整流器など）を備えたサブシステムに対してローカルに実装することも可能です。

3 適用される規格およびコード

ELM-PSシステムの設計、製造、設置、および運用において考慮すべき適用規格は、ITER電気設計ハンドブック - コードとスタンダード（TR-20-005）に記載されており、ITERのウェブサイトで入手可能です。主要な規格を以下に示します：

NF C 13 200: 高電圧電気設備*
NF C 15 100: 低電圧電気設備*
NF C 18 510: 電気ネットワークおよび設備、電気環境における作業*
IEC 60146: 半導体コンバータ
IEC 60076: 電力変圧器
IEC 61000: 電磁適合性
*フランスの規格の特性を考慮し、IOは契約の実行およびゲートレビュー中に技術専門家および/または外部

第三者を関与させ、これらの規格の実施に関して請負業者を指導します。設置が完了した後、独立した機関による検査が行われ、システムが適用されるフランスの規格（主にNF C 13 200、NF C 15 100、NF C 18 510）に適合しているかどうかが確認されます。この検査の完了は、契約を締結するための条件となります。
機械的構造部品（その固定具を含む）の場合、供給者はユーロコードおよび/またはASMEコードを使用して機械的完全性の確認を行う必要があります。

作業の範囲
契約の実行は、図5に示すように、7つの活動フェーズと7つのゲートレビューに整理されます。
図5. IO手続きに基づく活動フェーズとゲートレビュー。
（詳細は英文技術仕様書を参照ください）

システムの分解および異なるサブシステムを考慮すると、異なる活動フェーズやゲートレビューを各サブシステムごとに独立して並行して実施することが許可されます。
この契約の範囲では、テストおよび試運転（COM）活動フェーズと運用準備レビュー（ORR）は、ダミーロードに関するテストと試運転のみを対象とします。ELMコイルを使用したテストは、運用および保守活動フェーズ中にIOの責任で実施されます。ただし、供給者にはこの活動フェーズの最初の数年間に技術的および人的サポートを提供するよう求められます。
概念設計（CON）、運用および保守（OPE）、および廃止（DEC）の日程は、現段階では暫定的です。入札の開始前に軽微なスケジュールの最適化が可能です。活動フェーズや概念設計レビュー（CDR）、フランスへの引き渡し（HTF）は、この契約には含まれていません。

〇暫定的なタイムライン
IO内部のマイルストーン、地域内の他のシステムの統合、および他のインターフェースシステムの設計スケジュールを考慮して、この契約に対する以下のマイルストーンが考慮されます：

〇概略日程
概略日程は以下の通りです：

マイルストーン	暫定日程
キックオフミーティング	2026 年第 1 四半期
最終設計の完了（設計およびインターフェースが確定）	2028 年第 1 四半期まで
建屋 11-L4（インバータエリア）での設置開始	2029 年第 1 四半期以降
建屋 13（整流器エリア）での設置開始	2030 年第 1 四半期以降
ダミーロードに対する試運転の終了	2032 年第 3 四半期まで

これらの日程は、現段階では暫定的です。入札の開始前に軽微なスケジュールの最適化が可能です。

【※　詳しくは添付の英語版技術仕様書「**Design, manufacturing, testing, installation and**

commissioning of the Edge-Localized-Mode Power Supplies system (ELM-PS)」をご参照ください。】
ITER 公式ウェブ　http://www.iter.org/org/team/adm/proc/overview からもアクセスが可能です。

「核融合エネルギー研究開発部門」の HP：　http://www.fusion.qst.go.jp/ITER/index.html
では ITER 機構からの各募集（IO 職員募集、IO 外部委託、IO エキスパート募集）を逐次更新しています。ぜひご確認ください。

イーター国際核融合エネルギー機構からの外部委託
に関心ある企業及び研究機関の募集について

＜ITER 機構から参加極へのレター＞

以下に、外部委託の概要と要求事項が示されています。参加極には、提案された業務に要求される能力を有し、入札すべきと考える企業及び研究機関の連絡先の情報を ITER 機構へ伝えることが求められています。このため、本研究・業務に関心を持たれる企業及び研究機関におかれましては、応募書類の提出要領にしたがって連絡先情報をご提出下さい。

Route de Vinon-sur-Verdon - CS 90 046 - 13067 St Paul Lez Durance Cedex - France

Date: 17 October 2024

Reference: IO/24/CFT/10029880/VML

Subject: **Call for Nominations for Design, manufacturing, testing, installation and commissioning of the ELM-PS**

Dear Colleagues,

The ITER Organization is pleased to invite the Domestic Agencies to nominate companies, institutions or other entities that would be capable of undertaking a turn-key contract for **Design, manufacturing, testing, installation and commissioning of the ELM-PS.**

Please find enclosed the Technical Summary and the tentative schedule for the tender below:

Call for Nomination due date	12 November 2024
Issuance of Pre-qualification Application	2 December 2024
Pre-qualification offers due	7 February 2025
Issuance of Call for Tender	4 April 2025
Call for Tender offers due date	20 June 2025
Estimated Contract Award Date	8 November 2025
Contract signature December	December 2025
Estimated Contract Start Date	January 2026

china
eu
india
japan
korea
russia
usa

The potential Candidates should have a recognized level of expertise, skills and demonstrated experience in the field mentioned above, as well the financial capability.

Could you please provide Procurement and Contracts Division with a list of suitable potential Candidates, mentioning their up-to-date contact details using the attached excel template. Then, the ITER Organization will invite them to prequalify.

Please send your proposals by e-mail to virginie.michel@iter.org by latest **12 November 2024**.

Yours faithfully,

Virginie Michel
Procurement Officer
Procurement Operational Delivery Group (POD)

Annexes:
- Nominations template
- Technical Summary

IDM UID
CBHH3M

VERSION CREATED ON / VERSION / STATUS
17 Oct 2024 / 1.2 / Approved

EXTERNAL REFERENCE / VERSION

Technical Specifications (In-Cash Procurement)

TECHNICAL SUMMARY Call for Nomination for Design, manufacturing, testing, installation and commissioning of the ELM-PS

This document outlines a summary of the technical requirements of the Edge-Localized-Mode Power Supplies (ELM-PS) system that needs to be procured by the ITER Organization (IO).
This system consists in 27 power supplies that are required to generate currents up to 15 kA or voltages up to 300 V, in DC and/or AC (0-50 Hz).
This system is to be procured by the IO, with a full turnkey contract that will include, but not limited to, the design, manufacturing, testing, installation and ...

TECHNICAL SUMMARY
Call for Nomination for

Design, manufacturing, testing, installation and commissioning of the Edge-Localized-Mode Power Supplies system (ELM-PS)

Table of Contents

1 Purpose

This document outlines a summary of the technical requirements of the Edge-Localized-Mode Power Supplies (ELM-PS) system that needs to be procured by the ITER Organization (IO).

This system consists in 27 power supplies that are required to generate currents up to 15 kA or voltages up to 300 V, in DC and/or AC (0-50 Hz).

This system is to be procured by the IO, with a full turnkey contract that will include, but not limited to, the design, manufacturing, testing, installation and commissioning of the 27 power supplies and their auxiliary systems (Medium & Low Voltage electrical distribution, instrumentation and control systems, cooling water distribution, mechanical structures, dummy loads…).

This document has the objective to provide preliminary information to potential companies or consortia that are interested in participating in the call for nomination for this tender and subsequent contract. The final technical specifications will be issued later and will be the only technical document to be considered for biding.

2 Background

The ITER Organization (IO) is a joint international research and development project for which the initial construction activities are underway. The seven members of the IO are the European Union (represented by F4E), Japan, the People's Republic of China, India, the Republic of Korea, the Russian Federation and the USA.

The project aims to demonstrate the scientific and technological feasibility of fusion power for peaceful purposes and to gain necessary data for the design, construction and operation of the first electricity-producing fusion plant. It will also test a number of key technologies, including the heating, control, diagnostic and remote maintenance that will be needed for a full-scale fusion power station.

The ITER site is in the Bouches du Rhône district of France. It includes the Headquarters of the IO and a construction worksite. The construction of the facility is on-going. Further information is available on the IO website: http://www.iter.org .

In the machine, several magnets and coils are implemented to control and stabilize the fusion reaction. Among them, 27 Edge-Localized-Mode coils are implemented, each of being connected to one ELM power supply. These coils are based on water cooled copper conductors and have resistance/inductance values in the range of 2.5 mΩ/250 µH.

Before launching this call for nomination, the IO has performed conceptual studies, to identify and specify interfaces, to anticipate sizes and masses to be considered for the buildings and to select the architecture of the system… These studies are considered in this document to provide impacting information to the suppliers. However, during the call for tender phase, the bidders will be able to propose their own solutions, with the condition that the mandatory requirements are fulfilled.

3 System presentation

3.1 Interfaces

The ELM-PS system is interfaced with other systems (not in the scope of this contract) that are summarised in Table 1.

Interfaced system	Description
Cooling Water	De-ionized water is provided by 12 feeders. The distribution of the cooling water between all the components of the ELM-PS system is included in this contract.
Medium voltage feeders	The main power is provided by two 22 kV (MV) feeders. The distribution of the MV between all the components of the ELM-PS system is included in this contract.
Low voltage feeders	Auxiliary power is provided by several 400 V (LV) feeders at different locations. The distribution of the LV between all the components of the ELM-PS system is included in this contract.
Control networks	The system is interfaced with different networks, including conventional control networks, data archiving networks and interlock networks… The implementation of control systems, control software development, internal networks and I&C cables… is included in this contract.
Buildings	The system is located in two buildings, each of them required different types of interfaces (see section 4) and requirements.

Table 1. Main interfaces of the ELM-PS system

3.2 ELM-PS system arrangement

The high-level ELM-PS system arrangement is presented in Figure 1.

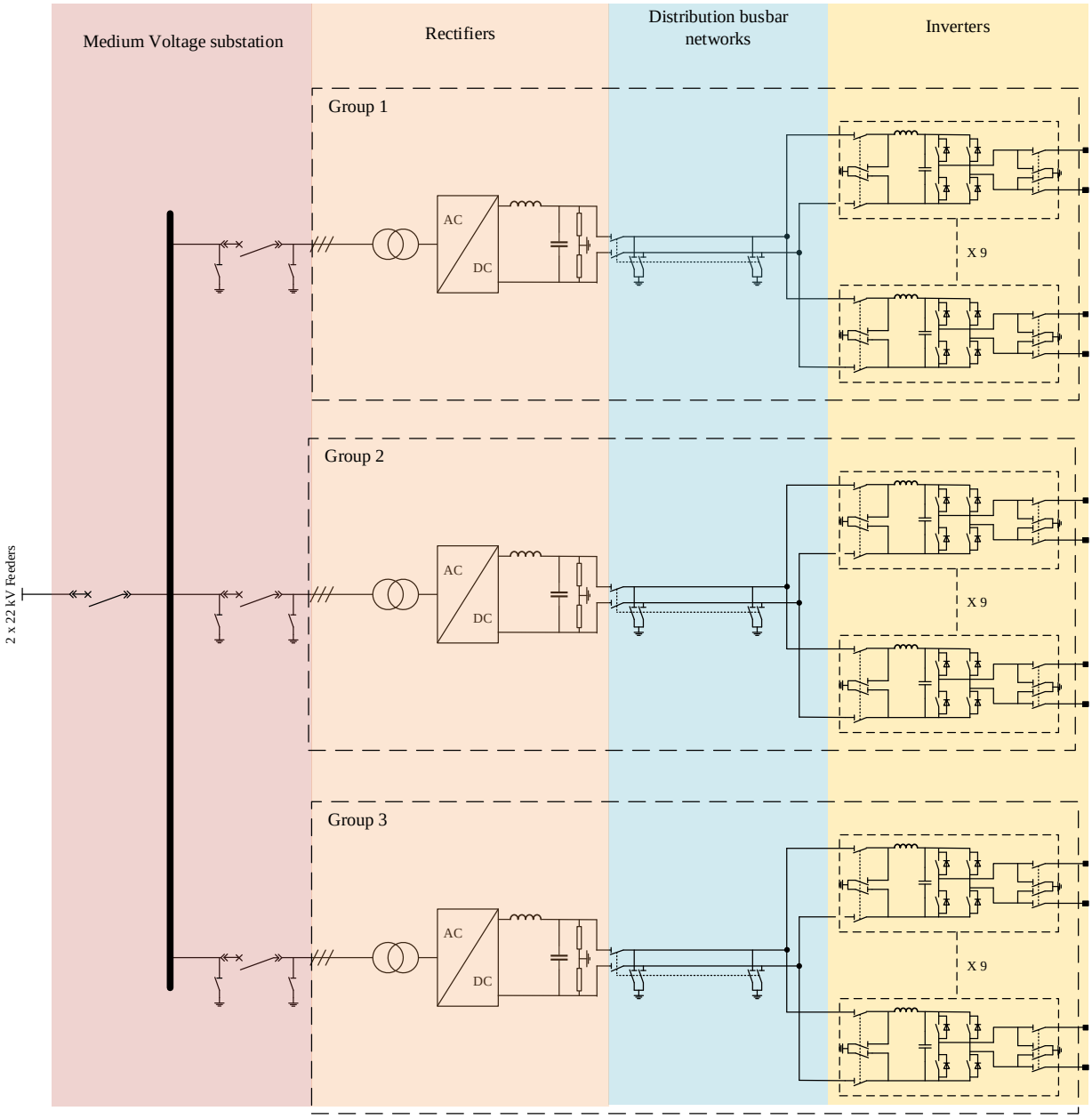

Figure 1. System arrangement of ELM-PS system.

The ELM-PS supplies system consists in three independent groups. Each group is composed of three main subsystems:

- One AC/DC rectifier that includes step-down transformer(s), power electronics unit(s), output filter(s), disconnector(s)… At the time of writing these lines, there are no strong justifications to impose a specific technology (Current source or Voltage Source) to the supplier.
- One distribution busbar network that distributes the DC power from the rectifier to 9 inverters. The current of the busbar network is in the range of 15 kAdc under a voltage of 350-450 V. The total length is in the range of 150 meters. It shall be mentioned that the IO already has design, manufacturing and installation experience for this type of busbar. IO's Intellectual Property could be made available for this contract.

- Nine DC/AC IGBT based inverters that receive the DC power from the distribution busbar networks and provide the requested current to the ELM coils. Each inverter is interfaced with already installed busbars.

Each group of 9 power supplies is operated and maintained independently (from the hardware and control point of view), like three independent systems. Consequently, each group has its own control system and independent interfaces with the ITER's central control system.

To interface the rectifiers with the MV feeders, a Medium Voltage (MV) substation is required. This MV substation is included in the scope of this contract.

In addition, 4 dummy loads (not shown in Figure 1) are required to test the system under its nominal rating, without using the ELM coils.

4 Integration in the buildings

The conceptual design presented in this section has the objective to provide information to the suppliers but does not correspond to the final implementation of the system. Indeed, based on the technical specifications, the supplier will have the entire responsibility to design and implement the system.

Three main areas are reserved for the system, as shown in Figure 2.

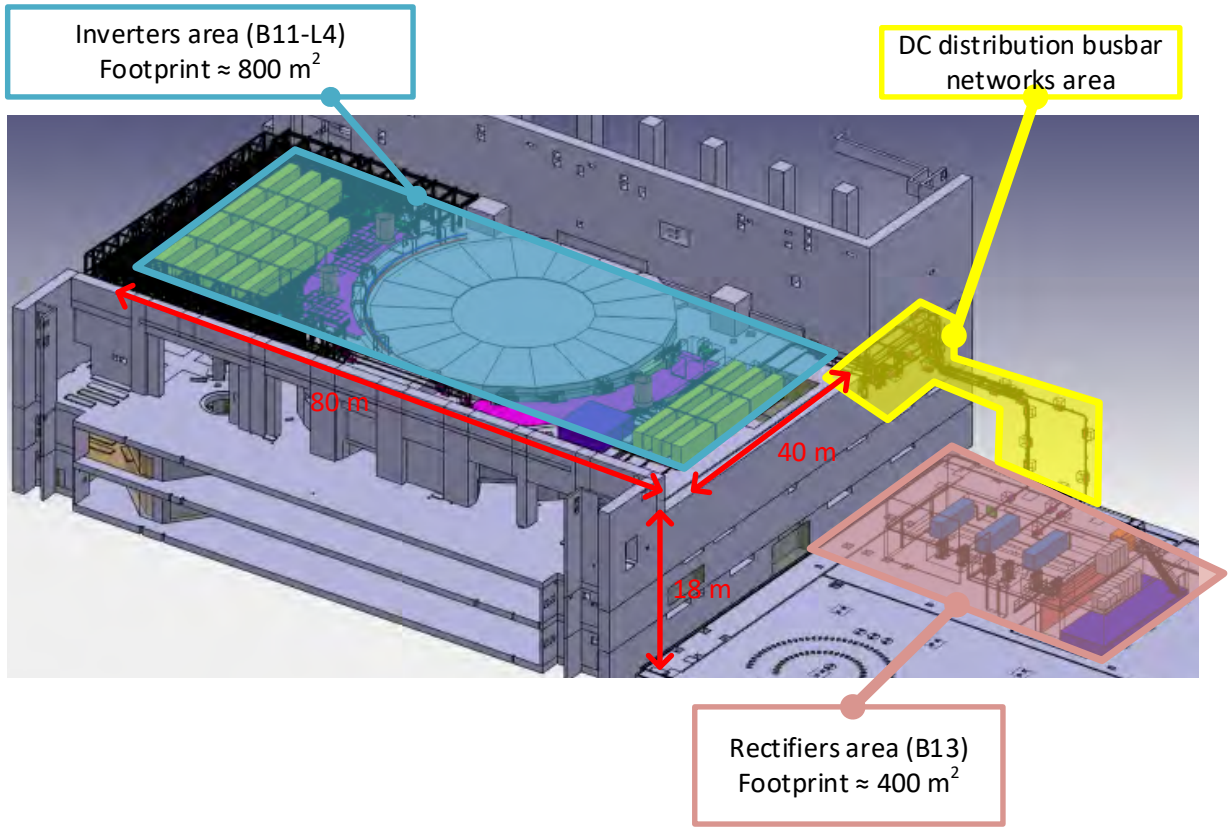

Figure 2. Available area for implementing the ELM-PS system

4.1.1 Inverters area (Building B11-L4)

The 27 inverters are implemented on a metallic false floor (not in the scope of this contract). Busbars, cables… can be routed under this false floor. In addition, several metallic platforms (not in the scope of this contract) are available to support the LV and I&C cubicles.

It shall be noted that due to the proximity with the main magnets of the ITER's plant, the components located in this area will have to operate with the presence of a static magnetic field

in the range of 10-40 mT, depending on the location of the components in this area. However, the components may be required to be qualified with a margin that will be specified.

To anticipate the effects, identify compatible technologies or mitigation methods, IO has performed theoretical analysis and tests. This experience will be considered in the technical specification, in which specific technologies, tests, or design criteria will be included to limit the risk to be managed by the supplier on this topic. In addition, IO has also developed a specific test facility that will be available to perform the required qualification tests.

4.1.2 Rectifier area (Building B13)

This area is reserved for the MV substation, the transformers, the rectifiers and the main control systems. Considering the available space, a two storeys metallic structure will have to be implemented. **The design, manufacturing and installation of this metallic structure are included in the scope of this contract.**

The conceptual design of the metallic structure is presented in Figure 3.

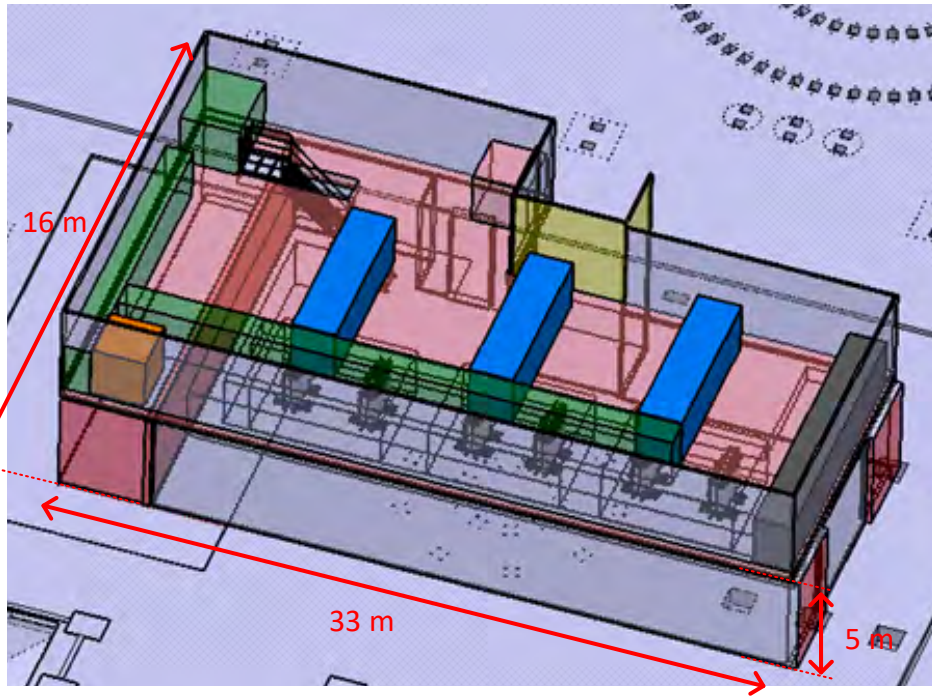

Figure 3. Conceptual design of the metallic structure

The space of the metallic structure is motivated by the space dedicated to ELM-PS system in the building. There are no limitations on the height of the structure. In the current conceptual design, the masses to be supported by the structure are in the range of 470 tons (distributed over the two storeys).

4.1.3 DC distribution busbars network area

A space reservation has been considered for routing the three DC distribution busbar networks. The busbars are first routed in the building's metallic structure and then fixed on the wall as shown in Figure 4.

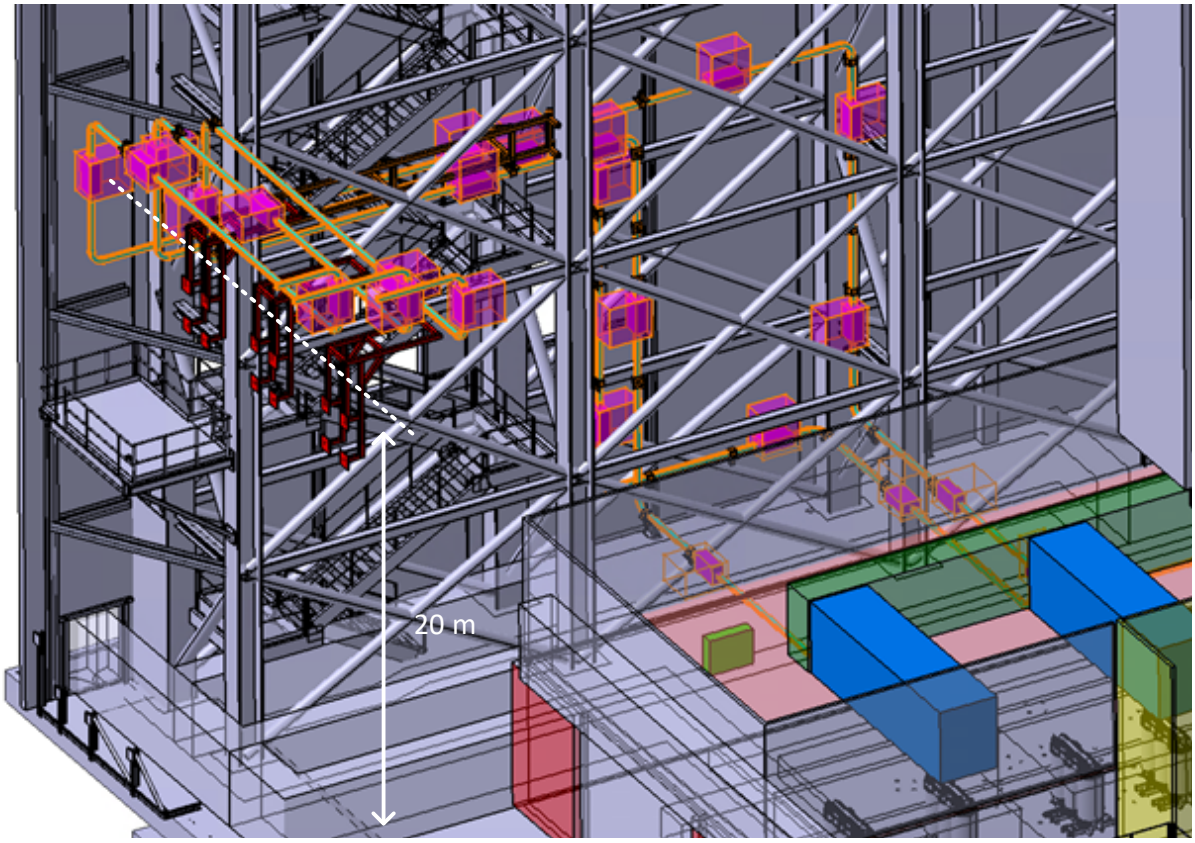

Figure 4. DC distribution busbars network routing.

Busbars' supports can be welded on metallic surfaces and screwed to concrete walls.

5 Technical requirements and scope of the contract

5.1 System electrical requirements

Each inverter has to be designed to generate a current of 15 kA or a voltage of 300 V. The maximum current and maximum voltage do not have to be generated simultaneously and the current will be limited by the impedance of the load. Based on this, the estimated output power of each inverter is in the range of 800 kVA.

At each group level, specific control modes will be used and none of all the inverters will be required to generate the highest voltage/current at the same time. This feature allows optimizing the system and reduces the power to be delivered by each rectifier to 5 MVA.

5.2 Control system

In addition to the local controllers required for specific subsystems (inverters, rectifiers…), two types of control systems need to be implemented, for each group of 9 power supplies :

1. One conventional control system, in charge of supervising the states of the ELM-PS system, providing control signals to the system's actuators (or local controllers) and interfacing each group of the ELM-PS system with the ITER central control system.
2. One interlock control system, in charge of implementing and supervising protection functions at the ELM-PS system level and interfacing each group of the ELM-PS system with the ITER's central interlock control system. Nevertheless, protection functions can be implemented locally, for the subsystems that are equipped with local controllers (inverters, rectifiers…).

At the plant level, the IO requests the implementation of specific controllers, listed in the sections hereafter. With these controllers, the suppliers can rely on the IO's technical support, development tools as well as a plant control system mock-up to facilitate the I&C integration and Factory Acceptance Tests of the ELM-PS system.

For the conventional and interlock control systems, two types of controllers can be implemented (slow and fast). Based on the required performance of the ELM-PS system, there are no strong justifications to select a fast control architecture. However, a fast control architecture can be selected by the supplier if required.

For the local controllers, the supplier is not required to use specific products.

5.2.1 Slow controller for conventional controls

SIEMENS Simatic S7 product range is requested. ProfiNet or ProfiBus field bus shall be implemented within their architecture up to the input/output cards. External interface with the ITER's plant control system shall be standard Ethernet.

5.2.2 Fast controller for conventional controls (if required)

PCI Express I/O bus systems are requested, with two types of hardware:

- One CPU/Network chassis which can be based on:
  - Industrial PICMG 1.3 PC 4U Computer
- Bus extensions (I/O chassis) can be based on:
  - PXI Express I/O Chassis Solutions,
  - CompactRIO I/O Chassis Solutions,

5.2.3 Slow controller for interlock controls

Siemens Simatic S7-400 FH product range is requested. In all the case, the integrity level of this controller shall be SIL-2 or SIL-3.

5.2.4 Fast controller for interlock controls (if required):

I&C Compact RIO chassis solution is requested. In all the case, the integrity level of this controller shall be SIL-2 or SIL-3.

5.3 Applicable standards and codes

For electrical and power electronics components, the applicable standards to be considered for the design, manufacturing, installation and operation of the ELM-PS system are listed in the ITER Electrical Design Handbook - Codes & Standards (TR-20-005), available on the ITER website. However, the main ones are listed hereafter:

- NF C 13 200: High voltage electrical installations*
- NF C 15 100: Low-voltage electrical installations*
- NF C 18 510: Operations on electrical network and installations and in an electrical environment*
- IEC 60146: Semiconductor converters
- IEC 60076: Power transformers
- IEC 61000: Electromagnetic compatibility

* Considering the specificity of the French standards, the IO will involve its technical experts and/or an external third party during the execution of the contract and the gate reviews to guide the contractor in the implementation of these standards. After the completion of the installation,

an inspection will be performed by an independent entity, to check the compliance of the system with the applicable French standards (NF C 13 200, NF C 15 100 and NF C 18 510 mainly). The completion of this inspection will be a condition to close this contract.

For mechanical structural components (including their fixations…), mechanical integrity verifications will have to be produced by the supplier, using the set of Eurocodes and/or ASME codes.

6 Scope of work

The execution of the contract will be organized in seven activity phases and seven gate reviews as shown in Figure 5.

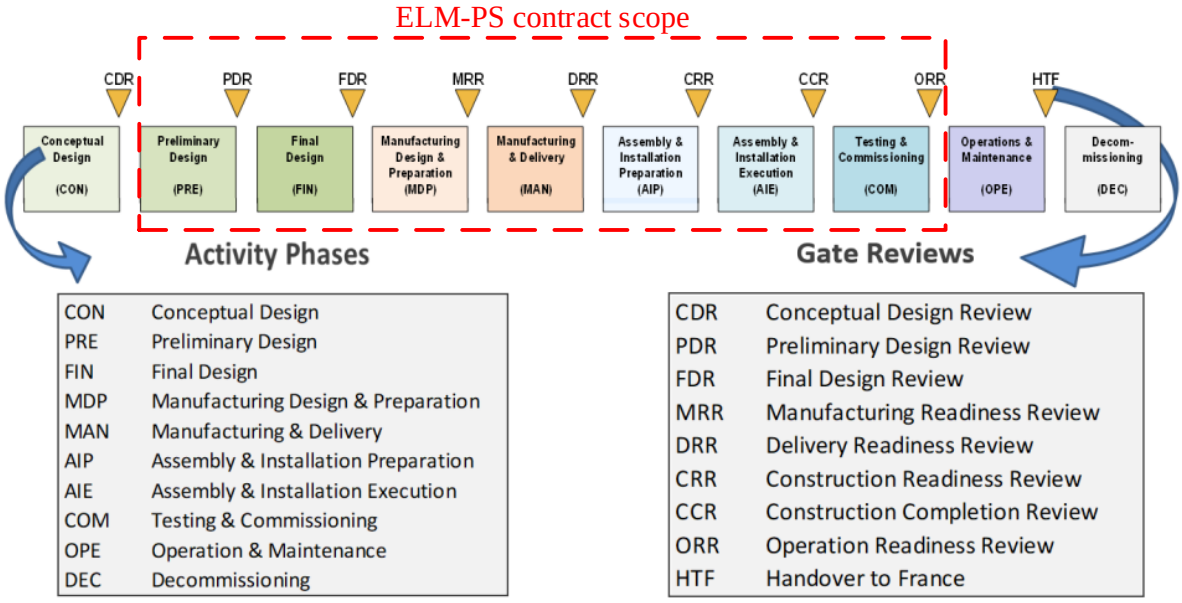

Figure 5. Activities phases and gate reviews as per the IO procedures.

Considering the system breakdown and the different subsystems, it will be allowed to perform different activity phases and gate reviews in parallel, independently for each subsystem.

In the scope of this contract, the testing and commissioning (COM) activity phase and Operation Readiness Review (ORR), will only cover the tests and commissioning on dummy loads. The tests with the ELM coils will be performed under the IO's responsibility, during the Operation and Maintenance activity phase. However, the supplier will be requested to provide technical and human support during the first years of this activity phase.

Conceptual Design (CON), Operation and Maintenance (OPE) and decommissioning (DEC) activity phases as well as Conceptual Design Review (CDR) and Handover to France (HTF) are not included in this contract.

7 Tentative timeline

Due to IO internal milestones, the integration of other systems in the area and the design schedule of other interfaced systems, the following milestones shall be considered for this contract:

1. Kick-of meeting: Q1-2026.
2. Completion of final design (design and interfaces are frozen): no later than Q1-2028.
3. Beginning of installation in the building 11-L4 (inverters area): no sooner than Q1-2029.
4. Beginning of installation in the building 13 (rectifiers area): no sooner than Q1-2030.
5. End of commissioning on dummy loads: no later than Q3-2032.

These dates are tentative at this early stage. Minor schedule optimizations are still possible before the beginning of the call for tender.

NOMINATIONS

IO/24/CFT/10029880/VML

Design, manufacturing, testing, installation and commissioning of the ELM-PS

Nominating Domestic Agency:

COMPANY NAME	WEB SITE link	POSTAL ADDRESS	POST CODE	CITY	COUNTRY	CONTACT PERSON	PHONE	E-MAIL	COMPANY INFORMATION (if any)