外部委託業者の募集

References: IO/26/MS/ICRH/JPK

“Four Ion Cyclotron Radio Frequency (RF) Sources for the ICRH system”

（ICRH システム用のイオンサイクロトロン高周波電源 4 基の市場調査）

IO 締め切り 2026 年 6 月 30 日(火)（JADA 締め切り 6 月 29 日(月)）

〇序文

本技術仕様書は、技術要件の一部を構成する「サービス及び供給に関する一般管理仕様書（GM3S）ー参照文献［1]」と併せてお読みください。

また、イオンサイクロトロン高周波電源の要求事項は SRD 51［20］に定められています。

これらの文書間に矛盾がある場合は、本技術仕様書の内容が参照文献［1］および［20］の内容に優先します。

〇目的

ITER は、核融合エネルギーの科学的・技術的実現可能性を実証することを目的とする国際共同研究開発プロジェクトです。

ITER プロジェクトは、欧州連合、日本、中国、インド、韓国、ロシアおよび米国の 7 か国・地域により、フランスのサン＝ポール・レ・デュランスにおいて共同で建設されています。

ITER のイオンサイクロトロン加熱・電流駆動（ICH）システムは、壁コンディショニングおよび各種プラズマ運転シナリオの実施に必要とされます。

ITER の ICH システムには、4 基の高周波（RF）電源が必要です。各電源は以下の性能を満たす必要があります：

- 出力：3 MW
- 運転モード：連続波（CW、2000 秒）
- VSWR：1.5（反射係数の位相に依存しません）
- 周波数範囲：40～55 MHz

各 RF 電源は同一の構成機器で形成され、38～57 MHz の周波数範囲で調整可能である必要があります。

代表的な RF 電源の構成機器は次のとおりです：

- 低出力 RF 電源
- ソリッドステート電力増幅器
- 高出力真空管式増幅器
- これらに関連するグリッド電源および保護回路
- キャビティのチューニングシステム
- 遠隔操作および保護のための計測制御（I&C）
- 水冷および空冷システム
- 伝送線路（3 インチ、6 インチ、9 インチまたは 12 インチ）
- 受入試験を実施するためのミスマッチ伝送線路

なお、HPA2 および HPA3 の陽極用高電圧電源装置（HVPS）は供給範囲に含まれません。
また、RF 電源の試験に使用する 3 MW ダミーロードも供給範囲には含まれません。
ドシステムの設計および供給は対象外とします。

4 基の RF 電源は、1 台のマスターシンセサイザから給電されます。
また、3 MW の出力は 12 インチの伝送線路（TL）に接続されます。
適用文書または参照文書の一部において、RF 電源の設計またはレイアウトが記載・説明されている場合がありますが、これらは入力条件として見なされるものではありません。供給者は、本技術仕様書に定める要求事項に適合する限り、任意の RF 電源設計を提案することが許されています。
本作業範囲は、4 基の RF 電源の供給、据付および ITER サイトにおける試運転を対象とし、主に以下の業務を含みます：

RF 電源の最終設計を策定するためのエンジニアリング業務
4 基の RF 電源の製作
IO の設計審査プロセスのためのエンジニアリング文書の作成
製作過程において必要となる最終設計の調整
製造工程の監督および報告
参照文献［4］に規定された検査および品質記録の作成
手順およびプロセスの認証・適格化に関する業務
各 RF 電源の工場試験
ITER サイトへの納入
ITER サイトにおける組立および据付
ITER サイトにおける試運転および現地受入試験（SAT）
洗浄および梱包
保管および保存措置
IO の要求に基づく契約管理
文書作成（例：設計報告書、系統図、図面、品質保証文書、据付・試験手順書、運転マニュアル等）
トレーニング

契約者から IO への所有権の移転は、IO による SAT 報告書の受入れ時に有効となります。
RF 電源の据付および試運転は、ITER サイト内の建屋 20 において実施されます。
ICRH システムおよびその RF 電源の概要は、以下の図 2-1 に示されています。

図 2-1 ITER サイトにおける ICRH の外観
（以下詳細は技術仕様書を参照ください）

〇作業範囲
本節では、参照文献［4］に定義されている契約履行要件に加えて、本業務の具体的な作業範囲を定義しま

す。
作業範囲は以下のとおり区分されます。

供給範囲＃1

- 設計の定義およびそれに関連する設計レビューの実施、並びにIOによる設計承認
- 主要機器の工場受入試験（FAT）を含む4基のRF電源の製造

作業範囲＃1

- IOサイトにおける4基のRF電源の据付

作業範囲＃2

ITERサイトにおける4基のRF電源の試運転（現地受入試験（SAT）により評価されるもの）
供給者は、本業務範囲全体に対して責任を負います。なお、所有権の移転は、IOにおいてSATが正常に完了した後に実施されます。

1 供給範囲＃1：ICRH用RF電源4基の設計

1.1 概要

RF電源に関する技術仕様、要求事項およびインターフェース要件は、以下の各節に定義されています。設計はこれらの要求事項に従って開発され、SATプロセスを通じてその妥当性が検証されます。
初期要求事項の反映状況については、設計レビューにおいて実証する必要があります。
契約者はRF電源の設計を作成し、インターフェース要件に従って建屋20（B20）の環境内に統合しなければなりません。
設計がIOへの承認申請に適した状態となった時点で、IOは最終設計レビューを実施し、製造に向けた設計承認を行います。
（以下詳細は技術仕様書を参照ください）

2 供給範囲＃1：ICRH用RF電源4基の製造

最終設計レビューが完了し、正式にクローズされた後、契約者はRF電源の製造に着手することができます。なお、工程上の制約により長納期品の一部については、IOの書面による合意に基づき、設計段階において事前に調達を開始する場合があります。

2.1 製造要件

RF電源はPIC（重要安全機器）には該当しない構成機器です。
したがって、製造要件は本仕様書に示された要求事項に適合するよう、エンジニアリング設計段階において確立され、製造工程において適用されます。
契約者および下請業者は、製造の各工程に対し、詳細な品質計画、参照文献［6］のテンプレートに基づく製造検査計画（MIP）、作業計画および手順書を作成しなければなりません。これらはIOに提出し、レビューおよび承認を受ける必要があります。
システムの統合、運用および保守の簡素化ならびにコスト低減を図るため、契約者は可能な限り市販品

（COTS）コンポーネントを使用する必要があります。
予備品の供給に関する提案は、IC H&CDサブシステムのRAMI解析に基づき、計画保守および突発保守の双方を考慮して提示する必要があります。これらの提案では、運用条件、標準品を可能な限り使用することの利点、ならびにITERの寿命期間中における部品の陳腐化リスクを考慮する必要があります。
製造公差は、据付後の全体公差を満たすよう設定するものとし、据付時の誤差および接続部品の公差を考慮する必要があります。
また、製造要件はSRD51［20］に示されている一般原則に従うものとします。

- すべての重要機器および重要部品を特定する必要があります。これらは各設計記述において明確に識別されなければなりません。
- システムのフル運転開始後12か月以内に必要となると合理的に想定される予備品は、遅くとも試運転段階までに調達する必要があります。
- 設計解析における材料特性データの参照元は、適用される構造規格またはITER材料特性ハンドブックとします。両者に相違がある場合は、ITER材料特性ハンドブックが優先されます。

商用材料は、ASTM、JIS、DINなどの適用規格に適合し、その等級、物理特性、化学特性、電気特性および試験要件が定義されている必要があります。
適切な証明書が供給者から提供されない材料については、調達の一環として特性評価試験を実施する必要があります。
また、溶接材料を含むすべての材料について完全なトレーサビリティを確保する必要があります。
水冷配管には耐腐食性材料を使用する必要があります。
設計段階で定義される材料リストについては、以下の情報の一部を提示する必要があります：

- 材料の概要および製造方法の簡単な説明
- 適用規格
- 納入条件（例：必要な熱処理、冷間加工など）
- 化学組成
- 各温度条件における最小値・平均値の熱的および機械的特性（試験方法および規格を含む）
    - o これらの特性が「納入時」の材料を対象とするのか、「製造後」の材料を対象とするのか、あるいはその両方であるかを明示する必要があります。
- 材料特性のばらつき許容範囲に関する具体的要件
- 必要となる証明書および材料特性評価報告

（以下詳細は技術仕様書を参照ください）

3 供給範囲＃1：ITERサイトにおける組立

3.1 作業内容

契約者は、IOの施設内における組立作業について責任を負います。
組立作業には、B20 L3で規定されたスペース予約（RFSエンクロージャ）内で実施されるすべての作業を含み、その範囲は図5-4および図5-5に示す通りです。
契約者は、組立作業を実施するために必要な資格を有する要員を確保し、これを提供します。
組立作業は、製造フェーズにおいて承認された組立手順に基づいて実施します。

RFSエンクロージャ外で実施される作業（本仕様書では「据付」と定義します）は、IOが責任を負います（図5-5参照）。
当該据付作業には、以下が含まれます：
- ソース運転に必要な各種ユーティリティ（冷却水、CODAC、圧縮空気、窒素など）の提供
- ダミーロードまでの伝送ラインの整備
据付作業は、RFS機器との接続点までをIOが実施します。
各RFSの組立および据付が完了した後、契約者は適合報告書を発行し、IOの承認を受けます。
当該報告書には、組立が適切に完了していること、およびシステムがダミーロード上での試運転に供する準備が整っていることを記載します。
※注記：
・組立および据付の期間中に、中間試験の実施が求められる場合があります。
・これらの試験は、組立手順において明確に規定されます。
・また、これらはサービス#2のスコープで規定される試運転には該当しません。
（以下詳細は技術仕様書を参照ください）

4 作業範囲　#2 – 試運転およびサイト受入試験

4.1 作業内容

契約者は、RFSの試運転を実施します。IOの職員が、試運転作業の調整を行います。
試運転計画および関連手順は、契約者が策定します。
これらは、コミッショニング準備レビューを通じて検証されます。
IOは、第5.1.5節に記載されたインターフェースに基づき、必要なサービスを提供します。
当該内容は、本技術仕様書の次版において詳細化および更新される予定です。
各RFSは、サイト受入試験（SAT）の実施準備が整う段階まで試運転が行われます。SATは、IO職員の立会いのもと実施されます。標準的なサイト受入試験の内容については、第13.1節に記載されています。
SATが正常に完了した後、契約者はSAT報告書を作成します。当該報告書は、IOの審査および承認に付されます。IOによるSAT報告書の承認により、RFSユニットの所有権は正式にIOへ移転します。
保証期間は、SAT承認日から開始されます。
（以下詳細は技術仕様書を参照ください）

〇作業実施場所

製造、組立、工場試験および梱包は、契約者の施設において実施されます。
組立、据付、試運転および最終受入試験は、ITERサイトにて実施されます。

〇IO文書およびIO支給品

1 IO文書

第4節を参照してください。

2 支給品（Free issue items）

規定せず。

〇スケジュール、主要マイルストーンおよび成果物

契約締結から作業スコープ完了までの想定最大期間は7年間です。

全体スケジュールは、ITERプロジェクトの要求により制約されます。

（以下詳細は技術仕様書を参照ください）

【※　詳しくは添付の英語版技術仕様書「**ICH RF Sources Market Survey Technical Specification**」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。

To: Potential respondents

Date: 6 May 2026
Subject: Market Survey
Letter Reference: IO/MS/26/ICRH/JPK

Dear Madam/Sir,

The ITER Organization (IO) is launching a Market Survey in view of a possible future procurement competition for the provision of the **Four Ion Cyclotron Radio Frequency (RF) Sources for the ITER Ion Cyclotron Heating & Current Drive (ICRH) system**. In the scope of work, it will include the design, manufacturing, testing, delivery, installation and commissioning.

In this context, we would like to request information from you to help us better define the procurement technical specifications and to assess the market's availability to:

- *Demonstrate its capability to satisfy the requirements outlined in the draft technical specifications attached to this market survey,*

or/and

- *Identify manufacturing capacity, achievable schedule, market and performance cost drivers and uncertainties related to the supply of ITER ICH RF Sources.*

The draft technical specifications ref FKNP8R attached to this Market Survey are a purely informational document, not binding for any party, for you to have more complete data to answer the questions. These specifications are drafted as if they were intended for a procurement.

We will highly appreciate it if you could answer the questions in the attachment and return it to the Procurement Officer in charge by email by **30 June 2026**, JunHyung.Park@iter.org, in cc to Andrew.Brown@iter.org

None of the answers that you will provide, nor any part of them, will ever be considered binding with the possible future competition, nor will be shared with any possible competitors.

The IO may invite you to follow up on remote meetings after receiving your responses to this Request for Information.

Yours faithfully,

Mr. Mack STANLEY
Head of Procurement Division

Mack STANLEY
Head of Procurement Division
06/05/26

Contact: Junhyung Park Procurement Division, Tel 33 4 42 17 61 27 e-mail: junhyung.park@iter.org

RFI Letter of Invitation_RF Sources_v1.0_Final_updated

Final Audit Report 2026-05-06

Created:	2026-05-06
By:	JunHyung Park (junhyung.park@iter.org)
Status:	Signed
Transaction ID:	CBJCHBCAABAAnS4zK6I2WF6OxPNyVX164KUxW3hj6JC

"RFI Letter of Invitation_RF Sources_v1.0_Final_updated" History

Document created by JunHyung Park (junhyung.park@iter.org)
2026-05-06 - 8:22:09 AM GMT- IP address: 193.52.216.130

Document emailed to mack.stanley@iter.org for signature
2026-05-06 - 8:22:45 AM GMT

Email viewed by mack.stanley@iter.org
2026-05-06 - 8:23:48 AM GMT- IP address: 104.47.11.62

Signer mack.stanley@iter.org entered name at signing as mls
2026-05-06 - 8:24:05 AM GMT- IP address: 193.52.216.130

Document e-signed by mls (mack.stanley@iter.org)
Signature Date: 2026-05-06 - 8:24:07 AM GMT - Time Source: server- IP address: 193.52.216.130 - Signature Appearance Selected: IMAGE

Agreement completed.
2026-05-06 - 8:24:07 AM GMT

IDM UID
22K4QX
VERSION CREATED ON / VERSION / STATUS
14 Nov 2025 / 9.3 / Approved
EXTERNAL REFERENCE / VERSION

MQP Level 1

MQP L1 ITER Quality Assurance Program (QAP)

The purpose of this Quality Assurance Program (QAP) is to ensure that ITER activities are performed at a level of quality appropriate to achieving the safety and performance objectives of the ITER Project in compliance with regulatory and industry quality requirements.
Also, the QAP ensures that sufficient objective evidence is maintained to demonstrate that the required quality has been achieved.

Approval Process			
	Name	*Action*	*Job Title / Affiliation*
Author	**Jung C. Y.**	**14 Nov 2025:signed**	**Head of Division**
Co-Authors			
Reviewers	**Lockridge D.** **Perrier G.** **Sriram K. R.**	**18 Nov 2025:recommended (Short Cycle)** **14 Nov 2025:recommended (Short Cycle)** **17 Nov 2025:recommended (Short Cycle)**	**Head of Department** **Head of Department** **Head of Office**
Previous Versions Reviews	**Becoulet A.** **Grammatico L.** **Neagu S.** **Orlandi S.**	**13 Oct 2025:recommended v9.1** **25 Oct 2025:recommended v9.1** **13 Oct 2025:recommended v9.1** **13 Oct 2025:recommended v9.1**	**IO/DG/SID** **IO/DG/ADM** **IO/DG/SQD/QMD/QA** **IO/DG/CP**
Approver	**Barabaschi P.**	**18 Nov 2025:approved**	**Director-General**
Information Protection Level: Non-Public - Unclassified *RO: Tiainen-Paquaux Miia*			
Read Access	**GG: MAC Members and Experts, AD: ITER, AD: External Collaborators, AD: External Management Advisory Board, AD: Nuclear Safety Inspectors, AD: OBS - Quality Management Division (QMD), AD: DA, AD: Auditors, AD: ITER Management Assessor, project administrator, RO, LG: 5th working group, AD: IO_Director...**		

#drn#

Change Log			
MQP L1 ITER Quality Assurance Program (QAP) (22K4QX)			
Version	***Latest Status***	***Issue Date***	***Description of Change***
v1.0	In Work	06 Sep 2005	
v2.0	Signed	14 Sep 2005	
v3.0	Signed	30 Nov 2005	
v4.0	Signed	05 Dec 2005	
v5.0	Signed	08 Dec 2005	
v5.1	Signed	08 Dec 2005	
v5.2	Signed	13 Jan 2006	
v6.0	Signed	07 Nov 2006	
v6.1	Signed	13 Nov 2006	
v6.2	Signed	14 Nov 2006	
v6.3	Signed	16 Nov 2006	
v7.0	Signed	19 Jan 2007	
v7.1	Signed	19 Jan 2007	
v7.2	Signed	22 Jan 2007	
v7.3	Approved	26 Jan 2007	
v8.0	Signed	17 Mar 2017	As part of the simplification/ optimization of MQP as approved by MQPWG, this Major revision of QAP reflects progress of project and new MQP process map defined by MQPWG. This includes the merge of 2NS3UH (ITER Management & Quality Programme (MQP)) into this version. This version has been pre-reviewed by QAA, concerned Process Owners-Representatives, DAs (iteration of drafts including review of their comments).
v8.1	In Work	31 Mar 2017	Changes to version 8.0 accepting RCO DDG's comments: (1) Delete DA from the definition of Performer (2) Add DA’s responsibility and the requirement for joint QA/QC work, as well as Project Team establishment when necessary.
v8.2	Signed	31 Mar 2017	Changes from version 8.1 to version 8.0 accepting RCO DDG's comments: (1) Delete DA from the definition of Performer (2) Add DA’s responsibility and the requirement for joint QA/QC work, as well as Project Team establishment when necessary. Changes from version 8.2 to 8.1: change from track mode to a clean mode by accepting the changes from 8.1 to version 8.0
v8.3	In Work	04 Apr 2017	Accepting COO DDG's request to add 'Construction Teams in Construction Organization should be noted as having full responsibility of Assembly and Installation Works, with a specific organization chart with defined specific responsibility' in Section 1.2.
v8.4	Revision Required	05 Apr 2017	integration of Reviewers comments: Section 2.5: Roles and Responsibilities: adding of a dedicated section for DA, strengthening the synergy approach for implementing Quality activities Section 1.2: project organizational structure, adding precision on Construction Teams Section V (reference): complement the list of external Regulation requirements by adding the PE/NPE Regulation references
v8.5	Approved	18 Apr 2017	As per DG's request: Changing 2.5.1 as

			The IO Director General may consult the IO Central Team Management Board (CTMB) before taking his decision to stop work for the ITER Project. Adding to 2.9: The Non-conformities shall be resolved with high priority and that this resolution shall not exceed 9 months in average and 12 months individually, except initial agreement from the IO DG or the QAA Head.
v9.0	In Work	13 Oct 2025	MQP level 1 documents, ITER Quality Assurance Program updates following the IO QMD internal review (E6BXBZ) and after integration of feedback from DAs' quality representatives via 'Draft review of PA AD_ITER Quality Assurance Program (QAP) (ELFGY7)' . The key changes made to ITER QAP are as following: - The Quality policy has been removed from this QAP and is integrated in ITER Policy on Safety, Security, Quality and Environment Protection (43UJN7) - Reflected IO current organization and MQP process structure (Management / Project Realization / Quality) - Harmonization with International ISO Quality Standards (ISO 9001 & ISO 19443) - Delete redundant or unnecessary requirements
v9.1	Signed	13 Oct 2025	MQP level 1 documents, ITER Quality Assurance Program updates following the IO QMD internal review (E6BXBZ) and after integration of feedback from DAs' quality representatives via 'Draft review of PA AD_ITER Quality Assurance Program (QAP) (ELFGY7)' . The key changes made to ITER QAP are as following: - The Quality policy has been removed from this QAP and is integrated in ITER Policy on Safety, Security, Quality and Environment Protection (43UJN7) - Reflected IO current organization and MQP process structure (Management / Project Realization / Quality) - Harmonization with International ISO Quality Standards (ISO 9001 & ISO 19443) - Delete redundant or unnecessary requirements
v9.2	Signed	12 Nov 2025	Comments from previous reviewers have been discussed and implemented.
v9.3	Approved	14 Nov 2025	Integrated reviewers' comments.

Table of Contents

1 Management and Quality Programme (MQP)

1.1 Introduction

According to the ITER Project Specification [1], the ITER Quality Assurance Programme is developed under an integrated ITER Management and Quality Programme (MQP) to ensure that:

- The level of QA appropriate to achieving the safety and performance objectives of ITER is specified;
- Regulatory requirements have been achieved; and
- Sufficient objective evidence is maintained to demonstrate that the required quality has been achieved.

The QAP promotes compliance with applicable regulatory [6] and industry quality requirements [11], fosters continuous improvement, and facilitates transparent communication among all Project Execution Entities (PEE) to ensure safety, reliability, and performance integrity.

The ITER MQP documentation is established in the following hierarchy.

- The MQP Level-0 documents, define guiding policies and principles which shall be translated throughout the MQP documentation.
- The MQP Level-1 documents shall list plans and specific requirements.
- The MQP Level-2 procedures and MQP Level-3 working instructions shall not duplicate the contents in the upper-level MQP documents but shall detail them further.

The QAP, as one of the Level-1 MQP documents, incorporates Level-0 principles defined in the ITER Project Management Plan (PMP) [2] and ITER Policy on Safety, Security, Quality and Environment Protection [3], and supports the management of activities affecting quality through the implementation of Level-2 procedures and Level-3 work instructions.

The MQP processes are categorized into Project Realization Process, Quality Process and Management Process [14].

Management process for IO Nuclear Safety, Occupational Health & Safety, Environmental Protection, and Security are integrated in ITER Integrated Safety, Environment and Security Management System Manual [4].

By process approach, the ITER MQP documents:

- Shall provide for a disciplined and systematic approach to activities affecting quality and for production of objective evidence to demonstrate that the required quality has been achieved;
- Shall detail requirements, assign responsibilities and authorities and provide for the performance and assessment of work

1.2 Scope

This ITER QAP applies to all quality-related activities and processes and all Project Execution Entities (PEE) involved in ITER project through all the stages and/or phases of ITER project (e.g. R&D, Design, Procurement, Manufacturing, Assembly & Installation, Commissioning, Operation, Maintenance).

The individual Project Execution Entities (PEE), (e.g. ITER Organization (IO), the Domestic Agencies (DA) and their respective supply chains) shall either implement (flow down) the applicable provisions from this QAP to their own established quality plans, or agree to adopt the ITER QAP as their quality plan in the completion of their scope of work on the ITER Project.

The extent of quality plan provisions applied to any specified task is proportional to, and appropriate for, the safety and/or project success significance of the task, as determined by the ITER Management.

1.3 Basic Principles and Responsibilities

The current ITER Project overall organization structure is described in the ITER Organization Chart [7].

The Quality Assurance (QA) activities shall be commensurate with the importance to safety, reliability, and performance of the ITER Facility [1][2].

Activities during ITER project phases that affect the quality of items and services shall be controlled by the development and use of MQP documents.
Critical Quality Activities may be addressed in MQP documents, as referenced in section 3.1.

Given the inherently complex and evolving nature of ITER Project for nuclear fusion science, the MQP reflects and supports multi-national collaboration, multi-parti structure, and multi-disciplinary integration.

The ultimate PEE responsible for the quality compliance of the ITER Facility is the IO, whereas the other PEEs are responsible for the quality compliance of items & activities. To ensure full implementation and delivery of their contributions to the ITER Project, the PEEs shall:

- Establish internal project management and QA systems meeting the ITER project quality and management requirements described in this QAP; and
- Ensure that each of its contractors performs in full compliance with quality requirements defined by the IO.

When the IO acts as manufacturer of Pressure Equipment or Nuclear Pressure Equipment (PE/NPE), the IO is considered “Performer” as per the Implementation plan for design & manufacture of PE/NPE [9].

1.3.1 Authorities for Maintaining the MQP

The Director General (DG) shall bear the ultimate responsibility for the quality of the ITER Project. The DG may delegate his authority on matters pertaining to quality.

The Quality Management Division (QMD), under the authority of the Director General, shall be responsible for developing and maintaining this QAP and for monitoring its implementation and effectiveness.

The IO QMD shall provide support to other PEEs in their efforts to provide sufficient level of Quality Management, QA, Quality Supervision (QS) and Quality Control (QC) activities.

This shall include but is not limited to monitoring of MQP performance and coordination of QA activities.

The Head of IO QMD shall have:

- sufficient authority and organizational freedom from cost/schedule pressures, and shall alert the responsible organization of any nonconforming conditions or risks regarding design, manufacturing, delivery, installation, testing and commissioning, maintenance, preservation and operations activities.
- direct access in all quality-related challenges, risks, opportunities, events and issues to the ITER Project Senior Management, including the DG and DDGs, and the Heads of other organizational units. This access ensures the capacity of the IO Quality team to identify quality problems, initiate actions, make recommendations, and verify implementation of solutions.

1.3.2 Domestic Agency (DA)

The DG specifies work activities performed outside the IO by procurement arrangement or contract documents. Applicable quality requirements shall be passed on to subcontractors, but the responsibility for meeting the necessary quality requirements remains with the contracted organization.

This term refers to an organization appropriately formed and appointed within and by each PEE to supply in-kind goods and services to the IO, on the basis of defined specifications.

To realize the Quality Objectives, the following shall be put into place:

- Each DA will have a well-defined management and quality program that will be reviewed and accepted by the IO.
- Each DA will take due consideration of the IO technical opinion
- Each DA will allow and facilitate, if requested, IO presence on the premises of any subcontractor.
- Each DA will perform, jointly with the IO, both internal and external QA audits to assess the QMS ensuring the propagation of the IO requirements.
- Each DA will perform, jointly with the IO, Quality Supervision onto its suppliers or contractors checking the quality of the products, i.e. compliance to the IO requirements in proactive way.

1.3.3 IO-DA Quality Leadership Team (QLT)

The IO-DA QLT [8] ensures

- MQP governance implementation, documentation change management, continuous improvements and collaboration between all Project Execution Entities in QLT scope;
- That the IO and DA quality management and internal control practices are in line with the ITER Policy on Safety, Security, Quality and Environment Protection [3] and the jointly defined annual objectives; and

- That the activities, analyses, and decisions within the QLT scope are properly communicated, tracked and monitored until completion and closure, and openly shared and propagated.

1.3.4 MQP Process Owner

Each MQP process is under the responsibility of a Process Owner designated by the DG, and the Process Owners shall ensure that the requirements defined in the MQP documents are deployed, implemented, maintained and improved in real-life workflows.

1.3.5 MQP documents' control and review

As stated in the Project Specification [1], the MQP documents as controlled documents shall:

- Provide for a disciplined and systematic approach to organize activities affecting quality and for production of objective evidence to demonstrate that the required quality has been achieved.
- Detail requirements, assign responsibilities and authorities and facilitate the performance and assessment of work.

All MQP documents are subject to continuous improvement as follows:

- Changes to MQP documents shall be formally reviewed.
- MQP changes shall be properly communicated to the impacted users.
- MQP structure and documents shall be reviewed every 3 years to assess the applicability and need for update.
- The impact of internal/external changes on MQP shall be assessed during the Management Review [13]

1.4 Quality Culture

The Quality Culture within the IO and DAs starts from the top management and is cascaded to each individual staff and finally reflected in daily behaviour, attitude and awareness with regards to quality.

ITER quality culture is achieved by taking responsibility on quality by all PEEs in a proactive and transparent manner to achieve quality objectives.

As per the ITER Policy on Safety, Security, Quality and Environment Protection [3], IO and PEEs shall consider nuclear safety, occupational health and safety, quality and environment as their first priorities. This policy shall be effectively communicated, well understood, and consistently implemented at all levels of the PEE.

1.4.1 Quality Objectives

The overall quality objectives are to ensure:

- Attainment of the level of quality necessary to accomplish the project objectives commensurate with the project's responsibility for protection of the public health and safety, protection of the environment, and reliable facility operation
- That Structures, Systems, and Components (SSCs) designed, procured, fabricated, installed, constructed, and tested for the project shall conform to established and documented requirement.

1.4.2 Performance Monitoring

To monitor the achievement of ITER quality objectives, the IO shall identify, track, and report indicators of project performance. For the performance monitoring at other PEEs than the IO, it may reach for assistance through the IO-DA Quality Leadership Team (QLT) [8]. Quality indicators shall be tracked on an ongoing basis and reported to responsible management at the concerned PEE(s).

For the purpose of achievement of ITER quality objectives, the performance indicators should include but are not be limited to:

- Assessment, audit, inspection and surveillance findings;
- Non-Conformance Report management status;
- Quantitative/ qualitative metrics of MQP processes performance; and
- Verification of corrective actions taken and effectiveness review.

1.4.3 Continuous Quality Improvement

ITER is convinced that those closest to the working level of an activity are the most knowledgeable of the activity and its problems or shortfalls. The IO management strongly encourages all personnel to offer their recommendations for improvements of its processes and programs. These recommendations should be considered at the lowest appropriate organizational level in order to expedite improvement implementation.

ITER recognizes that there will be problems during the course of the project. Project personnel are required and encouraged to report problems to appropriate management for correction. Identifying problems is the necessary first step in getting them fixed and preventing their recurrence. This forms the basis for a continuous improvement culture. Root Cause Analysis and Corrective Action should be utilized to correct current issues and prevent reoccurrence.

Lessons learned from both failures or successes during events, incidents, CFSI detection or implementation and evaluation of systems, processes or programs should be used to identify strengths and weaknesses, and therefore to improve the MQP.

1.4.4 Quality Support Service

The PEEs are supported by quality services, for example Non-Destructive Test, Quality Inspection, Laboratory Testing & Calibration, Quality Audit, Quality Training, or NCR support.

Quality support services are implemented in a controlled manner to ensure all PEEs are aware of the quality culture and to encourage a questioning attitude.

1.5 Graded approach to the application of quality requirements

The IO applies graded approach to ensure that application of the requirements related to MQP, documentation, monitoring and measurement is commensurate with ITER Project stakes and complies with relevant regulatory and organizational standards.

1.5.1 Identification of PIC/PIA and determination of defined requirements

In application of INB Order [6], the “Protection Important Components” (PIC) and “Protection Important Activity” (PIA) are identified and classified. These PICs and PIAs including their defined requirements are linked to the main safety functions in ITER, and they are managed in MQP Nuclear Safety Process according to [4].

1.5.2 Quality Classification

For applying a graded approach, a quality classification is introduced to provide a basis for the management of structures, systems and components (SSC), spare parts and activities necessary for ITER operation or for supporting ITER operation.

A Quality Classification scheme shall be used to identify items requiring less stringent quality requirements with consequential cost saving, and to establish a basis on which a stepwise hierarchy of quality requirements can be developed.

All items important to the safety and performance of the ITER Facility shall be assigned Safety and Quality classifications. Requirements shall be defined for those classifications.

2 Project Realization Process

2.1 Configuration Management

Configuration Management (CM) is the process that shall ensure:

- The characteristics of the SSCs comprising the ITER plant are identified and documented and changes and/or deviations to these characteristics are properly developed, assessed, approved, issued, implemented, verified, validated, recorded and incorporated into the project documentation.
- The activities, and their associated cost and schedule data, to achieve the objectives of the project are identified, documented and changes or deviation to these are properly developed, assessed, approved, issued, implemented, verified, validated, recorded and incorporated into the project documentation.
- The management and technical processes required to support these activities are identified, documented and changes or deviation to these are properly developed, assessed, approved, issued, implemented, verified, validated, recorded and incorporated into the project documentation.
- Consistency is maintained between the parameters, the requirements, the physical and functional configuration of ITER and its documentation, particularly as changes and/or deviations are made throughout the ITER life-cycle. CM extends beyond the design, ultimately controlling all documentation referred to in construction, and operation.

CM shall be applied to the parameters, systems, components, instructions and procedures whose failure to satisfy requirements could lead to inconsistencies of design, violations of safety requirements, non-compliance with regulations, significant loss of operational capability, or significant changes in cost or schedule.
At ITER, following CM approach is used for CM implementation:

- Identified needs for change to the established configuration baselines are managed through the Project Change Request (PCR) procedure,
- Specific demands to depart from a particular requirement of an item’s current approved configuration during procurement and manufacturing phase are managed by the Deviation Request (DR) procedure,
- Changes to be implemented during the construction/ installation activities are managed through Field Change Request (FCR) procedure,

- Non-compliance with requirements from the approved configuration at the end of the manufacturing or installation activities are treated as non-conformities and managed through the NCR procedure.

2.1.1 Identification and Control of Items

Identification shall be maintained on the items or in documents traceable to items, or in a manner that assures that identification is established and maintained. The suitable means shall be determined according to the type of item and its conditions: for instance, complexity of the product, unitary or serial products, risk of mixing of material grades, etc.

The traceability system should be proportionate to the risk of mixing items during their life cycle. It shall be maintained by procedural methods that cover receipt, identification, storage, and transfer to production, temporary storage and use in production, availability of correct inspection documents at the final inspection.

Control shall be established to assure that only correct and accepted items are used or installed.

Items of production (batch, lot, component, part) shall be identified from the initial receipt and fabrication of items up to and including installation and use in ITER activities. This identification shall relate an item to an applicable design and other pertinent specifying documents. Physical identification shall be used to the maximum extent possible. Where physical identification in the item is either impractical or insufficient physical separation, procedural control or other appropriate means shall be deployed.

Identification markings shall be applied using material and methods that provide a clear and legible identification and do not degrade the function or service life of the item. Markings shall be transferred to each part of an identified item when subdivided and shall not be obliterated or hidden by surface treatment or coating unless other means of identification are substituted.

When applicable codes, standards, or specifications include specific identification or traceability requirements, this shall be identified and controlled.

Items having limited calendar or operating life or cycles shall be identified and controlled to preclude use of items whose shelf-life or operating life has expired.

Provisions shall be made for the control of item identification consistent with the planned duration and conditions of storage such as:

- provisions for maintenance or replacement of markings and identification records due to damage during handling or aging,
- protection of identifications on items subject to excessive deterioration due to environment exposure,
- provisions for updating existing plant records.

2.2 Documents and Records

2.2.1 Control of Documents

The IO Document Control process shall be established to control the preparation, review, approval, issuance, distribution, revision and validation of documents, which prescribe all activities affecting quality, essential to the management, performance and assessment of work in the IO. An electronic document management system shall be used to aid in document control and management.

A system for control of documents and data to assure appropriate review and approval for use shall also be established and implemented by all organizations performing ITER-related activities, using clearly established protocols for which documents shall be reviewed, by whom, and in what time period. These systems shall include procedures to be used to implement quality program requirements, thus to ensuring that all activities affecting quality are planned, controlled, and documented. The document control systems shall assure only correct and current information is available for the performance of ITER activities.

Types of documents subject to controls include, but are not limited to:

- Procurement and contract documents, including document deliverables
- Management plans
- Quality regulation and plans
- Technical documents (i.e., design drawings, safety documentation, technical specifications, etc.)
- Licensing Documents
- MQP Process, Plan, Procedure, Working Instruction, etc.

Documents prepared, used, and maintained for each work activity shall be controlled from preparation through to distribution. The control shall assure that documents, including changes, are reviewed for adequacy and approved for release by authorized personnel and are distributed to and used at the location where the prescribed activity is performed. The control also includes change notice and revision controls for documents to ensure the timely issuance of the revisions of the controlled documents. Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval unless the applicant designates another responsible organization.

The control process shall ensure that documents are approved according to a prescribed method before they are issued for use. Applicability of the documents for use shall be clearly defined. The responsibilities for approval shall be clearly defined by senior management. An effective electronic document management system shall be built on and it shall utilize the necessary controls applied for this process. The system shall support clear identification and version control. Documents stored in the system shall be protected by online security and made available through controlled access. In case wide public distribution is requested, documents shall be cleared through a defined publication process.

2.2.2 Records

Records provide objective evidence of activities performed or results achieved. Those activities that result in data, technical reports, drawings, specifications, and analyses for use by the IO shall provide a traceable trail to be preserved to resist deterioration for the necessary retention times.

Original items, or documents, should be provided where possible, but a high-quality reproducible (digitalized) copy is acceptable.

Records shall be accessible at all times during the specified retention periods. Retention times of records and associated test materials and specimens shall be established to be consistent with the statutory requirements and knowledge management of obligations of ITER. Access to locations where records are retained should be controlled. Responsibilities for maintaining and operating the records process and the facilities for the storage of records should be clearly defined and documented.

The responsibility to identify, collect, classify, index, file, and maintain records of work performed for the IO shall be specified in contract documents and scopes of work. The indexing system and the filing system should provide proper identification and ability to retrieve requested records. Records shall be filed in a storage system that provides a suitable environment to minimize deterioration or damage and prevent loss.

Special processed records such as radiographic film, electronic media (such as magnetic media, optical media), archival samples, and photographs shall be handled and stored to preclude damage. At a minimum, manufacturer information for proper handling and storage should be used in preparing proper controls for these types of records. When transmitted to IO for final storage, records in special formats should be converted into high-quality digitalized documents to allow long-term storage, retrieval and accessibility.

2.2.3 Sign-Off Authority

The direction for ensuring proper level of review and approval for the key types of documents generated or received by PEEs for use in the ITER Project shall be specified by considering the significance of the project document and the impact on other project activities.

2.3 Design

Design control shall apply through the lifetime of the technical items, SSCs. The control of design activity shall ensure that specified design requirements are met in the design solution and on the end-product in accordance with the design input. The control of design activity including verification activities shall be done using plans and documented processes which shall ensure a level of control commensurate to the risk, safety role and complexity of the end-product to be developed.

Design control records shall include not only final design documents, such as drawings and specifications, and revisions to those documents, but also documentation that identifies the important steps in the design process, including sources of design inputs that support the final design, calculations, design development computer models, and computer software used in design.

2.3.1 Design Planning

Design plans shall be prepared for each design work package and for each design stage. The design plans shall be the basis for the execution and control of the design development activities. The plans shall describe objectives, scope, design inputs, tasks to be performed, processes to be used, outputs to be delivered, verification and validation methodology, risks, organization, roles and responsibilities, key milestones, design interfaces necessary to accomplish the design

activity, ensuring that the final design meets the specified requirements. The design plans shall be properly updated as the design evolves.

The design activities shall be assigned to qualified personnel with adequate resources as per 4.2.

2.3.2 Design Input Control

Design inputs shall be identified, assessed for adequacy to design development, documented, and controlled. The design inputs shall be defined prior to the design development. Any changes in the design inputs shall be identified, assessed and accordingly controlled.
The design input shall consider

- functional and performance requirements
- applicable statutory and regulatory requirements (incl. safety)
- industry codes and standards
- technical requirements including interfaces
- potential consequences of failure due to the nature of design
- information derived from previous similar designs (where applicable)

In particular, the design requirements shall be complete, unambiguous and not in conflict with each other. The organization shall retain documented information on design and development inputs.

2.3.3 Design Development

The purpose of the design development activities to define the activities to be done starting from given design inputs (and any derived technical constrains identified during the design development process) up to design output generated documents that satisfy the applicable requirements.
Design development shall be carried out in accordance with approved design plan and applicable procedures. The design output which can be technical specification for SSC products and their operation, drawings, results of analysis shall be documented and recorded.
At each development stage, the design output shall be traceable to the design input with documentation in sufficient detail to permit design verification.

Design output shall contain or make reference to monitoring and measuring requirements, as appropriate, and acceptance criteria for completion of the actual design work at the end of each design phase. Design development procedures shall ensure that the design outputs meet the design requirements including any necessary actions taken to solve the problems determined during the reviews, or verification and validation activities.

2.3.4 Design Interface Control

Design interfaces shall be identified, established documented, and placed under configuration control including coordination among the participating design organizations. Interface controls shall include assignment of responsibility and establishment of procedures among participating design organizations for review, approval, release, distribution, and revision of documents involving design interfaces. Design information transmitted across interfaces shall identify the status and applicability of the design information or design document provided, and identify incomplete items that require further evaluation, review, or approval. All interface requirements shall be associated with their verification requirements.

2.3.5 Design Verification and Validation

Design verification shall be performed in accordance with planned arrangements to ensure the design outputs have met the design inputs. Design verification method(s) shall be determined for each input requirement and planned for each appropriate stages of the design and construction of the SSC. The results of design verification shall be documented with the identification of the verifier clearly indicated.

Design verification shall be performed by competent person(s) or group(s) different from those having performed the design.

Acceptable verification methods should include, but are not limited to, any one or a combination of the following:

- design reviews (analysis of documents),
- alternate calculations,
- qualification testing,
- benchmarking against a similar successful design.

Design verification shall be performed before release for procurement (unless done as part of a procurement action), manufacturing, construction, or unconditional release to other organizations for use in associated designs. Any unverified design information shall be identified and controlled during design verification process. However, in all cases, the design verification shall be completed before the design is relied upon to perform its function.

Where tests are necessary such as qualification or final product testing for verification and/or validation of the design, these test shall be performed in accordance with planned arrangements to ensure that the resulting product is capable of meeting the requirements for the specified application or intended use, where known. Validation shall follow successful verification and shall be completed prior to the delivery or implementation/operation of the product. Records of the validation results and any necessary actions shall be maintained.

2.3.6 Analysis and Calculation

Analysis models are used to develop/optimise a design and/or to verify and/or validate the design and/or requirements. The process and its procedures for analysis model development are strongly linked with those for design development, and design verification and validation.

The analysis model including the boundary conditions and applied loads shall be consistent with the design. The analysis model shall be formally reviewed and validated, as the software for which the model is generated. Consistency of the analysis model with the as-built structure shall be demonstrated when construction and assembly is completed. If the as-built structure is somehow different from the design model, a reconciliation of the analysis model as its results with the as-built structure should be performed.

In some cases the complete analysis model validation by experimental testing or other means may not be possible until the final hardware product is created and operated. When this is the situation, operational testing plans should provide the necessary data points to achieve full validation. Interim benchmarks can and shall be established that provide reasonable interim confidence in the model's validity as part of the formal process planned to fully validate the model.

Where the interim benchmarks or testing cannot be met, such lack of control shall be clearly stated in the technical basis documents of the affected systems. As for the software validation, the experimental program of ITER shall then take into account this issue with the aim of model validation.

2.3.7 Design Change Control

Changes to designs and design outputs shall be identified, documented, and controlled. The changes shall be reviewed and approved before implementation. The review of design changes shall include evaluation of the effect of the changes on other designs and/or constituent products already delivered.
Design Change Control should also focus on planning of required change actions and verification method of the design modification and design integrity.

The changes shall be approved by the same affected groups or organizations that have reviewed and approved the original design. When a design change is approved, the contents of the design change shall be incorporated in all affected documents.

2.4 Software Control

Any software used for R&D, design, manufacturing, installation, construction, commissioning, and operation of ITER facility shall be appropriately qualified prior to approval for use to provide adequate confidence that a software item or product conforms to established technical requirements.

The qualification shall be done to demonstrate that the software adequately and correctly performs all intended functions and user needs.

The procedures and work processes used to establish and maintain control of software shall formulate a software management methodology, including authorization control, for software acquisition, and development, the deployment and configuration management of the software used, and change, maintenance, and disposition.

2.5 CAD Process

CAD models & drawings representing the components & systems used in the ITER Project shall be unambiguously identified, controlled and verified for validity prior to their publication and use for downstream activities.

The CAD models and drawings development shall be managed based on a CAD work-plan and be implemented based on:

- trained & certified users per 4.2.
- validated CAD infrastructure meeting project requirements (such as complex geometrical interfacing systems requiring common design data management, tools and methods)
- pre-defined project standards & processes
- CAD manual requirements.

The developed CAD data shall be verified to comply with the project standards & processes and CAD manual requirements. Only after the verification, the CAD data can be used for CAD exchange process and/or other downstream processes like publications.

2.6 Manufacturing, Assembly and Installation Process

Manufacturing, Assembly and Installation shall be controlled to the extent necessary to ensure items conform to ITER procurement requirements and supervisory authority.

All activities shall be controlled to the extent necessary to ensure that the installation of each item shall not compromise the integrity and the safety:

- of the item to be installed,
- of the assembly where item is installed and of the ITER facility.

2.6.1 Planning

Approved planning shall be established and shall define:

- the operations to be performed
- the identification of competent and qualified personnel to perform the task
- the systematic sequential progression of operations
- The work procedures or instructions required to comply with the requirements of the defined work scope.

Planning shall include a review to ensure that:

- all activities have been incorporated
- The work can be accomplished as specified
- the time and resources are sufficient to accomplish the work in accordance with the specified requirements.

2.6.2 Execution

Work shall be carried out under controlled conditions:

- using approved drawings, procedures, standards and other documents
- according to approved pre-established checklists of operations
- assigning competent and qualified personnel as appropriate
- using controlled and calibrated measurement and test equipment
- Ensuring that engineering and design changes during operations are documented and controlled.

Prior to implementation, work documents shall be reviewed for compliance with ITER requirements, approved “for manufacture”, and controlled.

Processes that cannot be adequately inspected after completion shall be carried out according to approved procedures implemented by qualified personnel using calibrated equipment, where applicable.

Where examination during final inspection is no longer possible particular attention shall be put on definition of examinations and tests before and during manufacturing, assembly and installation.

Documents and records shall be maintained to reflect the progress status of item’s configuration, and approved “as built” on item completion.

Arrangements to verify the completion of manufacturing, assembly and installation activities shall be defined and implemented.

A Factory Acceptance Test (FAT) shall be carried out at a facility/factory of PEE as per contractual requirements prior to the shipping to verify that the SSC is compliant with technical requirements.

This verification shall be formally documented and shall confirm that SSCs have been manufactured, assembled and installed to the specified requirements as applicable.

2.6.3 Handover

Provisions shall be made to control and coordinate the handover of completed works from one party to another and from the manufacturing, assembly and installation to the commissioning and operations phases.

These provisions shall ensure maintaining of the integrity of the completed works and shall include:

- review for completeness and accuracy of documentation relating to transferred items including contractor release notes
- identification of the boundaries of transferred systems and equipment
- proper planning and implementation of record transfer.

2.7 Handling, Storage and Transportation

2.7.1 Handling and Transportation of ITER Items

Special requirements for the handling and transportation of items to prevent damage or deterioration shall be contained in specifications, drawings, or supplier documents that become part of the documentation package for them.

Handling and transportation processes should allow for different methods to provide appropriate care in handling and transportation in accordance with the manufacturer's recommendations. Handling and transportation provisions shall consider types of containers, preservation, and other environmental or safety considerations applicable to the items. Where multiple PEEs are involved, procedures shall describe interface and any chain-of-custody requirements.

2.7.2 Storage of Items

Preservation of equipment and materials during transport, storage, and construction activities shall be managed to ensure SSCs retain their condition and performance before entering operations, including prevention of deterioration over time and protection from external damage.

It shall indicate necessary storage environment, any special protective measures during storage and specific shelf-life if applicable. The requirements and recommendations for preservation, primarily specified by the suppliers, shall then be followed by any PEE who receives the items.

2.8 Commissioning

ITER commissioning is to validate that the system meets its design and safety requirements, and to bring the system to an operating mode.

For system commissioning, ITER plant system requirements shall be decomposed into functions, and plant system functions shall be tested from the component level up to system and integrated testing.

This Site Acceptance Test (SAT) should be conducted when IO decides to formally accept the component or system upon delivery during construction or as part of system commissioning.

At the end of the construction period, an Integrated Commissioning of ITER systems shall be performed to demonstrate that the integrated operation of the Tokamak and to ensure readiness for safe plasma operation.

Following the commissioning of a particular system, it may enter into a temporary operation to deliver a service but not ready for operation.

2.9 Operation and Maintenance

2.9.1 Operation

ITER facility shall be operated in accordance with the operational program and the operating states of the Tokamak Machine in compliance with regulations applicable to ITER as a Basic Nuclear Installation (INB).

The operation of ITER facility shall enable access to a wide variety of operational domains and scenarios, including operating in proximity to operational limits and conditions.

All events and return of experience during operations shall be captured and analyzed in order to continuously improve the operation processes.

During operations, systems and/or operating procedures could be modified as a result of operational experience, site conditions, optimization of performance or maintenance

2.9.2 Maintenance

Maintenance activities shall be undertaken at specific intervals by qualified resources to ensure critical SSCs will perform their expected functions that are required to preserve or restore the safety, reliability, and availability of ITER facility.

The type and frequency of maintenance activity applied to each SSC is commensurate with the SSC’s classifications, design function and required performance according to safety analysis, regulatory requirements, performance analysis, and codes and standards.

In addition, foreign material shall be managed over the full life-cycle for ITER SSCs to prevent or mitigate the potential deleterious effects of foreign material on systems to perform their intended functions.

The maintenance, supervision, surveillance and in-service inspections tasks shall be implemented via detailed procedures.

3 Quality Processes

3.1 Inspection and Testing

PEEs responsible for Critical Quality Activity (CQA) shall execute Inspections and Testing as per the requirements in contract documents and in compliance with applicable codes, regulations and standards.
And, IO, DAs or their authorized representative shall monitor and control the execution of Inspection and Testing activities in terms of Quality Supervision (QS) focusing on critical items and important operations by using a graded approach as per 1.5.

For execution of Inspection and Testing, intervention points shall be identified on an approved Inspection Plan (e.g. Manufacturing Inspection Plan (MIP) and/or Inspection and Test Plan (ITP for assembly, installation, or commissioning) and ensure relevant planning and allocation of appropriate resource.

Inspection Plan shall be developed before the beginning of the operations based on their design requirements (including instructions, procedures and drawings) and address:

- Requirements and instructions applicable to particular operations,
- Operations to be inspected or witnessed by DA, IO, and (Agreed) Notify Body, etc.
- Reference documents providing traceability and recording of the verification and completion of these operations

Inspection and Test shall be performed by competent individuals other than those who performed the activity being inspected or tested, and Quality Supervision shall be performed by SQEP from IO, DA or their representative. IO Quality Supervisor shall be qualified, and their competences shall be maintained according to 4.2.
Each Inspection and Test shall not be bypassed and that equipment, material, or fabricated assemblies shall not be released for further work activities until all inspections and tests are complete and the results accepted.
When non-conformance is detected during Inspection and Test activities, non-conformance report (NCR) shall be issued according to the 3.3.

After Inspection and Test, the results shall be documented and evaluated to assure that applicable requirements have been satisfied. The Inspection and Test records shall be maintained as per 2.2:

Where IO acts as manufacturer of Pressure Equipment or Nuclear pressure Equipment, the Quality Supervision should be managed as per [9].

3.2 Calibration of Measurement and Test Equipment (M&TE)

M&TE shall be uniquely identified, properly controlled, calibrated, and adjusted at specified periods to maintain accuracy within necessary limits.

M&TE shall be calibrated before put into service according to an established calibration plan at appropriate determined intervals by competent personnel.
The calibration of M&TE shall typically be traceable to certified equipment or a national or internationally recognized measurement standard. Where no such standard exists, the basis for calibration shall be justified and the results shall be documented.

M&TE shall be safeguarded from adjustment, damage and deterioration that would invalidate the calibration status and subsequent measurements results. And, M&TE shall be suitably marked, tagged, or labelled to indicate their identification number from which it shall be possible to check its calibration status on records.

When M&TE is damaged, overdue for calibration or found to be out of calibration, it shall immediately be removed from service by segregation, prominent labelling or marking.
The validity of previous measurement shall be evaluated and, when necessary, appropriate corrective action shall be taken.

Calibrations records including necessary information should be available through M&TE calibration certificate.

3.3 Non-conformance Management

Any item, process or work that does not fulfil its specified requirements shall be identified and segregated as being nonconforming. Each nonconforming item or work shall be prominently identified, tagged, or uniquely labelled and, when practical, segregated to prevent its mis use.

The non-conformance report (NCR) shall be issued by the appropriate PEEs specifying the requirement and evaluated by IO Responsible Officers, then resolved by the PEEs as defined in contract documents and applicable scopes of work.

NCR shall be immediately raised in IO NCR database to record the NC and relevant treatment for their resolution, including evidence of remedial or corrective actions taken.
A graded approach is applied which classifies the non-conformance as major or minor in consideration of 1.5.

Following the review and approval of proposed actions to the non-conformance, the item or work shall be placed back in service, repaired, reworked, or rejected. If an item is repaired or reworked to return it to a satisfactory condition, it shall be re-inspected to confirm its fitness for use.
A technical justification shall be documented for the acceptability of a nonconforming item determined as use-as-is or repair.

3.4 Quality Assurance

3.4.1 Self-Assessment

The Responsible Officers should conduct appropriate and timely assessment of assigned tasks. The readiness of an activity or one phase of an activity, to proceed to the next phase or to the next follow-on activity needs to be assessed and agreed upon prior to proceeding. These self-assessment will be of varying degrees of formality, as appropriate to the activity being evaluated.

3.4.2 Management Review

The IO Senior Management shall regularly assess the adequacy and effective implementation of the MQP to ensure its continuing suitability, adequacy, effectiveness and alignment with the strategic direction of the organization [13].

Management Review input includes impact of known changes to the internal/external requirements (regulation, safety, environmental aspects), information on audit results, MQP process performances, non-conformities including the corrective actions status, and lessons learned for improvement.

Management Review output includes improvement activities, any need for updating of project objectives or MQP processes, and resource needs.

The results of Management Review shall be documented and maintained.

3.4.3 Quality Audit

The Quality Audit is a systematic, independent and documented process for obtaining objective evidence and evaluating it objectively the adequacy and effectiveness of the QMS and the application of requirements, in order to identify risks and improvement opportunities.

These audits shall be performed in accordance with audit criteria, including regulations, standards, policies, procedures or requirements, by qualified auditors who are independent from the activities being audited.

Together with the DAs, the IO's Quality Management unit establishes an annual audit program for the DG approval.
Individual Quality Audits shall be scheduled in a manner to provide coverage and coordination with ongoing activities, based on the status and importance of the activity. The scheduled audits may be supplemented by additional unplanned quality audits of specific subjects when necessary.

Quality Auditors shall be qualified and their competences shall be maintained according to 4.2. The audit team shall be identified prior to the beginning of each quality audit. Quality Auditor could participate in an audit as Lead Auditor, auditor and/or technical expert.
Quality Auditors shall be granted sufficient authority and organizational freedom to have a value-added and effective audit, and they perform a quality audit by interviewing the auditee using specific checklist if necessary.

The Quality Audit result shall be documented in a defined quality audit report format and agreed with auditee before officially issued. Quality Audit findings shall be recorded in a database for tracking purpose. Quality Audit findings shall be closed when actions are implemented and necessary evidence is provided to the quality auditors. The verification of quality audit actions normally should happen during the subsequent quality audit.
Quality Audit results shall be reported to the concerned management layers.

3.4.4 Prevention of Counterfeit, Fraudulent and Suspect Items (CFSI)

IO's oversight of PEEs' QMS will support effort to reduce the risk of CFSI entering the ITER site. The procurement document as per 4.3 shall have a CFSI clause as a general terms and conditions, and it shall state that the items or services provided by the supplier shall not include CFSI.

When CFSI is detected by PEEs, IO shall take appropriate actions, such as, but not limited to:

- Communicates immediately with the French regulatory body and Agreed Notified Body (ANB) where applicable
- Items to be quarantined until retuned to supplier
- Identification of CFSI supplier from the IO procurement database
- Take legal actions if necessary

IO shall ensure through oversight and quality audit activities, that potential CFSI's are assessed and if necessary investigated and that necessary measures and controls are in place to cover activities for the identification and control of potential CFSI from the suppliers.

4 Management Process

4.1 Project Control

4.1.1 Project Planning and Control

The ITER project planning and control involves a comprehensive framework for developing and managing the schedule of work including the risks that influence achievement of the project schedule, milestones, or project cost.

4.1.2 Risks and opportunities

In ITER Project, the risks and opportunities which potentially could impact the project's technical performance, cost and schedule are identified, assessed and mitigated.

The risk and opportunity management process is central to the effective management and successful on time and cost delivery of ITER and will be used to inform project decision making at all levels throughout the lifecycle of the ITER project.

4.2 Human Resource Management

4.2.1 Competence Requirements

Line managers should ensure that the work is performed by competent people. Line Managers should ensure that their staff is appointed on the basis of an assessment of his/her suitability for the position. This suitability shall consider ability to apply skills, knowledge, processes and attitudes to perform the job to specified standards in an effective and efficient manner. This necessary competence may be developed through education, experience and formal training.

Documented procedures for selecting, evaluating, and training the personnel whose work affects the performance and effectiveness of MQP processes shall be available.

Staff education, training, experience, competence and qualification requirements should be consistent with the complexity of their functions that might be assigned to the personnel.

Documented information as evidence of competence shall be retained and where applicable, actions shall be taken to acquire the necessary competence and evaluate the effectiveness of the actions taken (like training, hiring or contracting of competent persons).

4.2.2 Training Requirements

Personnel shall be trained, as appropriate, on their organization's specific missions, plans, and procedures for performing assigned tasks, and a process for ensuring effectiveness of training and maintenance of competence should be defined.
Documentation of personnel training shall be established and include such items as attendance sheets, training outlines, and read-and-acknowledgment sheets, as appropriate, for the training given.

Training needs and their fulfilment shall be assessed in order to evaluate the grading process for implementation of training of the staff. Training for a significant activity may require application of a systematic approach to training, including needs analysis, training design, training development, training delivery and evaluation. Training for an activity of lower significance may

not require full application of the systematic approach to training or a specific qualification for performance.

4.2.3 Qualification and Certification

The IO shall control qualification of people performing Critical Quality Activity (CQA) including special process. Performance of a significant activity may require specific qualification and certification such as welding, non-destructive examination, nuclear safety and quality supervision.
Whereas special processes are performed by other organization assigned for the work activity, these organizations shall establish and maintain appropriate procedures and the documentation of personnel qualifications as applicable and in accordance with specifications supplied by the IO.

4.2.4 Matrixed Engineering Services Management

The IO utilizes a matrixed engineering resource model to optimize expertise and flexibility across the project needs. Engineering resources are assigned to the various projects based on technical requirements, availability, and project priorities, while maintaining their competencies in alignment within the respective functional organizations.
Resource allocation and competency development are coordinated through regular reviews between project managers and functional managers, ensuring that quality objectives and project milestones are consistently met.

4.3 Procurement

Items or services to be contracted by the ITER Project shall be specified in procurement documents either as an In-Cash procurement through a Contract or Purchase Order (PO) or a Task Agreement with a DA or as a Procurement Arrangement (PA) under In-Kind procurement.

Components technical requirements may involve conformance assessments or product compliance requirements such as arising from the INB Order [6], the European Pressure Equipment Directive (PED) or Nuclear Pressure Equipment Order (ESPN) [9].
Where these requirements are applicable, those regulatory requirements for pressure, nuclear safety and conformity assessment shall be defined in the procurement document. Such documents shall be reviewed, approved and controlled.

The Contracts shall be placed according to selection and award criteria derived from the technical requirements. Contractors' Quality Plan shall be evaluated and approved by the IO or the DAs for the procurement activity for which they will be used.

Items or services relevant documentation shall be reviewed and formally accepted by the IO prior to delivery.

4.3.1 Identification of the need to be procured

The need for an item or service is usually identified from a Work Package. A Technical Specification shall be issued describing in detail all the requirements.

4.3.2 Establishment of Technical and Quality Requirements

Technical and quality requirements shall be prepared in the form of technical or equipment specifications. The procurement process covers the technical and quality review of the

procurement documentation to ensure that appropriate technical and quality requirements, as well as acceptance criteria, are adequately and clearly stated.

Procured items or services shall be in accordance with the governing statements of work and any additional requirements. These documents shall specify the scope to be performed, the required documentation, the qualifications of those performing the work, and the required schedule of performance. These documents shall also include all appropriate technical and quality requirements. The reviews and approvals of these procurements shall be in accordance with the approval process.

4.3.3 Selection and Award of Contractors

The evaluation of the potential Contractors shall include the assessment of their quality capabilities (programmatic and quality of items provided). Qualified suppliers shall have demonstrated relevant financial, technical, and quality capacity to supply items or services at the quality level required, substantiated by appropriate documentation.

DAs are responsible for the work performed either by them or Contractors in the frame of Procurement Arrangements and Task Agreements signed with the IO.

4.3.4 Monitoring of Contractors Performance

The extent of contractor monitoring will be a function of the criticality of the item being supplied and the performance history of the contractor for similar items or services. Contract performance monitoring should be performed through in-process inspections of item or documents review, as stated in appropriate Inspection Plan that could be performed at the Contractor's facility and/or upon delivery of the completed item or service. Sub-Contractors of critical items should also be monitored to ensure that items and services conform to requirements.

4.3.5 Item Deviation from requirements

Contractors may request to deviate from the technical specifications or quality requirements contained in the contract. The Contractor concerned shall describe in details the proposed deviation identifying the changes, additions, or deletions to the technical requirements. Any deviation request (DR) shall justify the adequacy of the proposed deviation and the potential impact on the technical requirements, as well as how the overall technical requirements will still be satisfied, state the extent to which the original document remains in effect; identify the number of items that will be affected by the proposed deviation; and provide a schedule of actions necessary to complete the proposed changes. Deviation requests shall be reviewed and approved.

Contractors may discover that the product does not meet the specified requirements. In such cases, a nonconformance report shall be submitted to the IO identifying the nature and extent of the nonconformance and requesting necessary action.

4.3.6 Item or Service Acceptance

Items or service acceptance shall occur after evidence that acceptance criteria have been met. Acceptance is predicated on the receipt of contract items or deliverables and inspection reports as well as evaluations, contractor oversight reports (e.g., audit, surveillance, and inspection), and contractor performance documentation.

Regarding services, contractors shall be required to provide deliverables in the form of reports, studies, progress reports, etc. These shall be reviewed and accepted by Responsible Officers.

The procured items shall not be released for unconditional use until all procurement requirements have been satisfied, including the resolution of nonconformances.

4.3.7 Use of Commercial-Off The-Shelf (items)

Any PEE procures and utilizes COTS for PIC/PIA shall be responsible for the conformity of all externally provided processes, products, and appropriate procedures shall provide reasonable assurance that a COTS item will perform its intended function during its lifetime.
The assurance is achieved by identifying their critical characteristics and verifying their acceptability by appropriate control methods.

Appendix A Acronyms and Definitions

Term	Acronym	Definition
Activity	-	task which contributes to the realization of the products or services
Commercial-off the-shelf (items)	COTS	A commercial grade item or activity that affects nuclear safety and that was not designed, manufactured or performed in accordance with specific nuclear requirements
Counterfeit, Fraudulent and Suspect Items	CFSI	**Counterfeit item** - items that are intentionally manufactured, refurbished or altered to imitate original products without authorization in order to pass themselves off as genuine **Fraudulent Item** - items that are intentionally misrepresented with intent to deceive. **Suspect Items** - items where there is an indication or suspicion that it may not be genuine.
Critical Quality Activity	CQA	Any activity and/or operation that if not performed correctly may affect safety, functionality or reliability of a product/item.
Item	-	All-inclusive term used in place of any of the following: assembly, component, equipment, material, module, part, software, structure, sub-assembly, sub-system, system or unit
Measurement and Test Equipment	M&TE	Tools, gauges, instruments, devices, or systems used to inspect, test, calibrate, or measure parameters
Management and Quality Program	MQP	The Quality Management System (QMS) for the ITER Project, centrally administrated by the ITER Organization (IO). Also referred to as “management baseline”
Process	-	A set of interrelated and interacting activities that use inputs to deliver an intended result
Protection Important Component	PIC	Specific category of systems, structures or components as defined in Article 1.3 of the INB Order [6]
Protection Important Activity	PIA	Any activity which is related to or can impact a Protection Important Component as per the Article 1.3 of the INB Order [6]
Quality Leadership Team	QLT	Responsible for the performance of quality management activities performed under the IO and DAs responsibility
Suitably Qualified and Experienced Persons	SQEP	A person who possesses the appropriate qualifications, knowledge, skills, and experience to perform a particular function to the required standards.

Appendix B References

[1] Project Specifications (PS) (2DY7NG)
[2] ITER PMP – Project Management Plan (AVAMQG)
[3] ITER Policy on Safety, Security, Quality and Environment Protection (43UJN7)
[4] ISMS - ITER Integrated Safety, Environment and Security Management System Manual (4HCWJU)
[5] ITER Organization Delegation of Legal Authority (4AFC6R)
[6] Order dated 7 February 2012 relating to the general technical regulations applicable to INB - EN (7M2YKF)
[7] ITER Organization at a Glance
[8] Terms of Reference (ToR) for IO-DA Quality Leadership Team (QLT) (9LUA5Z)
[9] Implementation plan for design & manufacture of PE/NPE (VE2DSP)
[10] ISO 9000 (2015): Quality Management Systems - Fundamentals and Vocabulary
[11] ISO 9001 (2015): Quality Management Systems, Requirements
[12] IAEA GSR part 2 (2016): Leadership and Management for Safety – General Safety Requirements
[13] Management Review (MR) Procedure (3L7SWX)
[14] Management and Quality Program (MQP)

IDM UID
FKNP8R
VERSION CREATED ON / VERSION / STATUS
30 Apr 2026 / 1.1 / Signed
EXTERNAL REFERENCE / VERSION

Technical Specifications (In-Cash Procurement)

ICH RF Sources Market Survey Technical Specification

This technical Specification is issued in the frame of the implementation of a Market Survey dedicated to the Ion Cyclotron Radio Frequency Sources

SUPPLY

Table of Contents

SUPPLY

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 addition the Ion Cyclotron Radio Frequency Sources requirements are defined in the SRD 51 [20].

In case of conflict, the content of the Technical Specification supersedes the content of Ref [1] and [20].

2 Purpose

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 ITER Ion Cyclotron Heating & Current Drive (ICH) system is required to perform wall conditioning and plasma scenarios

The ITER ICH system requires **4 RF sources**, each providing 3 MW output power in CW mode (2000s) at VSWR= 1.5 (for any phase of reflection coefficient) in the frequency range 40 – 55 MHz

Each RF source shall be made of identical components and shall be tunable for the frequency range of 38 to 57 MHz.

The typical RFS sources components are:

- low power RF sources
- Solid state power amplifier
- high power tube-based amplifiers
- their related grids power supplies and protection circuits
- Tunning system for the cavities
- I&C for remote operation and protection
- Water and air cooling
- Transmission lines (3”, 6”, 9” or 12”)
- A mis matched transmission line to perform acceptance test.

The HPA2 and HPA3 anode High Voltage Power Supplies (HVPS) are excluded from the supply.

The 3 MW dummy load to perform the RF testing of the source is excluded as well.

SUPPLY

The 4 sources are fed by one master synthesizer. The 3 MW output power is connected to a 12”TL.

In some of the applicable or reference documents, an RF source design/layout may be mentioned/detailed/indicated. This shall not be considered as an input and **the supplier shall remain free to propose any RF source design compliant** with the requirements defined in the present technical specification.

The scope of work will cover the supply, installation and commissioning on ITER site of the 4 RF sources, and mainly comprises the following activities:

- Engineering activities for producing the Final Design of the RF sources
- Manufacturing of the 4 RF sources
- Production of engineering document for the IO Design review processes
- Final design adjustments as required during the manufacturing process
- Supervision and reporting of the manufacturing process
- Inspections and quality records, as specified in the [4]
- Activities for certification/qualification of procedures and processes
- Factory testing of each RF sources
- Delivery to ITER site
- Assembly and installation on ITER site
- Commissioning and Site Acceptance Tests on ITER site
- Cleaning and packaging
- Preservation and storage
- Contract management as required by IO
- Documentation (not inclusive list: design reports, diagrams, drawings, quality assurance documents, installation and test procedures, manual of operation)
- Training.

The transfer of ownership from the contractor to IO shall be effective at the IO acceptance of the SAT report.

The installation and commissioning of the RF sources will be performed in the Building 20 at ITER site.

An overview of the ICRH system and its RFS source is shown in the following Figure 2-1.

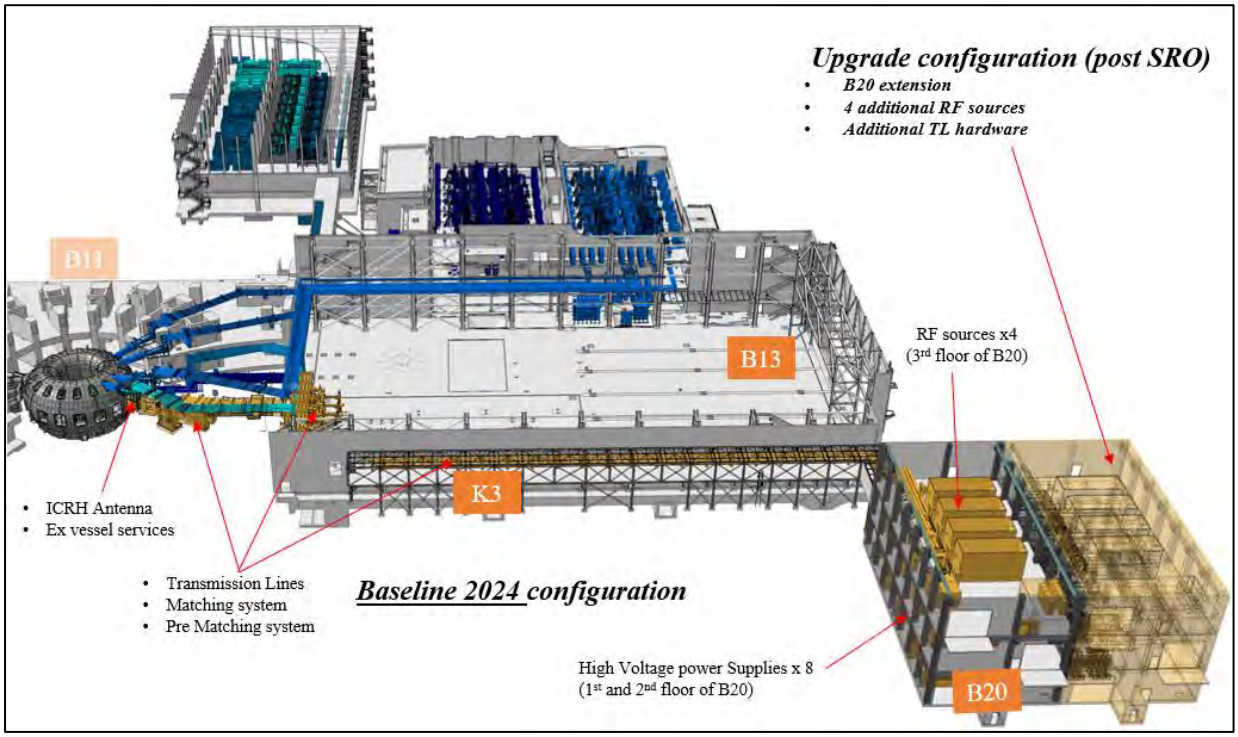

Figure 2-1: Overview of the ICRH system in ITER site

3 Acronyms & Definitions

3.1 Acronyms

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

CRO	Contract Responsible Officer
GM3S	General Management Specification for Service and Supply
IO	ITER Organization
PRO	Procurement Responsible Officer
ATP	Authorization to Proceed
CODAC	Control, Data Access and Communication (ITER subsystem)
COTS	Commercial of The Self
FDR	Final Design Review
FAT	Factory Acceptance Test
GIP	Generated Intellectual Property
HVPS	High Voltage Power Supply
HP	Hold Point
HPA	High Power Amplifier
ICH&CD	Ion Cyclotron Heating & Current Drive
IDP	Input Data Package
IO	ITER Organization
LCU	Local Control Unit

LPM	Litre per minute
MMTL	Mismatch Transmission Line
MIP	Manufacturing & Inspection Plan
MRR	Manufacturing Readiness Review
NP	Notification Point
PCS	Plasma Control System
P&ID	Piping & Instrumentation Diagram
PFD	Process Flow Diagram
PDR	Preliminary Design Review
PSC	Plant System Controller
PS	Power Supply (Unit)
RAMI	Reliability, Availability and Maintainability Inspection
RF	Radio Frequency
R&D	Research & Development
SAT	Site Acceptance Test
TL	Transmission Line
VSWR	Voltage Standing Wave Ratio

3.2 Definitions

Terms used in this specification are covered under Section 2.1 of the GM3S that is requiring a definition to ensure proper understanding of the document. Please note definition of the Contractor, although defined in Ref [4] 2.1 is duplicated here as the term is largely used within this document.

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

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.

During execution of the contract the latest version of documents at the time of contract signature shall be applicable. Future application of these referenced documents will be addressed case by case mutually. 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.

These reference documents shall be implemented for the components supplied by the contractor, wherever applicable. The list of reference document is given in the Table 4-1. For a better understanding, they are grouped with some explanations. Further details could be exchanged during the kick-off meeting.

Ref.	Title	No.
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: 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_7GJHSE & ITER_D_7M2YKF
[2]	ITER Procurement Quality Requirements & ITER Quality Assurance Program (QAP)	ITER_D_22MFG4 & ITER_D_22K4QX
[3]	Quality Classification Determination	ITER_D_24VQES
[4]	General Management Specification for Service and Supply (GM3S)	ITER_D_82MXQK
[5]	Procedure for Management of Deviations & Nonconformities	ITER_D_2LZJHB ITER_D_22F53X
[6]	Manufacturing Inspection Plan (MIP) Template	ITER_D_QV7GQF
[7]	ITER function category and type for ITER numbering system	ITER_D_2FJMPY
[8]	ITER numbering system (for parts/components)	ITER_D_28QDBS
[9]	Specification for Labelling of Equipment on ITER Project	ITER_D_VYJ7U2
[10]	Procedure for the CAD management plan	ITER_D_2DWU2M
[11]	ITER Document Breakdown Structure Overview	ITER_D_43327Q
[12]	Risk and Opportunity Management Procedure	ITER_D_22F4LE
[13]	#00 - PGC Volume 1 Internal Regulations Environmental requirements	ITER_D_T6V4RP ITER_D_27WDZW ITER_D_97WRFP

SUPPLY

Ref.	Title	No.
	Contractor Safety Management Procedure Procedure for Occupational Health and Safety Hazard Identification and Assessment Vehicle Access and Traffic Circulation and Parking on the ITER Site ITER Site access Procedure General Management Specification for Executing Entities at the ITER Site	ITER_D_Q2GBJF ITER_D_AJLQRF ITER_D_N3MG3V ITER_D_S3893D ITER_D_YX55YY
[14]	Working Instruction for the Delivery Readiness Review (DRR)	ITER_D_X3NEGB
[15]	Procedure for Transportation of Components to ITER Site	ITER_D_RY5C6Q
[16]	Design Review Procedure	ITER_D_2832CF
[17]	Working Instruction for Manufacturing Readiness Review	ITER_D_44SZYP
[18]	Order dated 29 September 2017 approving Nuclear Safety Authority Decision 2017-DC-0591 of 13 June 2017 on the minimum technical design requirements to be met by workplaces in which electrical equipment that emit X-rays is used.	ITER_D_VH8MYG
[19]	Assessment of French Order of 29 September 2017 on technical requirements to be met by workplaces in which electrical equipment emit X-rays.	ITER_D_WDYTR6
The following documents provide technical information on applicable standards/rules at IO. Some of them are quite general as the ITER Plant Control Design Handbook. The list of applicable standards shall be adapted as per the proposed design component characteristics. Some other documents specify the interface/operation requirements.		
[20]	SRD-51-IC (Ion Cyclotron Heating and Current Drive System (ICH&CD))	28B33K
[21]	SRD-51-HV (Ion Cyclotron Heating & Current Drive Power Supplies (ICH&CD PS))	2MHS2W
[22]	Plant Control Design Handbook	ITER_D_27LH2V
[23]	Electrical Design Handbook Part 3: Codes and standards	ITER_D_2E8DLM
[24]	Electrical Design Handbook Guide A: Electrical Installations for SSEN Client Systems	ITER_D_2EB9VT
[25]	IO cabling rules	ITER_D_335VF9
[26]	EDH Part 4: Electromagnetic Compatibility (EMC)	ITER_D_4B523E
[27]	IO Cable catalogue	ITER_D_355QX2

Ref.	Title	No.
[28]	Codes and Standards for ITER Mechanical Components	ITER_D_25EW4K
[29]	3 1/8 inch EIA Transmission line flange	ITER_D_4FHCF3
[30]	6 1/8 inch EIA Transmission line flange	ITER_D_4FHGF2
[31]	12 inch Transmission line flange: fix and swivel	ITER_D_4FJGBX ITER_D_3QT2B6
[32]	ICH System Concept of Operation	ITER_D_3MBC4P
The floor response spectrum needed to carry out the seismic simulation will be provided by ITER. The following documents provide guidelines for seismic analysis.		
[33]	Instructions for Seismic Analyses	ITER_D_VT29D6
[34]	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
[35]	IO Building 20 FRS Data	ITER_D_EALT5G

Table 4-1: list of reference documents

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 in addition to the ones mentioned in this section.

The following standards are applicable for the execution of this project. These codes and standards shall be implemented for the components supplied by the contractor, wherever applicable.

4.2.1 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

  (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/cm². 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.

4.2.2 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 [29] [30] [31] shall be used.

Pressure equipment: Directive 2014/68/EU:

- 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.

4.2.3 Codes and Standards for mechanical components

Commercial material shall conform to the applicable standard (ASTM, JIS, DIN, etc.) for the definition of their grade, physical, chemical, and electrical properties and related testing. All materials for which a suitable certification from the contractor 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).

SUPPLY

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 [28].

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
- 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

SUPPLY

- 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
- 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.

4.2.4 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 [23], EDH Guide A: Electrical Installations for SSEN Client Systems [24], EDH Part 4: Electromagnetic Compatibility (EMC) [26], Plant Control Design Handbook [22]), the International Electro Technical Commission (IEC) and NFC 15-100 & NFC 13-200. Applicable standards shall be listed by the contractor. They shall be submitted to IO for review and approval/acceptance.

All applicable French local and national rules, regulations and decrees shall be strictly followed. There is a requirement in France to have a legal inspection (NFC 15-100 & NFC 13-200) of any electrical equipment before it is energized for the first time. The contractor shall implement all the requirements of such legal inspection during production of items in factory and conduct legal inspection at factory before shipment to ITER. The contractor is also responsible for the clearance for Legal inspection of their supplied components at ITER, France.

4.2.5 CE Marking

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. Other useful information can be found in the “Guide of implementation of directives based on the New Approach and the Global Approach”: http://ec.europa.eu/enterprise/policies/single-market-goods/files/blue-guide/guidepublic_en.pdf.

Applicability of CE marking on Components/sub-systems etc. shall be listed by the Contractor They shall be submitted to IO for review and approval/acceptance.

If delivery will be a "partly completed machine" then CE marking may not be applicable according to the EU Machine Directive. However, contractor shall issue a certificate of incorporation of RF source components along with regulatory technical documentation to substantiate the demonstration of conformity to regulation. COTS integrated in contractor’s delivery shall have CE marking.

5 Scope of Work

This section defines the specific scope of work, in addition to the contract execution requirement as defined in [4].

The scope of work is broken down as follow :

Scope of Supply#1:

- Design definition with an associated design review and acceptance of the design by IO
- Manufacturing of the 4 RF sources including the FAT of the main components.

Scope of Service#1:

- Installation of the 4 RF sources at IO site.

Scope of Service#2:

- Commissioning of the 4 RF sources at ITER site assessed by A Site Acceptance Test (SAT).

The supplier shall be responsible of the full scope. The transfer of ownership will be done after the successful completion of the SAT at IO.

5.1 Scope of Supply #1 Four ICH Radio Frequency Sources Design

5.1.1 Description

The RF source technical specifications, requirements and interface requirements are defined in the following sections. The design shall be developed in accordance with these requirements their validation through SAT process. The initial requirement propagation shall be demonstrated at the design review. The contractor shall produce the RFS source design and shall integrate within the B20 environment in accordance with the interface requirements. Once the design is ready for being submitted to IO for acceptance, IO will organize a final design review, in order to accept the design for manufacturing.

5.1.2 Design requirements

The following requirements shall be followed:

- The RF sources components shall use technology that is currently available, and for which reliability level can be determined before being installed in ITER. This reliability shall be defined during the design phase and compatible with the overall the ICH minimal

inherent availability target (from 88 % to 97 % depending on the system operation functions)

- The RF sources shall be capable of an efficient, continuous operation under high variation of VSWR up to a maximum value of 1.5, for any phase of reflection coefficient.
- The IC system shall be designed to operate at discrete bands of 2 MHz fully covering the desired frequency range.
- In-band electronic modulation shall be provided from each mid band frequency, up to ±1 MHz deviation, with a frequency resolution of 1 kHz.
- RF power control: The amplitude and phase of each RF source output power shall controlled in a closed control loop and compared with a time variable suitable reference, provided by the associated subsystem controller. All equipments of the IC system shall comply with the RF power control requirements.

  The ramping up of all RF sources output power shall be synchronized with a maximum delay of 10μs. the output power specification is given in the Table 5-1.

Forward power control range (MW)	0.005 to 3.5
Power modulation accuracy (%)	5.0
Power modulation frequency (3dB break) (kHz)	1.0
Max RF power rise time (full modulation range) (ms)	200
Response to a trip request (μs)	< 10
Overshoot	< 5%
Max residual power with RF power source ready (power reference at 0) (kW)	2.0

Table 5-1: Output power control specification (per RF source)

The frequency modulation specification is given in the following Table 5-2.

Output frequency range (MHz)	n1*
Frequency step (kHz)	1. 0
Offset frequency (kHz)	0.1
Frequency modulation (MHz)	±1.0
Closed loop response to a frequency step (Δf<±1.0 MHz) (μs)	100
Frequency overshoot (kHz)	< 20

Table 5-2: Frequency modulation requirements

Note * n1: value has to be compatible with Frequency Range and Modulation Bandwidth described in Table 5-4.

The phase modulation specification is given in the following Table 5-3.

Phase control range (°)	360
Minimum output power level allowing phase control (kW)	5
Absolute phase accuracy, including offset and noise (°)	3
Closed loop response to a phase step ($\Delta\phi<\pm 90°$) (μs)	20
Phase overshoot (°)	< 20
Max time interval to lock (any frequency and phase) (ms)	10

Table 5-3: Phase modulation requirements

- The maximum output harmonic level shall not be higher than –20 dBc at any power level and frequency with matched load.
- For the 4 operating modes, the RF power sources will have to be operated at any fixed frequency between 40 and 55 MHz.
- The RF power sources shall accept a high level of transient reflected power up to VSWR=2 (for any phase of reflection coefficient) duration 1s, 10% duty cycle.
- The change from one frequency to other shall be performed without RF power in ≤ 6 minutes.
- RF sources shall be located in electro-magnetic enclosures, individual or common ones (including, if needed X-ray protection shield for the tube), as required to operate RF source within the EMI limit. It shall be also used to provide personnel protection against RF and DC high voltages.
- The power dissipated in air inside the RF buildings by the RF sources shall not exceed 25 kW per RF source.
- The RF power sources shall be designed to optimise the system efficiency during steady state working conditions.

5.1.3 Operating requirements

5.1.3.1 General operation requirements

The RF source system is a key actors for the implementation of ICH operation and protection functions

SUPPLY

The RF source shall fulfil the operation requirement parts of ICH System concept of Operation [32].

The RF source shall be operated remotely through its Local Control Unit. The RF power sources shall comply with the operation modes:

- Plasma heating and current drive
- Wall conditioning
- Antenna conditioning
- RF source test on dummy load

The system shall be equipped with instrumentation for the automatic control of RF power, frequency, phase and protection against Voltage Standing Wave Ratio (VSWR).

Inputs for automatic protection against arcing in antennas, dummy loads, transmission lines, matching systems and power sources shall be included in the design.

In normal operation the RF source shall be remotely operated via the Plant System Controller (PSC).

The RF source shall be locally or remotely monitored and controlled by the Local Control Unit (LCU) for debugging/commissioning operation and data acquisition.

All the RF measurement equipments integrated in the RF source shall be designed to allow calibration for relevant parameters.

For any internal parameter exceeding pre-established thresholds, set at nominal values (e.g. electronic tubes grid current, anode power dissipation …), the output RF power shall be limited to a safe value, within a timeframe compatible with components technical limits. Safety thresholds shall be set at nominal working parameters.

If some limiting condition will appear at antenna and transmission lines, it shall be communicated to the PSC and in response PSC will modify the set point of requested power; the source shall respond accordingly.

The limitation thresholds shall vary accordingly to the duration of the overrun (fast and slow overload detection).

The RF power sources shall automatically and safely recover from a power trip to normal operation.

SUPPLY

Each RF power source shall insure its own protection first of all by reducing the RF output power level or switch off the RF power/anode and grids voltage, and shall be protected against:

- VSWR variations beyond the specified level on the RF output, for any phase of reflection coefficient
- All internal malfunctioning (over current, over voltage, over temperature, breakdowns …)
- All abnormal commands (over range signals, non-consistent commands)
- Water/air cooling interruption
- Pressurized air interruption
- PSC or CODAC failure
- Electrical power supply interruption.

5.1.3.2 I&C requirements

The Local Control Unit shall be design as per ITER PCDH [22].

The documentation, software codes and tool for computing process, allowing equipment maintenance and calibration shall be part of the procurement.

5.1.3.2.1 Local Data Acquisition System

Several status (single bit), data (multiple bits) and signals shall be generated during the operation of RF Sources. Alarm signals shall be matrixed and handled in priority groups. Circular memories capable of few minutes of data storage shall be operated in trigger mode so as to maintain / available to the IC Plant System Control (PSC) request of the record of unforeseen events. Minimum event duration will be defined by IO in consultation with the supplier during design phase.

Signal list and its characteristics required for the PSC and CODAC will be provided by IO.

Signal interfacing topology for hard wire interlock for intra plant system will be finalized and provided by IO.

Communication and interfacing protocol between LCU and PSC shall be as per PCDH.

5.1.3.2.2 Sequence control system

The description below, summarized in Figure 5-1, refers to a basic operating conditions (level of readiness) in which each of the 4 RF source system can be in use.

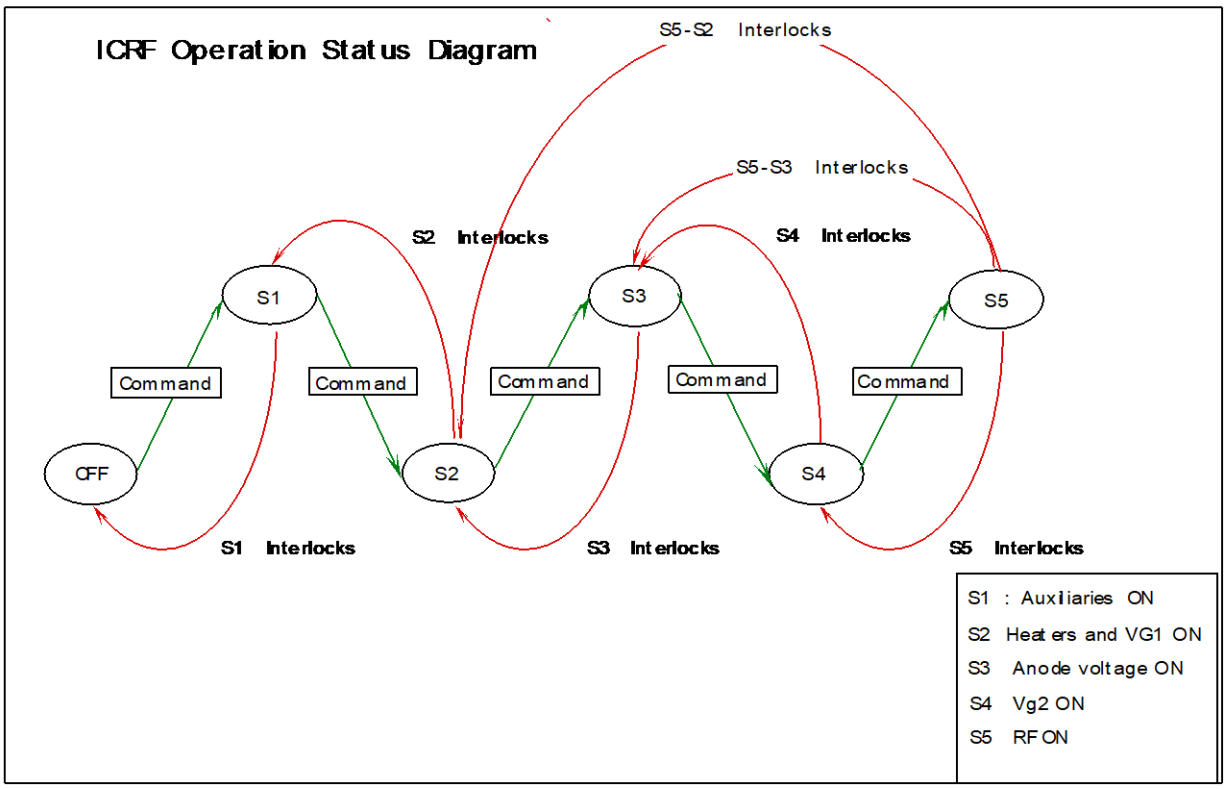

Figure 5-1: Basic state diagram of RF power source

The supplier may refine the required states, but the ones mentioned in Figure 5-1 are the minimum ones. Transitions from one state to another shall be requested by a manual or automatic command, acknowledged, executed if the plant and environment conditions are compatible with that state and aborted if these conditions are not met within a pre-set time lag from the request.

System parameters (such as frequency, power, etc.) can be adjusted independently of the status of readiness. This is defined in the interface with Plasma Control System (Cf. Table 5-5,) and in the System Concept of Operation [32].

Each Subsystem interfacing with RF sources is set into (and out of) operation under the supervision of a dedicated programmable logic controller, through a sequence of levels of readiness from the “OFF” to the “RF ON” state. In normal mode of operation, the RF power can be safely applied to the plasma in the amount and with the time profile requested by the PSC.

The 4 RF source systems are driven independently through the start-up/down sequence and can rest for an indefinite time at each level, unless:

- An operator command requests a higher or lower level of the sequence and/or
- An alarm incompatible with the actual level of readiness occurs.

In the first case, the level of readiness is modified according to the request. In the second case, it is switched down to a level in which the alarm is either reset or can be ignored. Both up- and

down- transitions may require several steps and involve time delays. They are executed in sequence and the execution of each step shall be monitored and logged.

Any external command request is acknowledged by a status signal which remains true until the command is executed. Specific alarm signals are flagged if the execution is prevented by one or more fault conditions and remains true until reset by automatic or operator action.

5.1.3.2.3 Real time Control system

There are three parameters- Frequency, Phase and Amplitude that shall be regulated for proper operation and as per experimental requirement and as per the interface with PCS (Cf. Table 5-5).

5.1.3.2.4 Protection and Health & Safety system

Protection may be fast or slow, managed through I&C components or hard wired. The fast protection shall act within 10 μs to insure the protection of the source and associated system. If the operating parameter crosses the maximum level specified by system designer, RF shall be withdrawn. In order to maintain operation, all these signals are connected to fault handling system which shall have intelligence to decide the action i.e. if the fault is external arcing, only RF shall be withdrawn and end stage control grid shall be set to blocking negative level and again reapplied with particular timing characteristics and if the fault is internal arcing then RF as well as HVPS shall be withdrawn and again reapplied with predefined timing characteristics. Timing characteristics will be defined during design phase.

5.1.3.2.5 Position Control Unit

RF source can be made of tube based amplifiers. The position Control System controls the positioning of the corresponding tuning element offline according to the operational frequency requested by Plant Control System. A set of positional data for each operational frequency shall be generated and saved as reference. Control motor shall be operated remotely under supervision of LCU and tuning element shall be positioned at particular position defined by the operational frequency. The interfaces between the RF sources and the I&C system are:

- Control signals for adjacent components (status of different Auxiliary power supply,….)
- Remote controls
- Measurements on auxiliary systems and services when required, such as flow, pressure, temperature, position…
- Status sharing in real time related to RF sources
- Data acquisition of RF measurements, control and safety signals
- Output for inner diagnostics of the generators

SUPPLY

- Real time control system (amplitude & phase waveforms, frequency, status…)
- Interlock and safety signals.

All Instrumentation and Control components shall be conformed to standards, specifications and interfaces as documented in the Plant Control Design Handbook [22].

5.1.4 Performance requirements

The RF power source main performance requirements are defined in the following Table 5-4

Sr. no.	Specification	Level & Units	Remarks
1	Operating Central Frequency Range	40-55 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
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, with 3.0 MW output power without changing tube biasing or input RF power.
4	Nominal output power	3.0MW	– Matched load condition: RF Power shall be demonstrated at 40 MHz, 42MHz, 53MHz & 55 MHz for 2000s. – Mismatched load condition: RF Power shall be demonstrated at 40 MHz, 42 MHz, 53MHz & 55 MHz for 2000s with VSWR 1.5:1 at 5 different phase angles.
5	Maximum VSWR	1.5	With any phase of reflection coefficient
6	Transient VSWR	2.0 (1s max)	Output power may be reduced
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 acceptance at 40 MHz, 42 MHz, 53MHz & 55 MHz.
9	Duty cycle	25%	
10	Input and Output impedance	50 Ω	
11	Emergency RF power cut-off response	<10 µs	
12	RF radiation limit	<1mW/cm^2	It shall be within the limits recommended by the

SUPPLY

Sr. no.	Specification	Level & Units	Remarks
			International Non-Ionizing Radiation Committee (INIRC).
13	Max frequency modulation frequency (Response time)	1 kHz	
14	Power modulation range at the load	2kW-3.0MW	
15	Max amplitude modulation frequency (Close-loop response time)	100Hz	
16	Max phase modulation frequency (Close-loop response time)	10 kHz (at fixed reference/any frequency)	

Table 5-4: RF source main performance requirements

The supplier is free to choose any configuration that will allow these specification achievements.

5.1.5 Interface requirements

The design of the RF source shall be compliant with the physical and functional interfaces.

The RF sources have interfaces with other PBS51 sub systems and with other ITER PBS (external interfaces). They are specified in the Table 5-5.

Interface	Name	IDM reference
Cooling water	IS-26.CC-51-001	334USK
Low voltage Power supply	IS-43-51-001 Interface between SSEN-LV-Class-II-IP and IC H&CD System	3NST27
	IS-43-51-003 Interface between SSEN-LV-Class-IV-OL and IC H&CD System	3P2RD4

SUPPLY

	IS-43-51-006 I&C Interface between SSEN and Ion Cyclotron H&CD System	UNLL5W
Cable tray	IS-44-51-001 Interface between Cable Tray System (PBS 44) and Ion Cyclotron H&CD System(PBS 51) for all types of cables	MV39SP
CODAC	IS-45-51-002 Interface between CODAC and IC.CI.ICH1	UP7QEQ
Central Interlock	IS-46-51-001 Interface Sheet (IS) between Ion Cyclotron Heating and Current Drive system and Central Interlock System	BEUS9H
Plasma Control System	IS-47-51-001 Architecture	KFZA76
Plasma Control System	IS-47-51-002 - List of signals and variables	KGQQMV
Central Safety System	IS-48.02-51-001 Interface Sheet between ICH&CD System PBS51 and Central Safety System (Occupational Safety) PBS48.02	MVHGRK
ICH High Voltage Power Supply	IS-51.HV-51.RS-001 High voltage interface between IC HVPS and IC RFS Systems	62JL2R
	IS-51.HV-51.RS-002 I&C interface between IC HVPS and IC RFS Systems	62HQH2

	IS-51.HV-51.RS-003 Key protection interface between IC HVPS and IC RFS Systems	62J8YX
ICH Transmission Lines	IS-51.RS-51.TL-001	F7NZY7
ICH Plant Control System	IS-51.RS-51.CI-001	
Building 20	IS-51-63.20-001 Interface Sheet between Ion Cyclotron Heating & CD System (PBS 51) and Building 20 (PBS 63.20)	BGM2DM
REMS	IS-51-64-001 Interface between Ion Cyclotron H&CD & REMS	UX5SQ2
Liquid And Gas	Interface Sheet (IS) between Liquid & Gas Distribution (PBS 65) and Ion Cyclotron H&CD System (PBS 51)	33G8CG
ICH Configuration Management Model in Building 20	AB-CMAF CMM for PBS 51 in Building 20 (SRO, DT1 and DT2)	EJMPD2

Table 5-5: List of RFS interfaces

As part of these interfaces are design dependent like the one dedicated to the Anode Power Supply (HVPS), the applicability of each of them will be defined in the next phase.

Anyway, the main dimensioning parameters are recalled in the following sections.

5.1.5.1 Interface with the Building 20

The maximum dimension of one RF source shall not exceed 3.4 m x 9 m x 5 m (W x L x H). The maximum weight of one RF source shall be 18 t.

SUPPLY

The maximum heat exhaust shall not exceed 1 % of the output power per source. The B20 crane available for installation and maintenance has 5 t capacity.

The building 20 is a three-floor building. The RF sources are located at the 3rd floor (Level 3).

The total space allocated for 4 RFS in Building 20 is 18.1 m x 9 m x 5 m as shown in the following Figure 5-2 and Figure 5-3.

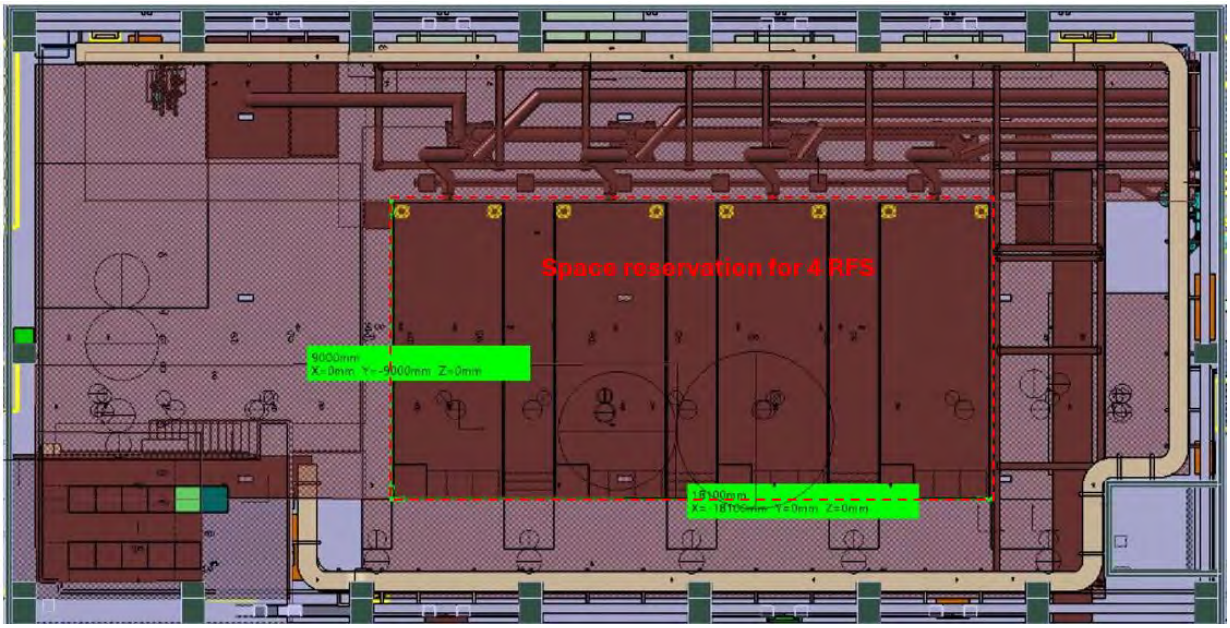

Figure 5-2: RFS space reservation at B20 L3 (view from top)

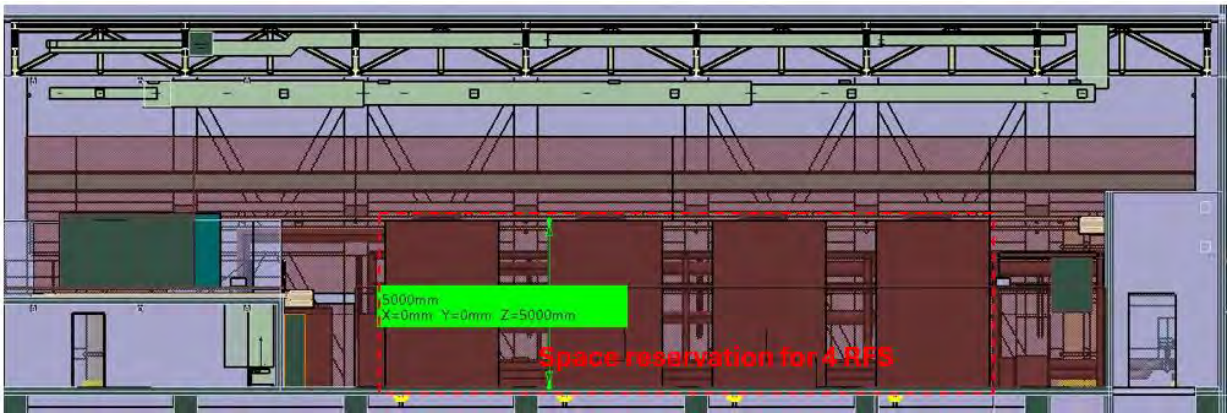

Figure 5-3: RFS space reservation at B20 L3 (side view)

RF enclosure, service platform along with ladder shall be compliant with the building interface requirements in particular for what concerned the pointed load (cf. Interface with Building in Table 5-5).

Outside temperature range at ITER is from -10 to 40°C with relative humidity (RH) range of 65-95%. However, inside temperature range in Building 20 Level 3 is [18°C-30”C] and RH ≤ 85%.

5.1.5.2 Interface with Transmission Lines

The interfaces with transmission lines are mechanical, electrical (RF) and functional (3 MW dummy load and protections). The RF flanges design for different transmission line dimensions are fixed and defined in [29][30][31]. It concerns in particular the interface with the PBS51 12" transmission lines. The interface at the outlet of the RF sources is done through a 12" Transmission line [31] part of a gas barrier. One volume of the gas barriers is shared with RFS; the resulting technical constraints are detailed in the interface document (cf. Table 5-5).

During test of the RF sources on Dummy Load at ITER site, the MMTL shall be installed before the dummy load, in between two transmission lines, which implies additional interfaces requirement associated with cooling circuit.

RFS I&C shall have a direct connection in between Transmission line protection system (for RF arcs for instance) for an RF switch off in less than 10 μs. As the transmission lines are as well contributing to the fast protection of the antenna, the RF switch off shall be implemented as well on the Master synthesizer to allow a simultaneous RF switch off of the 4 RF sources.

5.1.5.3 Interface with High Voltage Power Supplies

The interface with HVPS is highly dependent on the layout chosen by the supplier. The details given in the IS on the HVPS topology **are indicative only**. Attention is given on the main efficiency required on the RFS that is driven by the PPEN power available and the HVPS target efficiency. 5.9 MW of DC power is available per RF source. The penetration of HVPS cables is fixed in building 20 as the HVPS will be installed at level 1 and level 2 of the building.
The interface comprises:

- High voltage terminal/transmission hardware
- Grounding /earthing point
- Control & Interlocks.

5.1.5.4 Interface with water cooling, Compressed Air and Nitrogen

The fluid systems provided by ITER for interfacing the RF sources are described below:

- Water loops (CCWS) with requirement on the inlet/outlet temperature (max inlet temperature 31°C, max outlet 60°C), inlet pressure (7.3 bars) and maximum pressure drop of 5.5 bars. The operation average heat load for 4 RF sources is 7.6 MW.

- Compressed air for valves actuators or pressurized transmission components, air cooled components,… (max flow and pressure defined; cf. Specific interface sheet in Table 5-5).
- Compressed dry nitrogen for pressurized TL and fluid drainage in RFS water cooling circuits (max flow and pressure defined; cf. Specific interface sheet in Table 5-5).
- Demineralized water for filling the circuits before connecting to the main loop.
- Draining and drying circuits (max flow rate will be defined in the next version).
- Air cooling/recycling in the surrounding environment of the RF sources, if needed.
- Moisture drain off.

5.1.5.5 Electrical Interface

The RF sources electrical interfaces with class II (Uninterrupted) supply are:

- Terminal block
- Grounding/earthing point
- Interlocks.

The RF sources electrical interfaces with class IV supply are:

- Line Terminal block
- Grounding /earthing point
- Interlocks.

5.1.6 Mechanical Requirements

Additional mechanical interfaces are within:

- The Key management system for HV Lock Out
- The Cable Trays for laying power cables and control/monitoring cables.

5.1.7 Electrical Requirements

The following requirements shall be considered:

- Electrical power for components/sub-systems as per layout: The utility power (~250 kW per RF source) at IO site are 400V±10% / 3 phase / 50 Hz and 230V±10% / single phase / 50 Hz.
- The contractor shall proceed to the connection of the RFS component’s grounding to the global Earthing/Grounding network [26].

- Any required Auxiliary power supplies supplied by the contractor shall interface with grids tubes.

5.1.8 RF source design assessment

The contractor shall deliver the RF source design package once the design is mature for being assess through an IO design review process [16]. At this stage, the data package provided in the appendix II shall be completed and shall be made available to the IO panel and experts at least 2 months prior to the design review. The deliverables produced during the final design phase are integral part of the FDR input data package. All documents shall be in approved state prior to the final design review.

According to the design review results, the contractor shall implement the necessary corrective action to update the design, as required by the design review panel. All the corrective action shall be implemented within a 6 month period, in order to close the design review. The manufacturing of the component shall not start until the formal closure of the final design review (unless agreed otherwise on long lead item procurement)

5.1.9 RF source design deliverables

The deliverable definition shall be in line with the IDP required for the Final Design Review. Typical IDP is provided in Annexure II.

Additional Preliminary design reports shall be provided by the supplier; their content level of maturity will be detailed in the next version of this specification.

The Table 5-6 specifies the different deliverables to be produced by the contractor during the design phase. All deliverables shall be submitted for IO review and acceptance.

DL#	Description	Type	Due dates
1	Quality plan (full scope)	Document	T0+1
2	RFS Preliminary Design Description report	Document	T0+6
3	RFS Preliminary structural analysis package	Document & analyses model	T0+12
4	RFS Preliminary LCU description	Document	T0+12
5	RFS Preliminary Layout drawings	Document + native CAD file + ENOVIA	T0+8
6	RFS Preliminary Interface Compliance Matrix	Document	T0+6

7	RFS Preliminary 2D drawings	Native CAD file + ENOVIA	T0+8
8	RFS Preliminary 3D model	Native CAD file + ENOVIA	T0+8
9	RFS Preliminary PFDs	Native CAD file	T0+14
10	RFS Preliminary P&IDs	Native CAD file	T0+14
11	RFS Preliminary Wiring & cabling & single line diagram package	Native CAD file	T0+14
12	RFS Preliminary Bill of material	Document	T0+6
13	RFS Preliminary validation plan	Document	T0+6
14	FDR IDP (Cf. 13.2)	Design Review Input Package	T0+20

Table 5-6: List of design deliverables

5.2 Scope of Supply #1 – Four ICH Radio Frequency Source Manufacturing

Upon completion of the final design review and its closure, the contractor may proceed to the manufacturing of the RF sources. To be noted that due to time constraint, some procurement of long lead item might be anticipated during the design phase, following a written agreement of IO.

5.2.1 Manufacturing requirements

The RF Source are non-PIC components. Therefore, manufacturing requirement shall be established during engineering design phase to comply the specifications listed in this document and shall be implemented during the manufacturing processes.

Detailed Quality Plans, Manufacturing Inspection Plans (MIP) as per template [6], work plans and procedures shall be developed by the contractor and Subcontractors for each step of fabrication. They shall be submitted to IO for review and approval/acceptance.

In order to simplify and reduce the cost of integrating, operating and maintaining the systems, the contractor shall use as much COTS components as possible.

Recommendations for spare parts provisioning shall be provided following the RAMI analysis of the IC H&CD subsystems, both for scheduled and unscheduled maintenance. These recommendations shall take into account the operating conditions, the benefits of using as many standard parts as possible, and the risk of components obsolescence over the lifetime of ITER.

The manufacturing tolerances shall be consistent with achieving the overall installation tolerances, taking into account inaccuracies that result from installation and tolerances of mating components.

However, the manufacturing requirement will follow the general rules described in SRD51 [20]:

All critical items and components shall be identified. These critical components shall be identified in each specific design description.

Spares can be reasonably expected to be needed within 12 months of full-time operation of the system and shall be procured no later than the system commissioning phase.

The source of material property information for design analysis shall be either the applicable structural code or the ITER Material Properties Handbook. In the case of conflict, the ITER Material Properties Handbook shall take precedence.

Commercial material shall be conformed to the applicable standard (ASTM, JIS, DIN) for the definition of their grade, physical, chemical, and electrical properties and related testing. All materials, for which a suitable certification from the supplier 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 material shall be provided.

Corrosion free material will be used in the water cooling pipes.

For a list of materials that will be defined during the design phase, part of the following shall be provided:

- Brief description of the material and of its manufacturing process
- Applicable standards
- Delivery conditions (e.g. required heat treatments, cold work, …)
- Chemical composition
- Required minimum, average thermal and mechanical properties at various temperatures, including the testing protocol and standards. It shall be mentioned whether the properties refer to the “as delivered” material or to the “as manufactured” material or both.
- Specific requirement on the maximum scatter band of the material properties
- Required certificates and characterisation reports

5.2.2 Quality Control Provisions during manufacturing

The “Manufacturing and Inspection Plan” (MIP) [6] produced by the contractor and Subcontractors 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 IO. The right IO listed above shall apply in relation to any Subcontractor and in this case the IO will operate through the contractor. The overseeing of the quality control operation by the IO shall not release the contractor from his responsibility in meeting any aspect of this Technical Specification.

5.2.3 Spare Parts

The contractor shall provide within this procurement a basic set of (essential) spare parts covering 1 year of equipment operational life. These spare parts can be used during commissioning and warranty period to ensure a high availability by a faster repair of the equipment, in such case the contractor shall replace at the earliest convenience the used parts at his own charge.

A list of essential spare parts is to be submitted with the tender proposal and the final list is to be agreed at the FDR, based on the results of the RAMI analysis, with the appropriate specifications of storage space and conditions.

The risk of obsolescence of the components shall be considered.

In addition to the above, the contractor shall propose a detailed list of spare parts that will cover 5 years of equipment operational life beyond the warranty period.

5.2.4 RFS assembly and Factory Acceptance Test

Factory Acceptance Test shall be part of the design validation plan, each RFS shall undergo the FAT campaign to validate its performances prior to delivery at IO.

The test description, purpose and justification shall be defined by the contractor and part of the offer with a dedicated quotation.

The detailed procedure shall be part of FDR input package, the FAT report shall be produced by the contractor. The approved FAT procedure shall be followed to perform the testing of each RFS. IO will witness the FAT at the contractor or its sub-contractor premises. On need basis, adjustment of the approved FAT procedure might be required, in such case, Deviation Request shall be submitted to IO review and approval prior to implementation.

After the FAT, any required retrofit on the RF source design shall be submitted through deviation request procedure to IO and taken in charge by the supplier after IO acceptance.

The FAT duration shall be defined in the schedule proposed by the supplier; it shall be compatible with the delivery schedule mentioned in Section 8 and with the overall contract schedule.

5.2.5 Packing, preservation & shipping

Once the FAT of a single source is completed, the contractor shall proceed to its disassembly and packing. Depending on the timeline, the contractor may have to store and preserve the components before delivery

The following generic requirements apply for the shipment of equipment from the manufacture/assembly site to the ITER Site. Suitable precautions shall be taken to avoid damage to the equipment. The components shall be fitted with the required accelerometers or other sensors and shall be packed as defined in 5.2.5.3**.** The equipment shall be controlled and inspected after packing, and during preservation phase.

5.2.5.1 Labelling and Traceability

All components and the main subcomponents 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" [7] and [8]. A detailed 'IO component identification standard' together with printed label templates and tagging standards will be provided by IO [9].

The equipment included in the scope of supply shall be fitted with a rating plate in accordance with the applicable standards. The rating plate shall bear the identification of the corresponding equipment in the project.

In addition, identification of the equipment and components shall comply with the labelling requirements defined in EDH Guide A [24].

5.2.5.2 Cleaning

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

5.2.5.3 Packaging and Handling

Any special IO or regulatory transportation requirements shall be documented and provided to the contractor prior to shipment.

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 ITER Site shall be clearly labelled and tagged.

The contractor shall design and supply appropriate packaging, adequate to prevent damage during shipping lifting and handling operations. Where appropriate, accelerometers or other sensors shall be fitted to ensure that limits have not been exceeded. Accelerometers shall be fixed onto each box and shall be capable of recording the acceleration along three perpendicular directions [15].

Shock absorbing material shall be used.

Each shipment shall be accompanied by a Delivery Report shall be prepared by the contractor, stating as a minimum [14]:

- 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 ’s name and full address
- Bill of Material
- Security Measures
- Release Note
- 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 IO and the contractor. The signature by the IO of the Delivery Report prior to shipment represents a Hold Point (HP).

5.2.5.4 Shipment, Transportation and Delivery

Before the shipment, a Release Note shall be prepared in accordance with the “Contractor Release Note” [14] and approved by IO.

Upon receipt of the package, 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 shipment from the documentation.

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

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 IO.

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

If the components are in an acceptable condition, the IO will sign the Inspection Report. The signature of the Inspection Reports is an IO Hold Point.

The original of the Inspection Report shall be kept by the IO and a copy of it shall be kept by the contractor.

Optional Hardware delivery

Additional hardware components (assembly tools etc…) required for the services described in this technical specification shall be defined and provided by the contractor.

Their compatibility with ITER applicable standards and handbooks such as EDH and PCDH shall be assessed during this contract execution and their implementation required IO approval.

5.2.6 RFS manufacturing & FAT deliverables

The Table 5-7 specify the deliverables required during the manufacturing and testing phase, and associated due dates.

DL#	Description	Type	Due dates
15	End of RFS #1 manufacturing report	Document	T0+34
16	End of RFS #2 manufacturing report	Document	T0+52
17	End of RFS #3 manufacturing report	Document	T0+62
18	End of RFS #4 manufacturing report	Document	T0+66
19	FAT report of RFS#1	Document	T0+34
20	FAT report of RFS#2	Document	T0+54
21	FAT report of RFS#3	Document	T0+64
22	FAT report of RFS#4	Document	T0+68
23	RFS #1 *And associated documentation as per 5.2.5* (Delivered at ITER site)	Hardware	T0+36
24	RFS #2 *And associated documentation as per 5.2.5* (Delivered at ITER site)	Hardware	T0+56

25	RFS #3 *And associated documentation as per 5.2.5* (Delivered at ITER site)	Hardware	T0+66
26	RFS #4 *And associated documentation as per 5.2.5* (Delivered at ITER site)	Hardware	T0+70
27	TBD (MMTL, lift tools, test tools, etc)	Hardware	All along the project

Table 5-7: List of deliverables during manufacturing and testing phase

5.3 Scope or Service #1 – Assembly at ITER site

5.3.1 Service Description

The contractor shall be responsible of the Assembly at IO premises. The assembly comprises all activities required within the space reservation (RFS enclosure (s)) specified in the B20 L3, as shown in the Figure 5-4 & Figure 5-5

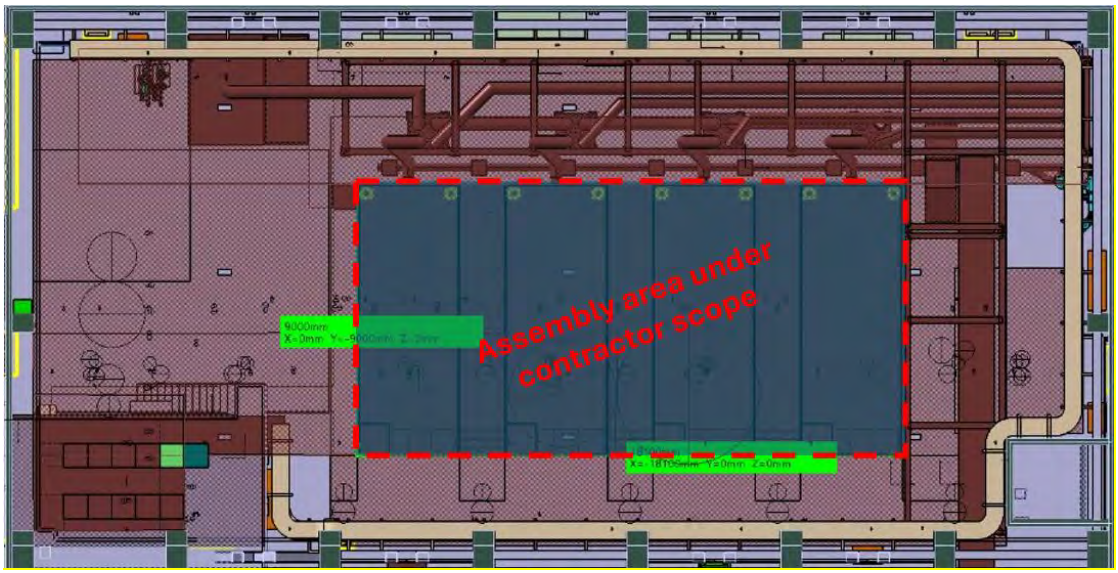

Figure 5-4: Assembly area for the 4 RFS in B20 at L3

The contractor shall provide the necessary qualified resources to perform the assembly activities. The activities shall be based on the assembly procedure approved during manufacturing phase. IO will be responsible for the activities outside the RFS enclosure(s), defined as “installation” in the rest of this specification, as specified in the following Figure 5-5. It consists in making available all services required to operate the source, like water cooling, CODAC, compressed air and nitrogen, as well as the transmission line up to the dummy load; the installation work will be performed by IO up to the connection point with RFS components.

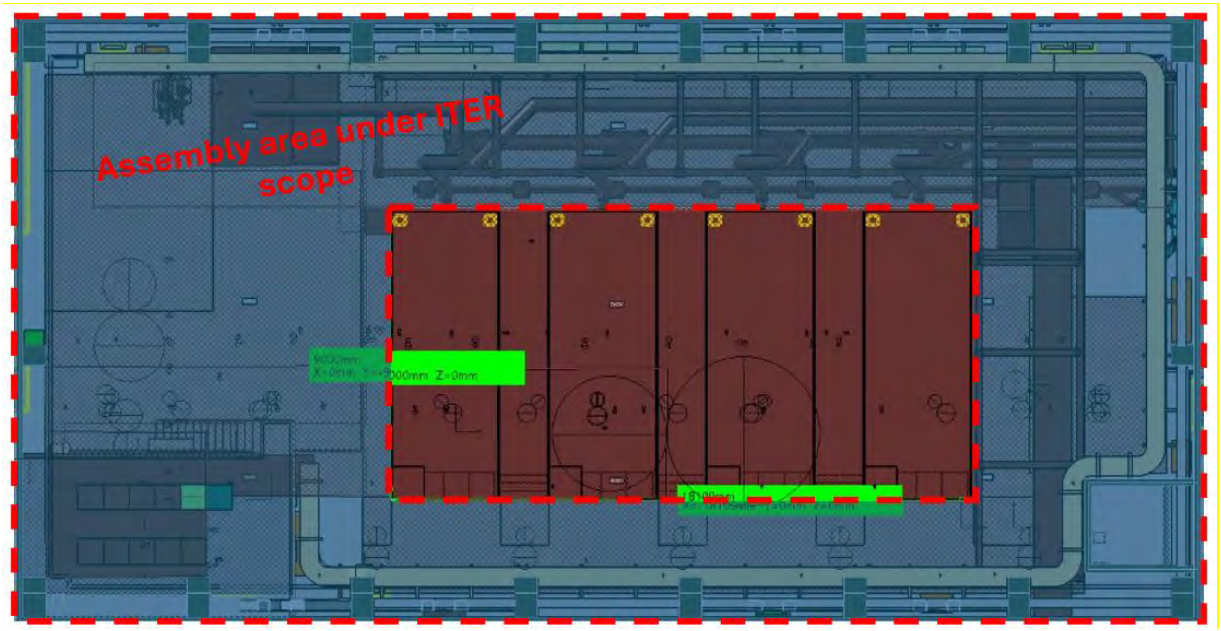

Figure 5-5: area under IO responsibility for assembly task

After completion of each of the RFS assembly & installation, a conformity report issued by the contractor and approved by IO stating that the assembly has been correctly completed and that the system is ready for being commissioned on the dummy load.

Note: Intermediate testing activities may be required during the assembly and installation phase; this shall be clearly identified in the assembly procedure and shall not be considered as commissioning activity describe in the scope of Service #2.

5.3.2 Site conditions

The equipment shall be installed at ITER Site, France, in the Building 20.

The outdoor environmental conditions of the site are summarized below:

- Elevation (above sea level) 315 m
- Outdoor temperature range -10 to 40 °C
- Average outdoor temperature over 24-hour period -10 to 35 °C
- Wind speed ≤ 140 km/h
- Outdoor relative humidity (24-hour average) ≤ 95 %
- Pollution Level (according to IEC Standard 60071-2) Level 1

5.3.3 Ambient conditions

The HVAC system for the Building 20 keeps the environmental conditions summarized below:

- Indoor temperature range 10 to 35 °C
- Indoor temperature range tolerance ±2 °C
- Room relative humidity 15 to 85 %

- Minimum air change rate 30 m³/hr/person
- Room pressure relative to outside environment Positive
- Minimum filtration efficiency: filter class (EN 779) G4/F7\

5.3.4 Facilities in the Building 20

The RF Buildings structure will provide to the contractor the following systems and services to ensure the necessary conditions and a suitable environment both for the staff and the equipment:

- Lighting and service power.
- Fire detection, alarm and suppression.
- Drainage systems.
- Earthing system and lightning protection.
- Heating, Ventilation and Air Conditioning system, including associated hot and chilled water distribution systems.
- Overhead cranes (rated for 5 tons – to be confirmed) and elevator.
- Potable water and drainage for personnel requirements where necessary.
- Access control system.
- Communication network system.
- Compressed air (dry) system.
- Temporary power supplies during installation for tooling etc
- Local support.
- Office space.
- Use of workshop.
- Telephone lines/ internet access etc.

Details on the facilities will be provided by IO during the design phase. It shall be assumed that the consumables (electricity and water) needed during the on-site assembly, on-site installation, on-site commissioning and on-site acceptance will be provided by IO free of charge to the contractor.

5.3.5 Assembly completion in B20

The Table 5-8 specifies the deliverables required during the ITER site assembly activities, and associated due dates.

DL#	Description	Type	Due dates
28	End of RFS #1 Assembly completion report	Document	T0+45*
29	End of RFS #2 Assembly completion report	Document	T0+62*
30	End of RFS #3 Assembly completion report	Document	T0+72*
31	End of RFS #4 Assembly completion report	Document	T0+76*

Table 5-8: List of deliverables during assembly at ITER site

* the due dates are indicative and shall be optimized as per compatible with coactivity limit and dummy load availability

5.4 Scope of Service #2 – Commissioning and Site Acceptance Test

5.4.1 Service Description

The contractor shall perform the commissioning of the RFS. IO staff will coordinate the commissioning work.

The commissioning plan and associated procedures shall be defined by the contractor and validated through a Commissioning Readiness Review.

IO will provide the services as per the interfaces described in Section 5.1.5; it will be detailed and updated in the next version of this technical specification. Each RFS shall be commissioned up to its SAT readiness. SAT will be performed in the presence of ITER Staff. A typical Site Acceptance Tests description is given in Section 13.1.

After successful completion of the SAT, the contractor shall produce the SAT report; it shall be submitted to the IO review and acceptance. Approval by IO of a SAT report officialise the RFS unit ownership transfer to IO. The warranty period shall start at the SAT approval date.

5.4.2 Service Duration

The Commissioning and SAT duration shall be specified in the schedule proposed by the supplier; it shall be compatible with the schedule mentioned in Section 8.

5.4.3 End of Commissioning & SAT

The Table 5-9 specifies the deliverables required during the ITER site commissioning & SAT activities and associated due dates.

DL#	Description	Type	Due dates
32	RFS #1 CRR package	Document	T0+46*
33	RFS #2 CRR package	Document	T0+63*
34	RFS #3 CRR package	Document	T0+73*
35	RFS #4 CRR package	Document	T0+77*
36	RFS #1 SAT report	Document	T0+48
37	RFS #2 SAT report	Document	T0+68
38	RFS #3 SAT report	Document	T0+78
39	RFS #4 SAT report	Document	T0+82

Table 5-9: List of deliverables during assembly at ITER site

6 Location for Scope of Work Execution

For the manufacturing, assembly, factory testing and packaging the Contractor will perform the work at their own location.

Assembly, installation, commissioning and final acceptance tests will be performed on ITER site.

7 IO Documents & IO Free issue items

7.1 IO Documents

See Section 4.

7.2 Free issue items

N/A

8 Schedule Milestones & Deliverables

The maximum expected duration from the contract signature to the completion of the scope of work is 7 years. The global timeline is constraint with the ITER project needs.

8.1 Contract schedule and associated Milestones

The overall timeline is specified in this section. The Figure 8-1 defines the maximum timeline for the **Scope of Supply #1 – design and manufacturing of 4 RFS** (as described in the Section 5.1).

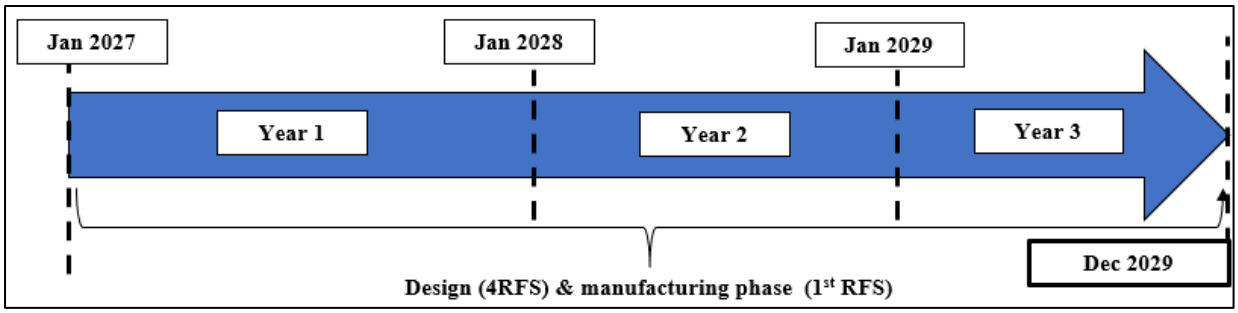

Figure 8-1: Design and manufacturing of RFS

The Figure 8-2 gives the global timeline for **Scope of Service#1 & scope of Service #2**, and the need dates for each individual RFS. To be noted that the most constrained RFS is the RFS#1, for which the installation shall start in January 2030, when the building 20 will be available.

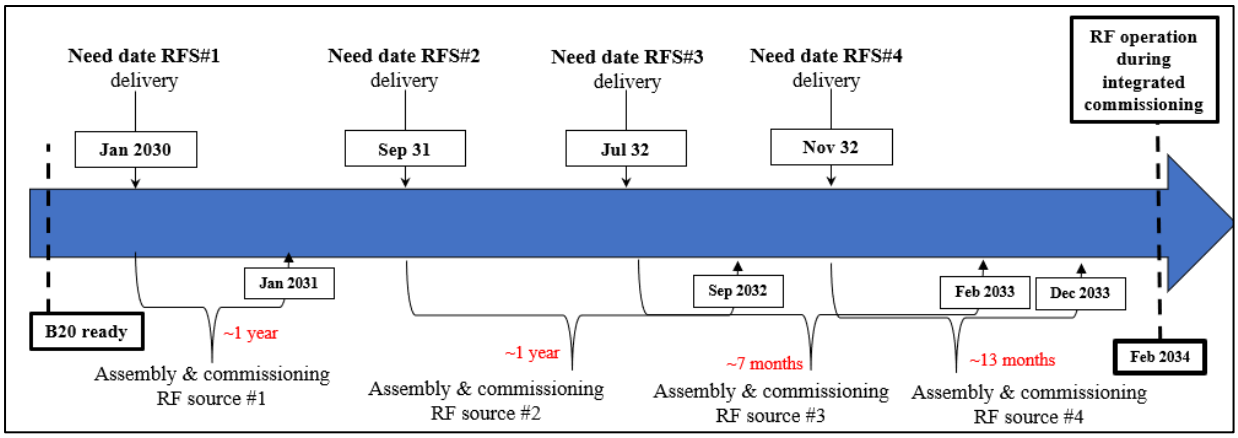

Figure 8-2: key Milestones (Need dates) for RFS delivery

The contractor shall produce the overall project schedule, considering the global timeline, and the need dates. In addition, the following ITER top level milestones (L1 milestones) shall be integrated in the execution schedule:

- L1 - End of IC RF Sources Procurement, Manufacturing and FAT → 24th December 2032
- L1 - End of IC RF Sources Installation and SAT → 23rd December 2033

The contractor shall issue the initial schedule for the whole project, and shall maintain the schedule forecast up to date throughout the overall work execution. The contractor is free to optimize the schedule according to its manufacturing capabilities, and shall demonstrate that need dates are achievable, in accordance with the Figure 8-2. The Final design review date is therefore not scheduled yet, since it is based on the contractor capacity to execute the **Scope of Supply #1 – design and manufacturing of 4 RFS.** the contractor shall provide the Final design review milestone, and it shall be not later than end of the second year (as shown in the Figure 8-1).

8.2 Deliverable summary

The contractor shall produce the deliverable as specified in the Table 5-6, Table 5-7, and Table 5-8. The following Table 8-1 summarizes the deliverables and dues dates to be provided by the contractor.

DL#	Description	Type	Due dates
Scope of Supply #1 – Design of 4 RFS			
1	Quality plan (full scope)	Document	T0+1
2	RFS Preliminary Design Description report	Document	T0+6
3	RFS Preliminary structural analysis package	Document & analyses model	T0+12
4	RFS Preliminary LCU description	Document	T0+12
5	RFS Preliminary Layout drawings	Document + native CAD file + ENOVIA	T0+8
6	RFS Preliminary Interface Compliance Matrix	Document	T0+6
7	RFS Preliminary 2D drawings	Native CAD file + ENOVIA	T0+8
8	RFS Preliminary 3D model	Native CAD file + ENOVIA	T0+8
9	RFS Preliminary PFDs	Native CAD file	T0+14
10	RFS Preliminary P&IDs	Native CAD file	T0+14
11	RFS Preliminary Wiring & cabling & single line diagram package	Native CAD file	T0+14
12	RFS Preliminary Bill of material	Document	T0+6
13	RFS Preliminary validation plan	Document	T0+6
14	FDR IDP (Cf.13.2)	Design Review Input Package	T0+20
Scope of Supply #1 – Manufacturing of 4 RFS			
1	End of RFS #1 manufacturing report	Document	T0+34
2	End of RFS #2 manufacturing report	Document	T0+52
3	End of RFS #3 manufacturing report	Document	T0+62
4	End of RFS #4 manufacturing report	Document	T0+66
5	FAT report of RFS#1	Document	T0+34
6	FAT report of RFS#2	Document	T0+54
7	FAT report of RFS#3	Document	T0+64
8	FAT report of RFS#4	Document	T0+68
9	RFS #1 *And associated documentation as per 5.2.5* (Delivered at ITER site)	Hardware	T0+36
10	RFS #2 *And associated documentation as per 5.2.5* (Delivered at ITER site)	Hardware	T0+56

11	RFS #3 *And associated documentation as per 5.2.5* (Delivered at ITER site)	Hardware	T0+66
12	RFS #4 *And associated documentation as per 5.2.5* (Delivered at ITER site)	Hardware	T0+70
13	TBD (MMTL, lift tools, test tools, etc)	Hardware	All along the project
Scope of Service #1 – Assembly at ITER site			
14	End of RFS #1 Assembly completion report	Document	T0+45*
15	End of RFS #2 Assembly completion report	Document	T0+62*
16	End of RFS #3 Assembly completion report	Document	T0+72*
17	End of RFS #4 Assembly completion report	Document	T0+76*
Scope of Service #2 - Site Acceptance Test and commissioning of the RFS			
18	RFS #1 CRR package	Document	T0+46*
19	RFS #2 CRR package	Document	T0+63*
20	RFS #3 CRR package	Document	T0+73*
21	RFS #4 CRR package	Document	T0+77*
22	RFS #1 SAT report	Document	T0+48
23	RFS #2 SAT report	Document	T0+68
24	RFS #3 SAT report	Document	T0+78
25	RFS #4 SAT report	Document	T0+82

Table 8-1: Deliverable summary table

9 Quality Assurance requirements

The Quality class under this contract is QC2, [4] GM3S Section 8 applies in line with the defined Quality Class.

In particular, The ITER Quality Assurance Program shall be applied to the full contract scope t and the contractor shall comply with the procedure **Quality Requirements for IO Performers (22MFG4 v64)**.

The contractor quality plan shall be provided at the beginning of the task.

All requirements of this Technical Specification and subsequent changes proposed by the Supplier during the course of execution of this Contract are subject to the Deviation Request process described in Procedure for the management of Deviation Request (ITER_D_2LZJHB) and Procedure for management of Nonconformities (ITER_D_22F53X).

10 Safety requirements

The scope under this contract doesn't cover neither PIC nor PE/NPE components.

Nevertheless, the following Defined requirement shall be considered in the design of the RFS. Therefore associated Protection Important Activity shall be identified and their monitoring shall be ensured during the execution of the work [20]:

- **[51ICs642-R;Defined Requirement]** The use of high power electronic tubes in RF sources can produce Xray radiation. Protective measures shall be defined and implemented to lower X-ray emission to a level such that the effective dose likely to be received by a worker, as a result of the use in that room of equipment emitting X-rays under normal conditions of use, remains below 0.080 mSv per month
- **[51ICs788-R;Defined Requirement]** The operation of the RF sources' high power electronic tubes generates X-rays. The tubes shall be shielded to make their X-ray radiation ALARA and to avert their classification as generators of ionizing radiation

Resulting requirements are defined in the following sections.

For Protection Important Components and in particular Safety Important Class components (PIC/SIC), the French Nuclear Regulation shall be observed, in application of the Article 14 of the ITER Agreement the Contractors and Subcontractors (if any) are informed that:

- ITER is a nuclear facility (an "INB", for Installation nucléaire de base, "Basic nuclear installation" in French regulation) identified in France by the number "INB no. 174".
- The ITER Policy on Safety Security and Environment Protection Management (ITER_D_43UJN7) must be circulated, known, understood and applied by all staff of the and cascaded down in the managerial lines of the contractors and sub-contractors.

In application of the ITER agreement, article 14, ITER follows the French Regulation for Nuclear safety. Because of its inventory in nuclear materials, ITER has been classified in France as a nuclear facility "*Installation Nucléaire de Base*" and in particular numbered as INB no.174 per the French Decree No. 2012-1248 dated 9 November 2012 authorizing IO to create a basic nuclear facility called "ITER" (ITER_D_CZK7M5) and the associated ASN Decision 2013-DC-0379 dated 12 November 2013 establishing the prescriptions applicable to ITER Organization for the design and construction of the licensed nuclear facility INB No. 174 called ITER (ITER_D_MU6PP3).

SUPPLY

10.1 Safety design criteria

The IC H&CD RF sources shall comply with the technical requirements of the French Order dated 29 September 2017 [9] and summarized in [18] setting the minimum technical design rules applicable to premises in which electrical equipment emitting X-Ray radiation is installed.

X-ray radiation and RF radiation near the vicinity of the equipment will follow the ITER standards (EN 55011, IEEE C 95-1991), and radiation protection directive 2013/59/EURATOM (transposed by French Decrees 2018-434 and 218-437) & shall be monitored by IO at IO 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.

Electronic tubes are high vacuum devices. The insulating parts are made of ceramics; they can break and implode violently, projecting dangerous debris. The RF cavities shall be fabricated to confine such debris.

High power electronic tubes dissipate very large amounts of heat. The cooling liquid can be at very high temperature. The untimely opening or break in a cooling circuit can release very hot water or steam. Sufficient protection shall be ensured for workers.

Access to the RF cavities during operation shall be forbidden by proper enclosures with key management system.

Equipment shall be designed to limit the propagation of fire to adjacent components. The inventory for all solid, liquid and gaseous toxic products for the HP 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 activity 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, Decrees 2018-434 (codifying French Public Health Code) and Decree 2018-437, [11]& [12]).

10.2 Safety limits

The dose rate of X-ray should be less than or equal to 0.5 µSv/hr measured at 0.1 m of any point that can be reached by operator in normal operating conditions [Decrees 2018-434 (codifying French Public Health Code) and Decree 2018-437 (codifying French Labour Code)].

The RF exposure for workers expressed as Equivalent Power density for plane waves shall be: $< 1.0\ mW/cm^2$ 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.

10.3 Safety monitoring requirements

Safety monitoring requirements shall be generated & submitted by the contractor for the approval of IO. Contractor shall monitor the same during factory acceptance test.

Monitoring shall be provided by 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.

X-ray emission will be checked during assembly, integration & commissioning and periodic measurement will be required, which is under IO safety division responsibility.

11 Seismic classification

The IC RFS is classified as Non-Seismic Components but the RFS design shall comply with the specified in this section.

The seismic analyses process for ITER components and the corresponding spectrum to be used for the analysis are defined in the [33], [34] & [35].

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 IO 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 contractor shall provide the RFS design assessment against SL-2 loading condition. It is part of IO 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 shall 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 applies to the area occupied by workers.

12 Special Management requirements

Requirement of GM3S [4] Section 6 applies in full.

12.1 CAD design requirements

This contract requires CAD activities, GM3S [4] Section 6.2.2.2 applies.

13 Appendices

13.1 Appendice I – SAT description

13.1.1 Test general conditions

All components used in the tests will be submitted to a specific validation: dummy load, transmission lines, etc. to make sure that no default on them will affect tests results nor test conditions.

All measurement tools will be calibrated, and the certificate will be available. Measuring equipment calibrations will be done every year.

All measurement errors bars will be defined and discussed within the design phase.

13.1.2 Test description

13.1.2.1 Functional and interfaces tests

Geometry:

- Check sources overall dimensions
- Check location of connections (water, electrical, etc…)
- Check source weight (before packaging, estimation by summing the different components weight)

Electrical:

- Electrical connections, grounding and protection circuits are OK (connector standards, cables sizes, etc….).

Control and instrumentation:

- Interlock and safety chains OK (logic, threshold and time response). It contains specific wire burn test for limitation of arc energy dissipation in tubes.
- Measurements are available in local and remote way.
- Local operation of the source via its controller is OK.
- Remote operation of the source via IC plant controller is OK.

Cooling

- Water cooling circuits are tested under real conditions; measurement of pressure drop at nominal flow.

- Air cooling circuits are tested under real conditions; measurement of pressure drop at nominal flow.

Assembly

- Source components assembly in terms of RF contact should meet full power tests on matched and unmatched load conditions. These tests are common with performance tests.

Mechanical test

- Check cavity movement (range and speed)
- Vacuum leak if applicable.
- Gas pressure test if applicable

13.1.2.2 Performance test

They have to ensure that all the specification requirements are met. They will be made in two types of operation mode: on matched mode and on unmatched mode.

All requirements will be verified.

Tests on matched load (VSWR ≤ 1.1)

It consists in full power 2000 s test at 4 frequencies 44 MHz, 55 MHz +2 frequencies in between.

For each frequency, measurement of:

- Output power calorimetric measurement (dummy load cooling circuits) and RF measurements.
- Reflective power amplitude and phase.
- Vacuum inside the end stage tube, if available.
- Tube operational parameters to ensure the stability of the working point, both electrical parameters and dissipation measurements (anode, screen grid voltages and currents, temperature, water flows,…). The complete list will be defined during the design phase.
- Bandwidth measurement
- Detection and suppression of parasitic oscillation measurements, if any.

Run tests: 5 successive pulses of 2000 sec demonstration pulses at full power with a duty cycle of 1/4.

Tests on unmatched load (VSWR =1.5)

It consists in full power 2000 s test at 4 frequencies 40 MHz, 55 MHz +2 frequencies in between.

For each frequency, output power and tube internal parameters will be checked at different reflection phase angles:

- For the two first sources: (0; 45°; 90°; 135°; 180°, 225°; 270°;315°)
- For the 2 balance sources: φ_{min}, minimum power phase angle (as defined in the previous test), φ_{min} +90°, φ_{min} +180°

Measurement of:

- Output power calorimetric measurement (dummy load cooling circuits) and RF measurements.
- Reflective power amplitude and phase.
- Vacuum inside the end stage tube, if available.
- Tube operational parameters to ensure the stability of the working point, both electrical parameters and dissipation measurements (anode, screen grid voltages and currents, temperature, water flows,…).

Detection and suppression of parasitic oscillation measurements, if any

The complete list will be defined during the design phase.

13.2 Appendice II – Typical FDR Input Data Package (IDP)

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.

The following list is an example of the documentation required for the Final Design Review. The list is provided for indicative purpose and might not be exhaustive.

Category	Document Type	Further Description
DOC	RF Source design description document	
CAD	General arrangement of components inside the RFS enclosure	CATIA files
CAD	51RSWD_PFD_001	Process flow diagram – water distribution
CAD	51RSWD_PFD_002	Process flow diagram – water distribution
CAD	51RSWD_PFD_003	Process flow diagram – water distribution
CAD	51RSWD_PFD_004	Process flow diagram – water distribution
CAD	51RSGD_PFD_001	Process flow diagram – gas distribution
CAD	51RSGD_PFD_002	Process flow diagram – gas distribution
CAD	51RSGD_PFD_003	Process flow diagram – gas distribution
CAD	51RSGD_PFD_004	Process flow diagram – gas distribution
CAD	51RSWD_PID_001	Process & Instrumentation diagram (cooling water)
CAD	51RSWD_PID_002	Process & Instrumentation diagram (cooling water)
CAD	51RSWD_PID_003	Process & Instrumentation diagram (cooling water)
CAD	51RSWD_PID_004	Process & Instrumentation diagram (cooling water)
CAD	51RSGD_PID_001	Process & Instrumentation diagram (gas)
CAD	51RSGD_PID_002	Process & Instrumentation diagram (gas)
CAD	51RSGD_PID_003	Process & Instrumentation diagram (gas)

SUPPLY

CAD	51RSGD_PID_004	Process & Instrumentation diagram (gas)
CAD	51RSA1-SLD-001	Single line diagram
CAD	51RSA2-SLD-001	Single line diagram
CAD	51RSA3-SLD-001	Single line diagram
CAD	51RSA4-SLD-001	Single line diagram
CAD	51RSA1-CBD-001	Cabling diagram
CAD	51RSA2-CBD-001	Cabling diagram
CAD	51RSA3-CBD-001	Cabling diagram
CAD	51RSA4-CBD-001	Cabling diagram
CAD	Local Control cubicle wiring diagram	
CAD	Auxiliary power supply wiring diagram	
CAD	Motor control cubicle wiring diagram	
CAD	Distribution board wiring diagram	
CAD	SSPA wiring diagram	
DOC	Plant System Instrumentation and Control Specification	
DOC	List of signals for the RF Source	
DOC	List of data	
CAD	Cubicle Hardware Configuration Diagram	
DOC	Description of Plant System State Machines	
DOC	Instrumentation and Control - Physical and Functional Architecture	
DOC	Equipment List	
BOM	Bill of material	
DOC	Technical Requirements Specification	
CAD	51RS assembly drawing	
CAD	51RSWD Isometric drawing	
CAD	Support structure drawing	
CAD	51RS Detailed Model	
DOC	Design Justification Plan	
DOC	Design Compliance Matrix - DCM	
DOC	Interface Compliance Matrix	
DOC	Functional Analysis Report-FAR	
DOC	Structural Integrity Report	
DOC	Seismic and dead weight calculation	
DOC	Thermomechanical calculation	
DOC	CANECO calculation	
DOC	CFD calculation	

SUPPLY

DOC	Any engineering analysis which is additional to the RAMI, HIRA, HOF which are listed hereafter	
DOC	REACH compliance justification	
DOC	RAMI analysis of the RFS	
DOC	HOF analysis of the RFS	
DOC	FAT & SAT Plan and Procedure	
DOC	Requirement Validation Matrix	
DOC	ROX and Research and Development Report	
DOC	Commissioning Plan	
DOC	Commissioning Test Procedure	
CAD	Part Drawing	
CAD	Installation Drawing	
DOC	Installation Execution Document	
DOC	RF Source concept of operation	
DOC	Operation procedure	
DOC	Maintenance procedure	
DOC	RF Source disassembly procedure	
DOC	RF Source maintenance and inspection plan	
DOC	Schedule and procurement plan	
DOC	Issue or Risk or Opportunity Analysis Report	
DOC	Change Request or Record, Deviation Request, Non-Conformance Report - NCR	
DOC	Contractor Quality Plan	
DOC	Sub Contractor quality plan	

china eu india japan korea russia usa
Route de Vinon-sur-Verdon - CS 90 046 - 13067 St Paul Lez Durance Cedex - France

Questionnaire Market Survey

Supply of the Radio Frequency Sources for the Ion Cyclotron Heating and Current Drive (ICH) system of ITER

Please note that this is not a Call for Nomination request, and the purpose of this survey is not to access and evaluate the capacity of your company. At this moment the ITER Organization (IO) is preparing a procurement strategy for this project. Therefore, we would appreciate very much if you will provide open and frank feedback.

We invite all potential companies, institutions or entities from ITER Member States to participate in this Market Survey by returning a completed questionnaire to the Procurement Officer in charge as follows :

Name of the PRO	:	Jun Hyung Park
Email of the PRO	:	JunHyung.Park@iter.org
Copy Email to	:	Andrew.Brown@iter.org
Last date to submit your response	:	**30/06/2026**

china
eu
india
japan
korea
russia
usa

Reference documents:

I. IO/MS/ICH/JPK/X Annex I: Technical Specifications ref FKNP8R and ITER Quality Assurance Program (QAP) ref 22K4QX
II. IO/MS/ICH/JPK/X Annex II: Template Schedule and Cost Feedback Table
III. IO/MS/ICH/JPK/X Invitation Letter

1. *General information about the Company compiling the questionnaire*

Company Name: ……

Address: ……..

Years in Operation: ……...

Main activities

Main activities	***Description***
1.	
2.	
3.	

Representatives to be contacted

Contact person	***Name + Title***	***Email address***	***Telephone***
Commercial Matters:			+
Technical Matters:			+

2. General Questions

2.1 Are you familiar with ITER project or comparable complex installation and do you have any knowledge of ITER requirements and guidelines as described in the reference documents of the technical specifications (Annex I)?

YES ☐ **NO** ☐

Please provide overview and/or any complementary information:

.....

.....

.....

.....

3. Questions related to feedback on ICH RFS technical specifications

3.1 Does the published Technical Specification provide you with a clear understanding of the project, its purpose and the roles and responsibilities expected to be undertaken by the future contractor(s)?

YES ☐ **NO** ☐

If NO, please list information you need from us:

.....

.....

.....

.....

3.2 For which scope or partial scope as described in the technical specification (Annex I) would you be interested in to apply for if there was a future tender competition? Please provide your feedback on the following Table 1 about the scope you are interested in:

Table 1 : Scope of work

Main Scope under contract	*Sub task under contract*	*Interest?*	
		Yes	*No*
4 sets of RF Sources	Design, Manufacturing, Factory Testing, Delivery		
4 sets of RF Sources	Installation		
4 sets of RF Sources	Commissioning, and Site Acceptance Test		

For the scope you are not interested in, please provide the reasons why:

.....

.....

.....

.....

3.3 Would you like to undertake the full scope mentioned in Table 1 above (against each phase of contract execution), or would you prefer just a part of it?

YES, undertake full scope ☐ ***NO, only part of the scope*** ☐

If NO, please explain which scope you would like to drop:

.....
.....
.....
.....

Table 2 : Summary of scope

Scope / tasks to be undertaken (from Table 1)	***Scope / tasks not to be undertaken (from Table 1)***

3.4 Would you consider organizing a consortium to cover the full scope, it has to be noted that subcontracting (excluding supply of materials) is only permitted to maximum of 40% of contract value, the limit of 30% doesn't apply to consortium members?

☐ ***YES, I could consider undertaking full scope in consortium with other company (ies)***
☐ ***NO***

If YES, please explain what your conditions would be to take part in a consortium:

.....
.....
.....
.....

Table 3 : Summary scope distribution

Scope / tasks to be undertaken by respondent (from Table 1)	***Scope / tasks to be undertaken by consortium members or subcontractors (from Table 1)***

3.5 Would you prefer that the tender was executed in several Lots and you select the Lots best suited to your capacity and skill sets?

YES, I prefer a tender in Lots ☐ ***NO*** ☐

If YES, please propose the breakdown of the full scope as described in the technical specification (Annex I) in several Lots you think relevant:

.....

.....

.....

.....

3.6 Do you (including possible consortium members) have the capacity to install on ITER site such specialized ICH RFS systems as part of your regular business operations, or do you subcontract these activities?

YES, it's our regular business operation ☐ ***NO, we subcontract*** ☐

If YES, please explain how your company is organized to handle such task:

.....

.....

.....

.....

If NO, please specify which part of the activity you have subcontracted, and which activity is performed by your company. Please provide your feedback in Table *24 below:*

.....

.....

.....

.....

Table 4 : Division of installation activities

Installation work by your Subcontractor	*Installation work by You*

If NO, please explain in four bullets, how you are controlling the "quality of work and quality control-assurance" of the task performed by your subcontractor:

- .....
- .....
- .....
- .....

3.7 According to the scope you are interested in, do you have similar mature products that can meet the technical requirements with reference to the technical specification (Annex I)?

YES ☐ **NO** ☐

If YES, please provide a detailed overview. Please report maximum five major systems that you believe have similar technical requirements that the ones we intend to procure:

1. .....
2. .....
3. .....
4. .....
5. .....

If NO, please indicate if you would be ready to engage the development of a prototype compliant with the technical specification and under which conditions (time needed, IO engagement…):

.....

.....

.....

.....

In case of prototype activity, is the provided technical specification applicable to the prototype? Do you have alternative proposal for prototype activity?

.....

.....

.....

.....

3.8 Do you have experience in installation and commissioning of RF sources in a comparable complex installation or in ITER as described in the reference documents of the technical specification (Annex I)?

If YES, please provide a detailed overview:

.....

.....

.....

.....

If NO, please indicate how you plan to deal with and comply to the requirements described in the reference documents of the technical specification (Annex I):

.....

.....

.....

.....

3.9 Do you see technical difficulties in the scope of the different parts of ICH RFS with reference to the technical specification (Annex I)?

YES ☐ **NO** ☐

If YES, please identify the main risks in following Table 5 with proposed remedial actions.

Table 5: Technical risk and remedial proposal

Technical difficulties from the specification	***Technical risk***	***Proposal to overcome the risk***

4. Question related to feedback on the manufacturing aspects

4.1 Do you see any schedule or technical risk on the availability of the components needed for the manufacturing of RFS considering the delivery schedule and numbers of RFS?

YES ☐ **NO** ☐

If YES, please indicate the risk you have seen and proposal for its mitigation:

.....

.....

.....

.....

4.2 Could you please provide a tentative planning for manufacturing, factory testing, shipping, installation, and commissioning for the scope you are interested in?

Please use the provided template (Annex II) and consider the start date (T0) as the clearance from IO to begin manufacturing.

4.3 Do you consider your present manufacturing capabilities allow you to manufacture the 4 RFSs in the dedicated period with reference to the technical specification (Annex I)?

YES ☐ **NO** ☐

If NO, please provide the maximum production rate you can achieve and explain the point(s) limiting your manufacturing capabilities and if possible and desired by your company, how to increase your capabilities:

.....

.....

.....

.....

4.4 Would you consider it possible to start a 7 year contract in 2027 (cumulated duration for the full scope), with a site installation and commissioning period not starting before 2030?

YES ☐ **NO** ☐

If NO, please provide further explanation:

.....

.....

.....

4.5 Would your Company(or possible consortium) cover the full scope of work for Manufacturing, assembly, factory testing, packaging and delivery to ITER site as a single contractor?

YES ☐ **NO** ☐

If NO, please specify and justify which part of the contract would be taken over by another company, and in which role: as a partner in a consortium or as a subcontractor? Please indicate the name and address of the potential company/companies if known at this time.

Please provide the information requested in the below table:

Works to be performed by another company (and % of the work)	***Partner in a consortium or Subcontractor + Name and Address (optional)***	***Comments***
…… ……		
…… ……		
…… ……		

4.6 Would your Company cover the full scope of work for Installation and assembly on ITER site as a single contractor?

YES ☐ **NO** ☐

If NO, please specify and justify which part of the contract would be taken over by another company, and in which role: as a partner in a consortium or as a subcontractor? Please indicate the name and address of the potential company/companies if known at this time.

Please provide the information requested in the below table:

Works to be performed by another company (and % of the work)	***Partner in a consortium or Subcontractor + Name and Address (optional)***	***Comments***
…… ……		
…… ……		
…… ……		

4.7 Would your Company cover the full scope of work for Commissioning and final acceptance test on ITER site as a single contractor?

YES ☐ **NO** ☐

If NO, please specify and justify which part of the contract would be subcontracted to another company, and in which role: as a partner in a consortium or as a subcontractor? Please indicate the name and address of the potential company/companies if known at this time.

Please provide the information requested in the below table:

Works to be performed by another company (and % of the work)	***Partner in a consortium or Subcontractor + Name and Address (optional)***	***Comments***
…… ……		
…… ……		
…… ……		

4.8 Do you see any difficulty in terms of interface and resources to meet the RFS technical requirements?

YES ☐ **NO** ☐

If YES, please describe briefly how you meet the specification requirement. Do you have any alternate proposal?

……

……

……

……

5. Quality Assurance and compliance to standards

5.1 Are you certified ISO 9001 or equivalent?

YES ☐ **NO** ☐

Please specify your certifications.

QA Certifications	*Comments*	*Validity Period*

5.2 Do you have inhouse quality control team to ensure quality assurance and compliance through the full contract cycle in compliance to ITER quality program?

YES ☐ **NO** ☐

If NO, please provide a brief overview how you can meet the quality control and assurance requirement:

.....

.....

.....

.....

5.3 Are you familiar with electrical French standards applicable on ITER site as stated in the reference documents of the technical specification (Annex I)?

If YES, please provide some justification and example:

.....

.....

.....

.....

If NO, please indicate how you plan to deal with and mitigate your lack of experience:

.....

.....

.....

.....

6. Feedback on commercial aspects

6.1 As stated in the technical specification (Annex I), the capacity to ensure a ± 1MHz, 1 dB bandwidth over 40 MHz to 55 MHz at fixed input power is required. Do you consider this requirement as difficult to reach and having a big impact on the final cost of the RFS?

YES ☐ **NO** ☐

If YES, please detail and provide a rough estimation of the impact on the final cost and the bandwidth reduction required to cancel the impact:

.....

.....

.....

.....

6.2 As stated in the technical specifications (Annex I), the capacity to ensure 3 MW CW output power on VSWR = 1.5 at any phase of the reflection coefficient from 40 MHz to 55 MHz shall be achieved. Do you consider this requirement as difficult to reach and having a big impact on the final cost of the RFS?

YES ☐ **NO** ☐

If YES, please detail and provide a rough estimation of the impact on the final cost while considering separately or at once:

- a VSWR reduction to 1.3 (transient at 2 for 1 s)
- a pulse reduction to 600 s or 1000s
- a lower efficiency (as per your proposal).

.....

.....

.....

.....

.

6.3 As stated in the technical specifications (Annex I), the Site Acceptance Tests include long pulses and run test session of 5 successful long pulse tests with a duty cycle of ¼. Do you consider this requirement as difficult to reach and having a big impact on the final cost of the RFS?

YES ☐ **NO** ☐

If YES, please detail and provide a rough estimation of the impact on the final cost while comparing it with a new SAT strategy you could propose with some justifications :

.....

.....

.....

.....

6.4 The Factory Acceptance Test has to be defined by the contractor and shall allow a risk mitigation of issue occurrence after delivery at IO site, such as interface or performance issues. The SAT scheme stated in the technical specification shall be used as guidance for this definition. Do you consider the FAT process strategy as having an impact on the final cost of the RFS?

YES ☐ **NO** ☐

If YES, please detail and provide a rough estimation of the impact on the final cost while comparing FAT strategies you could propose with some justifications:

.....

.....

.....

.....

6.5 Project Cost

If possible, could you please indicate, for the supplies and services you are interested in, your estimate of the project costs based on rough-order-magnitude in the following format. It is requested from the potential contractors to segregate the costs related to:

- *Manufacturing, assembly, factory testing and packaging.*
- *Delivery/transportation to ITER site.*
- *Installation and Assembly on ITER site.*
- *Commissioning and Final acceptance tests on ITER site.*
- *Contract Management, documentation and training.*

Template (Annex II) is provided with this document to submit your feedback. Please fill the details in two tables on the provided templates and submit the pdf version along with this document.

All prices shall be in Euros (€) net of all duties and taxes. As an international organization the ITER Organization is exempt from all taxes and duties. The Supply shall be delivered on the basis of DAP Incoterms 2020, Saint Paul les Durance-France.

Note: *All the companies who participate in this questionnaire are requested to submit the cost estimation as non-binding basis. The target uncertainty of the estimation should be within +/-15%. The information will help the IO to estimate the approximately level of the market prices.*

7. General Comments

7.1 How do you rate the probability of your company tendering for this contract?

LOW ☐ **MEDIUM** ☐ **HIGH** ☐

If LOW or MEDIUM, please identify and explain the reasons/showstoppers for your company to participate in the project:

.....

.....

.....

.....

7.2 In your opinion, what sort of contract type would be best for implementing the work and give your reasons as to why you think this contract type has advantages over any other type?

.....

.....

.....

.....

.....

.....

.....

7.3 Please indicate any other information that may be relevant for this market survey.

.....

.....

.....

.....

.....

.....

.....

Signature: COMPANY STAMP

Name: .....

Position: .....

Tel: .....

Date: .....

Note: How to fill the table

1 This file contains two tabs. Please ensure you fill in your input on both tabs

2 Rows correspondence to sr. no 1, 3, 5, 7, 9 and 11 should indicate the cost number

3 Rows correspondence to sr. no. 2, 4, 6, 8 and 9 should indicate the cost for each set for each biannual period. It is possible that the cost will be the same for biannial. The unit for cost should be in Euros

4 Adjust the cell height and width as needed to display the full value, number, or text

5 Convert this file to PDF format for submission (landscape orientation in A4 format on one page)

6 This document is an integral part of the “Market Survey Questionnaire.” Partial submission of the document is not acceptable.

CASE -1 : Full Scope 4 Radio Frequency Sources manufacturing, test, installation at IO site and commissioning (full performances)

Sr. No	Scope	2027	2028	2029	2030	2031	2032	2033
1	Design & integration							
2	please indicate the fraction of sub contracted cost if any							
3	Manufacturing							
4	please indicate the fraction of sub contracted cost if any							
5	FAT							
6	please indicate the fraction of sub contracted cost if any							
7	Delivery at IO							
8	please indicate the fraction of sub contracted cost if any							
9	Installation							
10	please indicate the fraction of sub contracted cost if any							
11	Commissioning							
12	please indicate the fraction of sub contracted cost if any							
	total							

Total Cost	€0.00

CASE -2 : Full Scope 4 Radio Frequency Sources manufacturing, test, installation at IO site and commissioning (performance revised)

Sr. No	Scope	2027	2028	2029	2030	2031	2032	2033
1	Design & integration							
2	please indicate the fraction of sub contracted cost if any							
3	Manufacturing							
4	please indicate the fraction of sub contracted cost if any							
5	FAT							
6	please indicate the fraction of sub contracted cost if any							
7	Delivery at IO							
8	please indicate the fraction of sub contracted cost if any							
9	Installation							
10	please indicate the fraction of sub contracted cost if any							
11	Commissioning							
12	please indicate the fraction of sub contracted cost if any							
	total							

Total Cost	€0.00