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MQP Level 2

Procedure for Identification and Controls of Items

This MQP Level-2 procedure describes general procedure for identification and item control. General purpose of identification and item control are:
• To ensure the traceability from early design to dismantling of items
• To provide under operation constraint fast retrieval to item related information
• Full traceability, maintenance, etc.
The contents of this procedure are 1) control items and attributes, 2) identifiers, 3) labelling / tagging, 4) item control throughout the project lifecycle, 5) item lists, e.g. Bill Of Materials, BOM's and 6) item control mechanism relying on material management database system. Responsibility assignment regarding item control is also described. Since there are several procedures and instructions for labelling for different scopes already, this document provides harmonization of those existing documents related to physical identification,... (Please see complete abstract on document metadata.)

Approval Process			
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Change Log			
Procedure for Identification and Controls of Items (U344WG)			
Version	***Latest Status***	***Issue Date***	***Description of Change***
v0.0	In Work	26 Oct 2016	
v1.0	Signed	03 Aug 2017	first version as per approved MQP doc request URMJ6X
v1.1	Signed	18 Sep 2017	Considered the reviewer's comments on v1.0, and revised. Definition of terminologies and relationship to CM process are enriched, in particular.
v1.2	Approved	25 Sep 2017	As commented by CIO/CMD head, rev. nums. of the latest approved versions of the applicable documents are added.
v1.3	Signed	11 May 2018	As per MQP doc Request - WK7ES6 Includes Module H needs
v1.4	Revision Required	05 Jun 2018	Update of Table of content Change reference number 3 from 28WP2P superseded by UXM79P As per MQP doc Request - WK7ES6 Author is changed to includes Module H needs Consistency with other MQP documents regarding definition of terminologies, control gates, the MQP-tree, to be done in future major revision
v2.0	In Work	03 Jul 2019	As per approved MQP doc Request - XYC6CF, the list of main changes are: Change 1: PE/NPE requirement is added (integration of comments from v1.4); Change 2: DA applicable requirements are added; Change 3: • Definitions of terminologies are aligned and centralized (especially kinds of Item-ID-Codes); • Transfer of Bill of materials to construction is described as a critical activity of ID Process; • Listed requirements for each type of PA, Check List and recovery actions are added in the appendixes, as requested by users. For further details, the document had been pre-reviewed (Y8W4F9) and author provided a summary table including the answer per comment.
v2.1	In Work	03 Jul 2019	Fixed some broken formats
v2.2	Approved	03 Jul 2019	Fixed some broken format

Table of Contents

1 Purpose

This MQP Level-2 procedure describes the general procedure for Identification and Control of Items (ID) Process in accordance with QAP [1], Sec. 3. 6. Purposes of ID Process are:

- To avoid confusion between different items and/or items in different statuses, e.g. pass/fail at certain Control Gate, verification test;
- To record, monitor and to enable traceability for all controlled items and their attribute data, e.g. status, location (installed or stored), responsible entity/person, and related documentation;
- To provide fast retrieval of item-related information, e.g. as-built record, under operation constraint, damaged equipment; and
- To comply with the requirements of nuclear and other regulations.

The ID-Process aims at ensuring "Full Traceability" for the item itself and the related data/documents. During the project lifecycle, the state of an item evolves, e.g. as-designed, as-built, etc. Item-related data/documents are generated in each phase of the lifecycle, and validated at each Control Gate or Control Point, in terms of completeness, consistency, conformance, etc. To realize the Full Traceability, all status and the related data/documents are recorded in the dedicated IT databases.

Applicability of this MQP-L2 for PA :

- Applicable for PA's to be signed;
- Regarding the signed PA's, appropriate level of authority to decide through formal process.

Responsibility assignments within ID-Process are also described regarding five individual types of PA's. Responsibilities of DA in each type of PA are summarized in Sections 6 and 7[1]. Short guidance is described in Appendix-C.

2 Scope

The scope of this document and the related sections/paragraphs are as follows:

i.	Controlled items and their attribute data;	
ii.	The three types of key Item-ID-Codes respecting "Three Ball Model," and other Item-ID-Codes;	(5.1)
iii.	Labelling and tagging to physical item;	(5.2 and Appendix-A)
iv.	Tagging to data/documents and/or to the described items in them, with Item-ID-Codes;	(5.3 and Appendix-B)
v.	Means for check of implementation and track, e.g. Control Gates[2], IT database system.	(5.4, 6 and Appendix-D)
vi.	Handover of material management and cataloguing related data to the IO construction entity (SmartPlant)	(5.4)

[1] As necessary, read other portions in the main content and the appendixes. Regarding in-cash contract, IO-Eng-RO to describe the ID-Process requirements in the contractual document, in compliance with this MQP document and the applicable MQP-L3's.

[2] Control Gate definition to be documented by Design Control and Configuration Management Processes.

Where the Controlled Items are items belonging to one or more of the following categories:

a) Items constituting the ITER System[3], e.g. Components, Parts, (Sub)Assemblies;
b) Temporary items, e.g. tooling, jigs, inspection equipment;
c) Consumables, e.g. welding filler material, chemicals;
d) Transportation package, e.g. crate;
e) Spare parts

Within the Controlled items, "Items constituting the ITER System" or groups thereof, are specifically called ITER Individually Distinguishable Items, IDI's. IDI is any item, or a group thereof, of interest to IO-CT's, in particular for logistics <As-Delivered>; warehouse, construction and future operation and maintenance <As-Handled on the ITER site>.

2.1 Out of Scope

- ITER Buildings (civil structures), System and Sub-System[4] are out of the scope;
- Definition of the required data and documents management according to the type of item in Engineering Phase, i.e. Design and Manufacture.
  Note: the data structures and minimal requirements for the item lists (standard names for attributes of items[10]) are parts of the ID Process.

This MQP document provides the overview of the ID Process and associate requirements. The details for the implementation are described the level-3 MQP documents, specific Work Instructions (WI's) and/or individual Technical Specifications of PAs and contracts, which will be generated by technical disciplines.

Fig. 1 shows the MQP document structure which details Section 3.6 of the QAP, the "Identification and Control of Items" process. Below MQP-L2 [U344WG] (this procedure), there are six MQP L-3 documents:

1) ITER Numbering System, e.g. ID-Code schema [3];
2) TTT-Codes to classify ITER Components [4];
3) Creation of Part Number of ITER, PNI and cataloguing [9];
4) Physical labelling and tagging [8];
5) Templates for BOM, Equipment List, etc., and standard attributes [10], and
6) Generation of ITER Bill of Materials (BOM) for Smart Plant Data Loading [36].

[3] In other documents, this is named "ITER Plant"
[4] The higher levels of the ITER PBS.

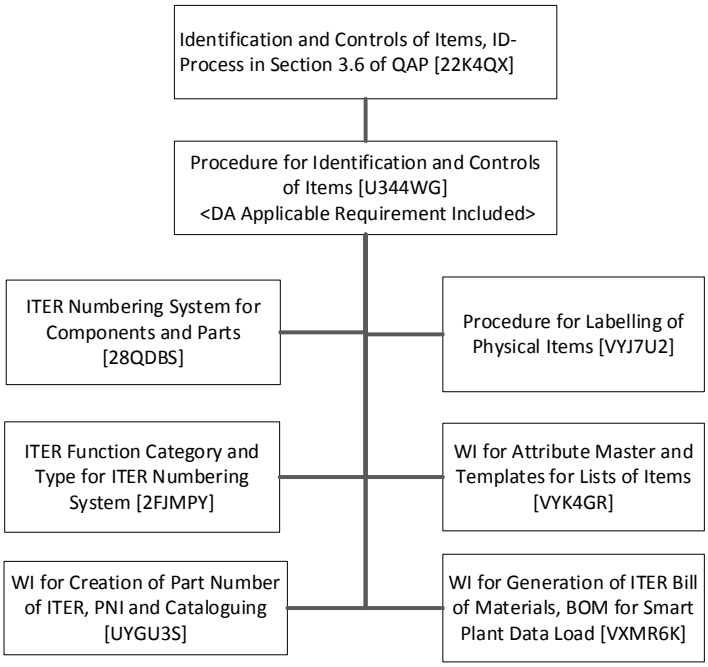


Fig. 1 MQP Document Tree Structure

3 Definitions and Acronyms

3.1 Definitions

1	3-Ball Model, 3BM	A data model aiming at identification and traceability of an item based on three key Item-ID-Codes and their relationship, namely Functional Reference Number (FR), Item-Type-Reference Num. (PNI) and Physical Item Ref. Num.(SN).
2	As-Built	Includes <as-manufactured>, <as-site-assembled>, <as-constructed>, <as-installed>. As-Built Item and the associated data/documents are tagged with the SN's and /or the Lot/Batch Numbers. *Note: As-Built Drawings differs from the original Design, Construction and Assembly Drawing." As-Built drawings describe the real physical items after manufacturing, site-assembly, installation, construction, etc., and include all changes, accepted non-conformities, etc.*
3	CAD-Ticket System	Used to generate or to change PNI's and TTT-Codes, and for cataloguing. Link: IO CAD Ticket System
4	Controlled Items	Items in the scope of the ID Process belonging to one or more of the following categories: 1. Items constituting the ITER System, e.g. Components, Parts, (Sub)Assemblies; 2. Temporary items, e.g. tooling, jigs, inspection equipment; 3. Consumables, e.g. welding filler material, chemicals; 4. Transportation package, e.g. crate, and 5. Spares of the above, as required.

		Those Controlled Items are in various states, such as "As-In the ITER System," "As-Designed" and "As-Built." As-Built Item is called "Physical Item," as well.
5	Data/Documents	In this procedure, "Data/Documents" means, for example, Technical Specification, List of Items, Drawings, Diagrams, 3D Models, individual physical or functional data. Those Data/Documents can be the source data for SP Data Load.
6	Engineering Dossier	The engineering dossier is a container of technical information for a given scope and purpose, that forms the building-blocks of the ITER configurations and baselines. See CM Process MQP [2]
7	Functional Reference Number, FR	The unique code identifying an ITER Component within the ITER PBS, as detailed in [3]. FR is one of the 3 types of key Item-ID-Codes of the 3-Ball Model, identifying an item "As-In the ITER System."
8	Handover Package (HOP) for Engineering Work Package (EWP)	See [7].
9	Item Type Descriptor	Item-Type-Descriptor is an optional descriptive code representing Item-Type tagged as well as PNI and/or MN. It can tag to an item accompanying with PNI. Item-Type-Descriptor is requested by IO Engineers to distinguish items without relying on any relational database, e.g. in a work field. The guideline and the format to be provided, later.
10	ITER Catalogue	Project-wide list of Standard Controlled Item-Types tagged with PNI's, the relevant attribute data and the reference documents. See [9] for detail. Since the ITER Catalogue is not a tool for tracking design features of an Item-Type, only general properties to distinguish and to classify Item-Types are listed. Design information of each Item-Type and change on it are controlled with the design documents and/or the Engineering Dossier on PLM/Matrix. *Note that the 3D-Catalogue (or Library) is a different catalogue listing 3D-Models associated with CAD-oriented data*.
11	ITER Component	ITER Components are the lower nodes of the ITER-PBS. An ITER Component is a major piece of equipment uniquely located within the ITER System, such as a pump or a tank, which is tagged with a FR. *Note: FR's do not exhaustively tag to items constituting the ITER system, but only tag to selected items, i.e. ITER Components, e.g. pumps, cables, supports, sensors. While PBS L1 to L3 Codes tag to items exhaustively within a same level. In other word, summation of items in each PBS level always becomes equal to the ITER System. For ITER Component tagged with FR's, not.* TTT-Code as a part of a FR is used for the classification of ITER Components [4].

12	IO-CT Engineering Responsible Officer, IO-Eng-RO	IO-Eng-RO means TRO for PA, PBS-RO, Transverse Function RO, etc., who is responsible for a certain system, sub-system, equipment, component, etc., on the engineering side (not on the construction side) For EWP-HOP preparation, "EWP-Leader" corresponds to the IO-Eng-RO.
13	ITER Individually Distinguishable Item, IDI	IDI is an item or a group of items of interest to IO-CT's, which constitutes the ITER System as a part/component. More specifically: • Item of as-delivered situation to the site (or to another manufacturer's premises, as necessary); • Group of items to be site-assembled , e.g. kit of interface components; • Items to be dismantled and re-assembled on site; • Items subject to maintenance; Non-IDI: • Items shop-assembled together as part of the product before shipping, e.g. interior of IDI; *Note 1: Depending on purpose:* • *Items assembled as a part of the product before shipping, and to be physically integrated at the site, e.g. Programmable Logic Controller (PLC), signal conditioner, etc. are not IDI's for logistics or warehouse, but are IDI's from construction and maintenance point of view, since they need to be uniquely identified for installing the connections/cables with other equipment during the site-assembly activities;* • *On-site sub-assembly can be recognized as IDI.* *Note 2: All IDI's or groups of IDI's shall be tagged with PNI's, and registered in SPMAT. Finally, relying on SPMAT, IDI's are controlled in logistics, warehouse and construction.* *Note 3: Systematic grouping of items, "kitting" is recommended taking into account the site-assembly process, so that quantity of IDI's to be managed is decreased.*
14	Item-Type	Design solution of item (independent of its instantiations), e.g. part, component, equipment represented with the Product Technical Specification, the Component Drawing, etc. *Note 1: IDI-Type is tagged with the Part Number of ITER, PNI, associated the Item-Type-Descriptor (optional) and/or the MN, as necessary. Any Item-Type should be identified and tagged with MN respecting the Quality Plan, QP [16].* *Note 2: All Standard Item-Types used in ITER are listed in the ITER Catalogue distinguish different Item-Types produced by a manufacturer catalogue.*
15	Manufacturer Model/Part Number, MN	The MN performs the same function of the PNI. MN's are used by manufacturers within their catalogues to distinguish different Item-Types produced by the manufacturer. PNI's are used in the ITER

		Catalogue to identify the same Item-Types, but accordingly to the ITER numbering conventions. *Note: MN is affixed to any item managed by the manufacturer respecting the contractual document and the Quality Plan (QP) thus establishing a link between PNI's and corresponding MN's and achieving full traceability down to the manufacture's data/documents.*
16	Packing List	See TDFC [15].
17	Part Number of ITER, PNI	The number identifying a given IDI-Type "As-Designed." PNI is one of the three key Item-ID-Codes of the 3-Ball Model. IDI, or groups thereof, shall be tagged with PNI. See ref [3].
18	Quality Control Records	Specified by Manufacturing Assembly and Installation, MA process. For DRR and CCR, all as-built data/documents are compiled as Manufacturing and Construction Quality Control Records, respectively. Tagging to physical items, to items in the data/documents and to the data/documents shall be ensured with these Quality Control Records.
19	Serial Number, SN	Key Item-ID-Code used to tag to physical item, "As-Built." SN's are used to distinguish different instances of the same Item Type. It can be Serial Number (SN), batch number, or lot number: • SN's are used for individual products; • Lot or batch number on multiple items of the same design, the same material, in the same contract/production, etc. *Note-1: In this document SN represents all Item-ID-Codes, e.g. Lot/Batch Num., tagging to As-Built item.* *Note-2: Only with SN, sometimes items are not uniquely identified. However, Item-Type-Code, e.g. PNI, MN, followed by SN is always the unique identifier.*
20	Standard/Non-Standard IDI-Types	Items are separated between Standard/Non-Standard IDI-Types in the material management system. "Standard IDI-Types" are created for use of 1) Bulk procurement by IO for construction, 2) Procurement and stock of spare equipment and parts, etc. • The Standard IDI-Types are typically: o Industrial standard parts, e.g. EN or ASME Pipes; o Parts or equipment of COTS items (catalogue by suppliers); o Some custom design items controlled by IO, for instance with the technical specification/dossier and/or in 3D Library; • "Non-Standard IDI-Types" are normally associated with custom components that have been designed and manufactured explicitly for ITER.
21	Tag	Tag means an ID-Code attached to an item, a data/document, etc., or

		an action to affix an ID-Code. Usually, in plant construction, the word “Tag” is used with the same meaning as “FR” affixed to a functional component. Consequently, “a tagged item” means an item designated with FR.”

3.2 Acronyms

Abbreviation	Description
BOM	Bill of Material
CCR	Construction Completion Review
CM	Configuration Management
COTS	Commercial Off-The-Shelf
CRR	Construction Readiness Review
CWP	Construction Work Package
DA	Domestic Agency
DRR	Delivery Readiness Review
EWP	Engineering Work Package
FR	Functional Reference Number
GA	General Arrangement (Drawing)
HOP	Hand-Over Package
IWP	Installation Work Package
MN	Manufacturer Model/Part Number
MRR	Manufacturing Readiness Review
NPE	Nuclear Pressure Equipment
P&ID	Process and Instrumentation Diagram
PA	Procurement Arrangement
PE	Pressure Equipment
PFD	Process Flow Diagram
PIC	Protection Important Component
PNI	Part Number of ITER
QP	Quality Plan
RASCI	R: Responsible, A: Accountable, S: Support, C: Consulted and I: Informed
SIC	Safety Important Component
SMDD	System for the Management of Diagrams and Drawings
SN	Serial Number
SP	SmartPlant
SPMAT	SmartPlant Materials
SPRD	SmartPlant Reference Data
UID	Unique Identifier
UOM	Unit of Measure
WI	Work Instruction
WP	Work Package

For other abbreviations, see; https://portal.iter.org/Pages/abbreviations.aspx

4 Reference Documents

Title of Document	UID
[1] Quality Assurance Program, QAP	22K4QX

[2]	Procedure for Configuration Identification and Status Accounting	TZV743
[3]	ITER Numbering System for Components and Parts	28QDBS
[4]	ITER Function Category and Type for ITER Numbering System	2FJMPY
[5]	Specification for Labelling of Equipment on ITER Project	TL25DK
[6]	ITER Site Signage & Graphics Standards	4ALJEU
[7]	WI for Construction Preparation (EWP/CWP/IWP)	UYGEDA
[8]	Procedure for Labelling of Physical Items	VYJ7U2
[9]	Procedure for Part Number of ITER, PNI and Cataloguing	UYGU3S
[10]	WI for Attribute Master and Templates for Lists of Items	VYK4GR
[11]	Instructions for CAD Documents Used for Tokamak Assembly Contracts	UC6CU3
[12]	TDFC_Bill_Of_Material_T4.0_S1	W9ZCNP
[13]	TDFC_Equipment_Component_List_T4.0_S1	WBXM7R
[14]	TDFC_Deliverable_List_T5.5_S3	WA93DF
[15]	TDFC_Shipping_or_Logistics_Record_T5.1_S3	WCGGUH
[16]	Requirements for Producing a Quality Plan	22MFMW
[17]	Procedure for the Preparation, Review, Approval and Award of Procurement Arrangements	2W4F7A
[18]	Sign-Off Authority (SOA) for Project Documents	2EXFXU
[19]	ITER System Design Process (SDP) Working Instruction	4CK4MT
[20]	Annex B Template Technical Functional Specification	28B3SF
[21]	Working Instruction for Manufacturing Readiness Review	44SZYP
[22]	Working Instruction for Construction Readiness Review	QXW4KQ
[23]	Working Instruction for the Delivery Readiness Review (DRR)	X3NEGB
[24]	Procedure for Transportation of Components to ITER Site	RY5C6Q
[25]	Procedure for Reception of Components at the ITER Site	RXCTBZ
[26]	Procedure for the Storage and Preservation of ITER Components at the ITER Site	RWYED5
[27]	Quality Classification Determination	24VQES
[28]	Safety Important Functions and Components Classification Criteria and Methodology	347SF3
[29]	List of the ITER Nuclear Pressure Equipment	34MZKE
[30]	List of Protection Important Components (PIC list) (EN)	JDS5K7
[31]	Procedure for the Management of Diagrams and Drawings in pdf Format Using the SMDD Application	KFMK2B
[32]	Pressure Equipment Directive 2014/68/UE	-
[33]	French ESPN Order dated 30 December 2015	-
[34]	Implementation for Design and Manufacture of PE/NPE	VE2DSP
[35]	Procedure for the Preservation of Equipment	WML9CF
[36]	Work Instruction for Generation of ITER Bill of Materials, BOM for SmartPlant Data Load	VXMR6K

5 Basic Principles

Objectives of Identification and Control of Items (ID) Process are:

- To avoid confusing items of different grades, etc.;
- To enable traceability of the concerned items:
  - To retrieve all related information efficiently in order to meet operational incident resolution needs;
  - To ensure proper execution of preventive inspection and maintenance;
  - To find compatible product for replacement;
- To obtain the status of items associated with Control Gate/Point, etc.:
  - Inspection results (by Pass/Fail/Hold);
  - Current location;
  - Responsible person/entity;
  - Reception date, etc.
- To control spares and items subject to maintenance;
- Full traceability: To enable linking any relevant data/document for the concerned item;
- To perform continuous process control & monitoring (status accounting).
  - At each Control Gate/Point, to ensure completeness, consistency and conformance within all the items and the item-related data/documents, i.e. the source data.
- To comply with the nuclear safety and other regulatory requirements;
  Note: ID-Process is a cross-cutting process over multiple MQP Processes (See Sec. 8).

In Sections 5.1 to 5.4, as an outline the ID-Process, the following are described; 1) Three Ball Model and the Item-ID-Codes, 2) Physical Label, 3) Item-Related Data/Documents, and 4) Cataloguing and material management in the ITER Construction Management System.

5.1 Three Ball Model and Item Identification

The principle of Three Ball Model (3BM) is applied to the ID-Process. As shown in Fig. 2, in 3BM, there are three states of the same item. Each state of item is tagged with a dedicated key Item-ID-Code [3], as follows:

i. **Functional Reference, FR** tags to an item <As in the ITER System>, called "ITER Component";

ii. **Part Number of ITER , PNI** tags to specified design solution of item, <As-Designed>, called "ITER Item-Type";

iii. **Serial Number, SN** tags to an item <As-Built>, called "Physical Item."

Where "As-Built" stands for As-Manufactured, As-Site-Assembled, As-Constructed, or As-Installed.

Note: Within this document, SN often represents all Physical Item ID Codes including Lot/Batch Num., Heat Number for metallic raw material, etc., for simplification.

Those key Item-ID-Codes are used to identify the different states the same item throughout the project lifecycle.

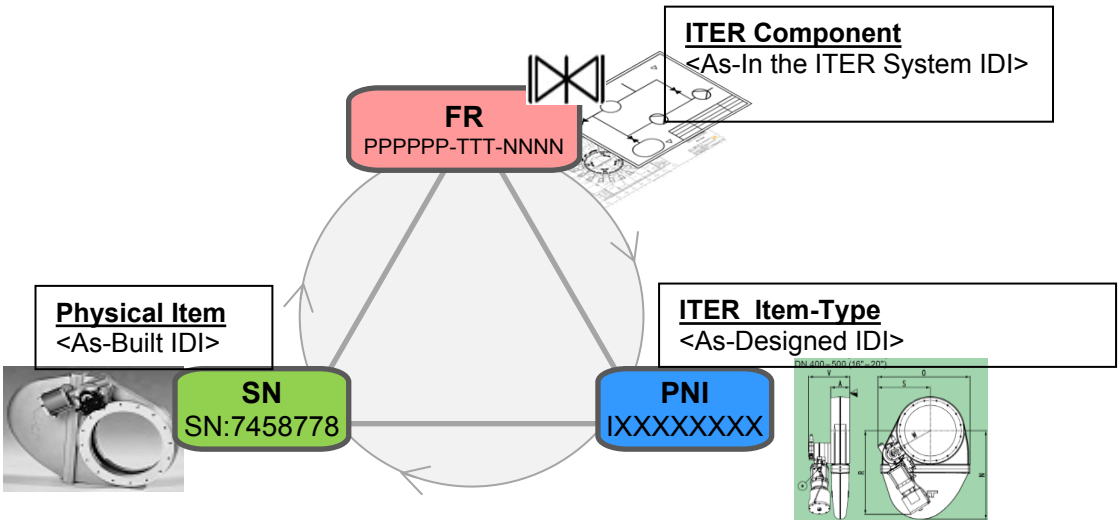


Fig. 2 Three Ball Model [3]

Among Controlled Items, Individually Distinguishable Items(IDI's) are controlled by IO-CT according to the 3-Ball Model.

Note that a mechanical ITER Component tagged with FR can be physically constituted with several IDI's tagged with individual PNI's, which are site-assembled together. The assembled item is recognized as the Parent IDI. While the constituting items are the Children IDI's.

Fig. 3 shows the tagging with Item-ID-Codes, i.e. FR, PNI and SN, throughout the project lifecycle including the Control Gates. This figure is explained in paragraphs 5.1.1 to 5.1.4.

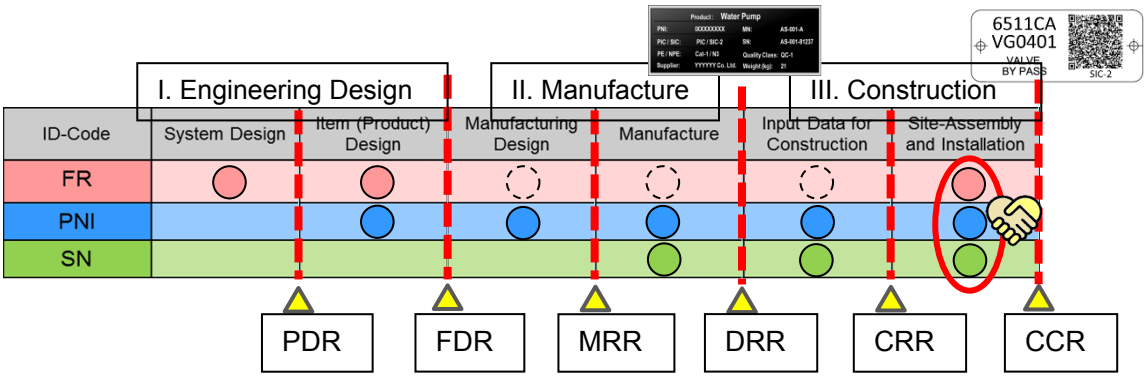


Fig. 3 Lifecycle of an IDI tagged with key Item-ID-Codes. At installation, all three types of key Item-ID-Codes are connected together [3]. Physical labelling occurs accordingly.

5.1.1 FR Creation and Tagging

- During the system design, all ITER Components shall be identified within diagrams, e.g. P&ID, Cabling Diagram, and/or in the Drawings/3D-Models, e.g. GA, Layout Drawing, CMMs, and tagged with FR's [3];
- Since FR's tag to only ITER Components, which have certain functions in the ITER System, e.g. water pumps, mechanical supports, not all IDI's used for the site-assembly are tagged with FR's;
- FR is generated by the IO-Eng-RO, then approved with the diagram and the Equipment List, Line List, etc.;

- All necessary FR's shall be generated no later than at FDR;
  Note: FR is not relevant during the Manufacture Phase (See the circles with dashed lines[5] in Fig. 3).

5.1.2 PNI Creation and Tagging

- Following the system design, the system is decomposed into assembly-level, then into individual item (or IDI)-level. After the decomposition, items are grouped by technical requirement[6], then designed as the identical design solution, i.e. IDI-Type tagged with PNI [3], [9];
- IDI's or groups of IDI's shall be tagged with PNI's, exhaustively. This implies that any item or group of items in Product or Assembly Drawing, shall be tagged with a PNI.
  Note: Exhaustive means tagging all small items individually, e.g. bolts, nuts; but also includes items which have been kitted (items grouped together). By kitting, quantity of necessary PNI's can be decreased.
- Only IO-Eng-RO can request new PNI's via CAD-Ticket System.
  If DA/Manufacturer requires additional new PNI's, they shall be request via the IO TRO;
- Newly generated IDI-Types tagged with PNI's are registered in the ITER material management system, SPMAT, associated with the attribute data. New Standard IDI-Types not included above yet are also included in the ITER Catalogue;
- Tagging with PNI may be required any time, including after the item design has finished;
- The format of PNI is specified in [9];
- All necessary PNI's shall be generated no later than MRR.
- PNI's on a physical item, on the 3D model, on those in data/documents and tagging to the related documents shall be the same. Even if a new format of PNI is requested via update of the approved MQP document [9] in the meantime, keep the original format of PNI.

5.1.3 SN Creation and Tagging

- All manufactured and/or procured items shall have SN and/or Lot/Batch Num.
  Note: Physical tagging with SN and/or Lot/Batch Num. shall be done, as necessary, so as to enabling tracing back the as-built records, e.g. the mill certificate, the inspection report, the calibration report;
- Manufacturer can decide the format of the SN, and whether or not to tag a physical item with a SN, if it is not specifically required;
- Physical items are tagged with SN's and/or Lot/Batch Nums., no later than DRR;
- As-Built PIC/SIC items shall be tagged with SN and/or Lot/Batch Num., physically and/or in the list of As-Built IDI's, so as that the related data/documents, e.g. Non-Conformity Reports are fully traceable.

[5] Major equipment with designated installation point in the ITER System can be tagged with the FR at the manufacturer's premises before shipment. Unique IDI's in the ITER System like pre-fabricated pipe spools are also tagged with FR's.
[6] This process is called as "Decomposition and Abstraction," or "Standardization." Consequent Item-Type-List is called "Catalogue."

5.1.4 Link between FR, PNI and SN

- When the delivered Physical Item is installed in the plant as an ITER Component, then it shall be tagged with the FR. At this final stage, a one-to-one relationship between SN and FR is established, and the three key Item-ID-Codes are consolidated;
- All items installed in the ITER System shall be tagged with the three Item-ID-Codes no later than CCR.

In Fig. 3, physical labels, i.e. Product Label and ITER Component Label, which include the Item-ID-Code(s), shall be affixed to the item no later than DRR and CCR, respectively.

During the project lifecycle, the related data/documents of these IDI's are also tagged with these key Item-ID-Codes. Finally, in the operation phase, any data/documents related to an ITER Component is retrievable with the "FR" linked together with other two, namely "PNI" and "SN." If replacement of an ITER Component becomes necessary, the PNI is found by referring to the FR. The cause of the failure of the ITER Component is to be investigated with the As-Built Quality Control Records tagged with the SN.

5.1.5 Manufacturer Model/Part Number, MN

- The MN has the same function for the manufacturer as the PNI has for ITER. They both identify Item-Types;
- Manufacturer shall tag to all the items and the item-related data/documents with MN's, respecting their Quality Plan (QP) [16].
  If the PNI is affixed to an item and referred to in the data/documents, the MN is not always necessary;
- Manufacturing Quality Control Records shall be tagged with MN (and PNI), and SN/Lot Num.;
- COTS items are already tagged with MN's in the manufacturer or supplier commercial catalogue. PNI's shall tag either to individual COTS items or to a group of them, in addition to those MN's;
- The link between PNI and MN is critical, since the link allows IO-CT to trace any ITER Item to the detailed manufacturing data/documents, and in so doing enables the Full Traceability of all item-relevant data;
- For IDI's, the MN will be recorded with the PNI in item lists in Manufacturing Dossier and Quality Control Records, e.g. As-Built IDI List;
- DA/Manufacturer should provide to IO-CT for information the MN-Code Scheme used for a group of IDI's before the MRR.

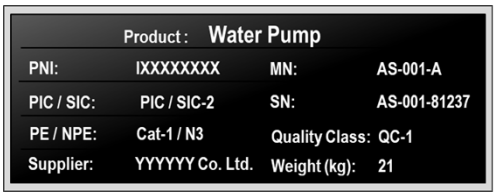
5.1.6 Others

- Consumables, General Tooling, etc. shall be tagged with PNI and SN and/or Lot/Batch Num.;
- CAD-Model Items are also tagged with FR's and/or PNI's, so that 3D models and Assembly Drawings related to an IDI can be easily identified.

5.2 Physical Labels and Marks

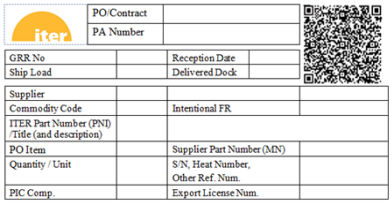
Physical labelling to each actual item is required. Fig. 4 shows an example of some typical labelling and marking. The mandatory contents are specified in ref [8] and Appendix-A. When ITER acts as manufacturer of PE and NPE, SN's and/or Lot Nums. shall tag to the

concerned items physically according to the requirements of IO implementation plan for the manufacturer of PE/NPE [33], [34], [35].



1) Product Label

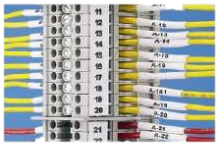
2) Shipping Label



3) Warehouse Label

4) ITER Component Label

5) Sign for Operation and Maintenance



6) Index Number

Fig. 4 Physical Identification Labels/Tags

1) Product Label

In Fig. 4-1), the Product Label includes a) the Part Number of ITER (PNI), b) the Manufacturer Model/Part Number (MN), and c) the SN. The Manufacturer shall attach the Product Labels or Tags physically to each item. Other marking, e.g. "CE" should accompany the Product Label, as necessary.

Note: For instance, if the area is limited, at least one Item-ID-Number to enable tracing back the data/ documents. For small items, e.g. bolts, nuts, tagging/labelling may not be required.

2) Shipping Label

See in Fig. 4-2) and ref [8]. (Scope of HS Process)

3) Warehouse Label

See in Fig. 4-3) and ref [8]. (Scope of HS Process)

4) ITER Component Label

In Fig. 4-4), FR is written on the label. The QR code can facilitate the access to the IT Database [5].

5) Signs

Fig. 4-5) shows a general sign on a pipeline, with the fluid-type name and the pipeline ID-Code [6].

6) Index Numbers

Fig. 4-6) shows an example for Index Number. The indexing rules, e.g. counting in clockwise or counter-clockwise direction shall be documented prior to the implementation.

Extended FR's for this purpose is explained in [3]

5.3 Item-Related Data/Documents

Fig. 5 shows the relationship between key Item-ID-Codes, a) attribute data of the item, b) data/documents tagged with the Item-ID-Codes, and c) data/documents in which the item tagged with the Item-ID-Code(s) is included. In other word, b) and c) are data/documents defining the item (or the report/record) and those describing (sub)system or an assembly including the item, respectively. Depending on key Item-ID-Code(s), the related data/documents are different. Similarly, types of Item-ID-Codes used as primary key code in various item lists are different.

If data/documents are related to items in the ITER System, i.e. to "ITER Components," the primary key Item-ID-Code is the FR. The maintenance report for the ITER Component is tagged with the FR. An operating temperature rating for certain ITER Components, is associated with that FR. Items tagged with FR's are included in the Equipment List, diagrams, etc.

Key Item-ID-Code	a) Attribute Data	b) Data/Documents tagged with Item-ID-Code	c) Data/Documents describing items tagged with Item-ID-Codes
FR ITER Component < As-in the ITER System>	System Physical / Functional Properties, e.g. GBS, max flow	Installation Procedure / Records, Operation Manual/ Records, Maintenance Records	System Design Definition Dossier including GA, PFD, P&ID, etc.
		(Site-Assembly) Design Definition Dossier, etc.	
PNI ITER Item-Type <As-Designed>	Item Physical / Functional Properties, e.g. Output Power	Product Design Definition, e.g. Product Tech Spec, Component Drawing, Data Sheet, Deviation Request*, etc.	Assembly Drawing, BOM, Construction Process Description (CPD), etc.
		Manufacturing Dossier, etc.	
SN Physical Item (As-Built>	Item As-Built Physical Properties, e.g. As-Built Tolerance	Mill Certificate, Inspection Report, Non-Conformity Report, etc.	List of As-Built Items, As-Built Drawing, etc.
		Quality Control Records, etc.	

*) A Deviation Request can also be related to a specific physical item tagged with SN.

Fig. 5 Correlation between key Item-ID-Codes, a) attribute data, b) tagged data/documents and c) data/documents describing items tagged with Item-ID-Codes

Similarly, data/documents related to Item-Type <As-Designed>, like product technical specification, are tagged with PNI's. Items tagged with PNI's appear in Assembly Drawings, BOMs, etc.

Finally, data/documents related to Physical Items <As-Built>, like Product Inspection Reports, Sensor Calibration Report, Non-Conformity Reports, etc. are tagged with SN. As-built data, like as-built dimensions, are also associated with SN.

5.3.1 Data/Documents Tagged with Item-ID-Codes

Data/ Documents related to IDIs shall be tagged with Item-ID-Codes, so that those data/ documents can be searched, filtered and/or sorted by Item-ID-Code, over the project lifecycle. Data/Documents tagged with various types of key ID-Codes are explained in more detail below.

Data/Documents Tagged with FR

- Installation records, calibration and/or maintenance reports of ITER Components are tagged with the FR;
- These documents are issued during installation or in subsequent phases of the project. *Note: After the system design is finished, the need for documents tagged with the FR is rare until the beginning of the Construction Phase.*

Data/Documents Tagged with PNI (and MN)

- Documents describing product design definitions are tagged with PNI's and/or MN's. Examples include product technical specifications, requirement specifications, drawings, etc.;
- Optionally, PNI can be followed by Item-Type-Descriptor (in parentheses, in order to avoid confusion), for instance "I12345678 (XXX-XXXXXX-XXXXX)". *Note: Item-Type-Descriptor is a descriptive code to be developed by IO-Eng-RO, as necessary. If applicable, the MN may be used as the Item-Type-Descriptor;*
- Respecting the Quality Plan, QP, all manufacturing documents shall be tagged with MN's, which are partly linked with PNI(s). This link is critical to achieve full traceability down to the specific manufacturer's data/document.

Data/Documents Tagged with SN

- As-built reports, e.g. mill certificates, as-built drawings, inspection reports are tagged with SN or Lot Num. ;
- One Lot, Batch or Heat Number can be associated to multiple Physical Items. This means that one mill certificate tagged with a Batch/Lot Num. refers to those multiple Physical Items.

Data/Document for Consumables, Tools, etc.

- Consumables and tools may not be IDI's, but these items and their related documents are tagged with PNI's;
- Related documents to these items are, for example:
  - Regular inspection and/or maintenance reports for tooling;
  - Calibration reports for inspection equipment;
  - Material Safety Data Sheet (MSDS) for chemicals, etc.

5.3.2 Data/Documents Describing IDI's Tagged with Item-ID-Codes

Items are controlled with various kinds of specific item lists. For instance, items are listed in a) Equipment List, b) BOM and c) List of As-Built IDI's generated in a) System Design, b) Site-Assembly/Item Design, and c) Manufacture, respectively. These item lists are associated with the Diagrams/Drawings, in which the items are described. Table B-1 shows the relevant types of specific item lists and the typical contents within ID Process.

Finally, ITER-BOM for SmartPlant Data Load is generated from the data/documents mentioned above, as the "source data."

5.4 Cataloguing and Material Management in the ITER Construction Management System

The ID-Process relies on the IT database system, namely SmartPlant (SP).

SP Data Loading with ITER-BOM consists of two parts:

SP Data Load-1:	Identification of IDI-Types, PNI Generation and Cataloguing [9]
SP Data Load-2:	Completion of all attribute data of IDI's on SPMAT [36]

Fig. 6 shows the two parts of the SP Data Loads during the project lifecycle. The ITER-BOM [36] is a specially prepared spreadsheet, which is different from traditional engineering item lists, e.g. Equipment List, BOM, for the data loading on SmartPlant at SP Data Load 1&2. After loaded on SPMAT/SPRD, the loaded data can be managed in an intelligent manner.

Note that the source data, e.g. traditional item lists, e.g. Equipment List, Line List, BOM for Design or Manufacture, shall be generated and controlled by the IO-Eng-RO, since the contents of the ITER-BOM are relevant only to logistics, warehouse management, construction and additional procurement, and following phases.

Additionally new data/documents for the warehouse control, the construction design and the as-built, etc. shall be added during the construction phase. More detailed steps of the process are described in the following section.

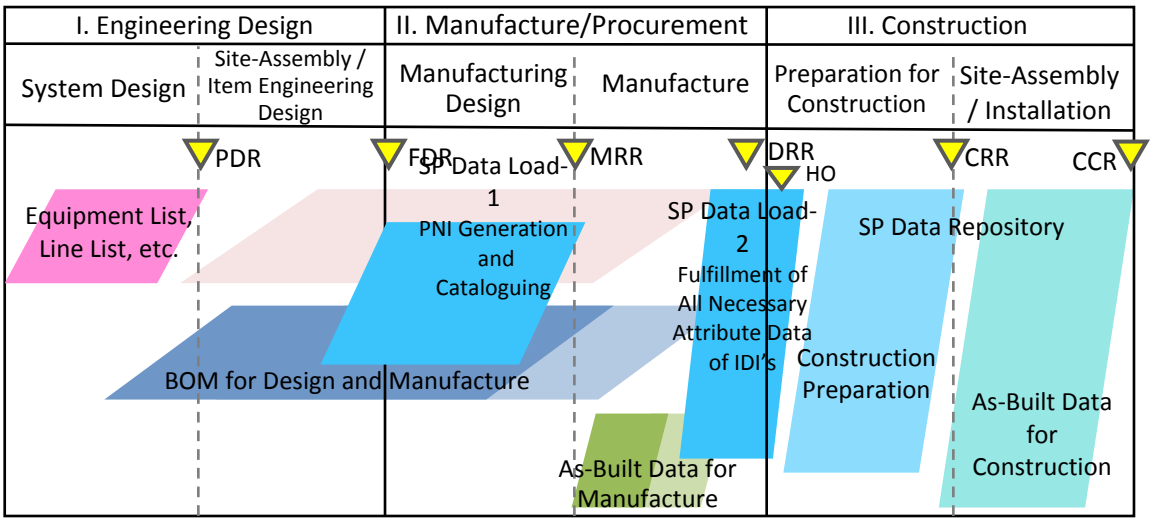


Fig. 6 Summary of the item-centric data/documents management

The SP Data Loads 1&2 are only summarized here. The detailed steps are described in MQP-L3 documents and the specific WI's [9], [36].

5.4.1 SP Data Load-1: Identification of IDI's, PNI Generation and Cataloguing

- ITER Individually Distinguishable Item, IDI shall be tagged with PNI;
- The IO-Eng-RO shall request the necessary PNI's via the CAD-Ticket System [9];
- The uniqueness of the PNI is verified with SPMAT/SPRD, then the proposed PNI is validated;
- After the validation, the IDI's tagged with the PNI's are registered in SPMAT associated with other attribute data;
- If the IDI is recognized as a Standard IDI, Tag & Item-Data Admin provides a dedicated format of PNI, which is then registered in the ITER Catalogue on SPRD.

5.4.2 SP Data Load -2: Completion of All Attribute Data of IDI's on SPMAT

- The data to be loaded at the SP Data Load-2 shall be validated in consistency with the official contents in the EWP-HOP [36].
- SPMAT data loading with the designated template of ITER-BOM to be completed before CRR;
- All listed IDIs, except for spares, are correlated with Contract, EWP/CWP, Assembly Requirement Drawing [11], etc. within the ITER-BOM to be loaded.

6 Workflow

Fig. 7 shows the flowchart of the ID-Process. There are three phases, i.e. I) Engineering Design, II) Manufacture/Procurement, and III) Construction. Six Control Gates and two Control Points, i.e. PA-Signed (an example of B-t-P PA) and Handover, HO, where data transfer occurs from one entity to another, are described. At each Control Gate/Point, status of each item is verified with the data/documents in the Engineering Dossier.

The two steps of SP Data Loads 1&2 are shown on the right of the workflow.

General rules:

- All items and the data/documents shall be tagged with FR, PNI and/or SN, as necessary;
- In Fig. 7, only general responsibilities are specified. Specificities of five individual types of PA's are explained later, according to this flowchart;
- This flowchart shall be respected in order to generate a technical specification for a direct contract by IO-CT as well;
- Execute Steps I-1 to III-6, sequentially. The order may be parallel or switched, but required process steps shall be completed before the designated Control Gate (See the Check List in Appendix-D) ;
- At each Control Gate, the completeness, consistency and conformance of various item lists including the ITER-BOM and the source data/documents shall be ensured;
- SP Data Load-1, i.e. PNI generation, registration on SPMAT, and cataloguing [9], shall be completed at the latest before MRR;
- SP Data Load-2 shall be completed after the HO, no later than CRR on the basis of the information provided for the EWP.

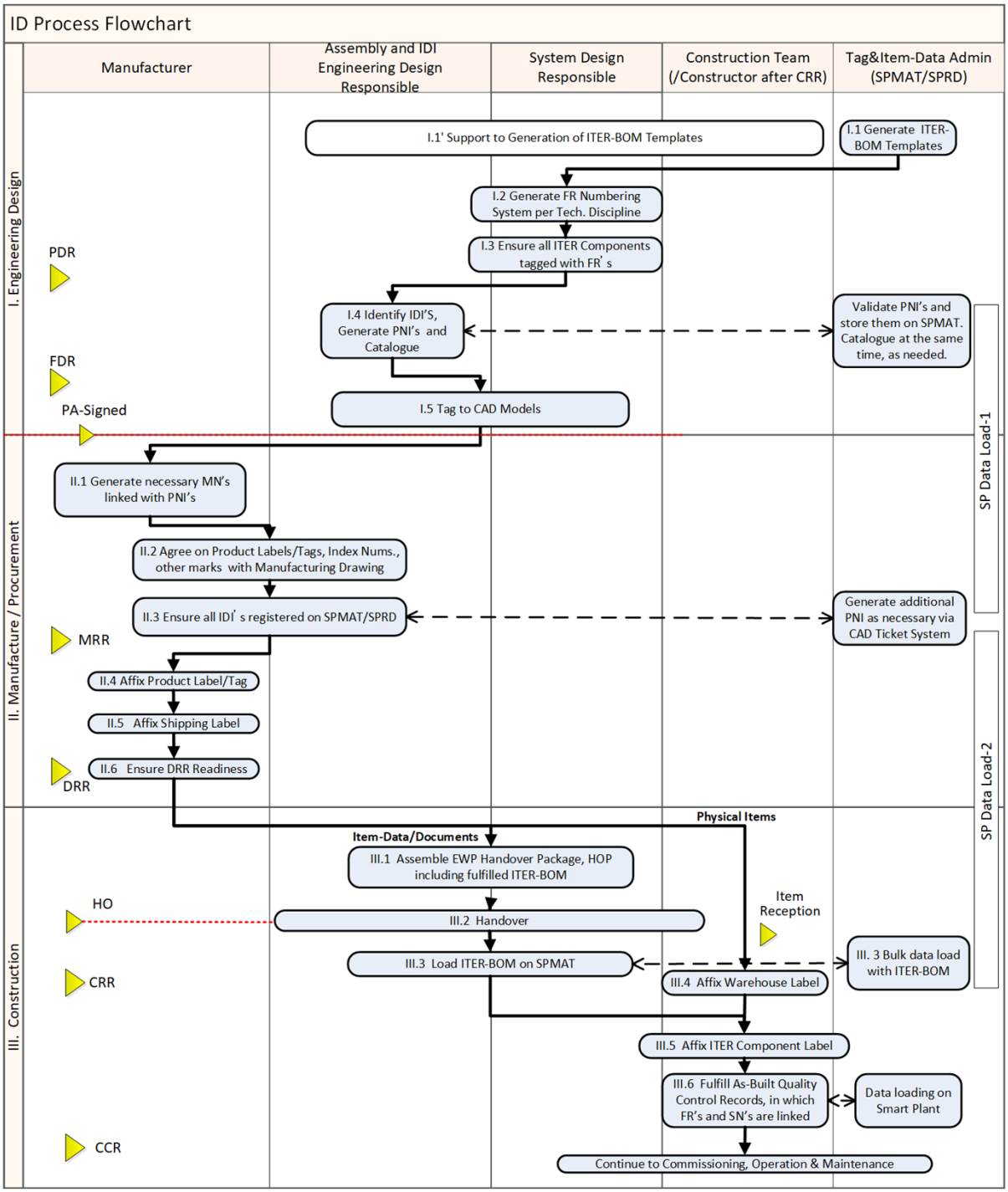


Fig. 7 Flowchart. This flowchart is valid for B-t-P PA as it is. Responsibility assignments for each type of PA are described in Section 7.

6.1 Process Steps

6.1.1 I. Engineering Design

I. a) System Design (Control Gate: PDR)

I. 1 Generation of ITER-BOM Templates

- Tag & Item-Data Admin shall generate ITER-BOM Template for each technical discipline, e.g. piping, mechanical, supported by IO-Eng-RO's and Construction Team.

I. 2 Generate FR Numbering System per Discipline

- System Design Responsible shall generate FR Numbering System per Technical Discipline;
- The document for the FR schema shall be approved before the implementation.

I.3 Ensure all ITER Components identified and tagged with FR's

- System Design Responsible shall tag to designed (major) ITER Components with the FR's, in the data/documents, e.g. diagrams, Equipment Lists, Line Lists;
- FR's are validated at the approval of the related data/ documents, e.g. Equipment List, Line List, diagrams.

I. b) Site-Assembly and Item Engineering Design (Control Gate: FDR)

I. 4 Identify IDI'S, Generate PNI's and Catalogue – SP Data Load-1 [9]-

- Assembly & IDI Engineering Design Responsible shall:
  - Identify all IDI's to be tagged with the PNI's;
  - Request the PNI's via IO-Eng-RO, who will issue a CAD-Ticket to obtain the necessary PNI's;
- Once the PNI's are validated, those IDI's are registered in SPMAT;
- Among them, Standard IDI's are catalogued in the ITER Catalogue on the dedicated IT database, SPRD (See the criteria in 3.1 Definition).

I. 5 Tag to CAD-Data, i.e. CAD-UID with FR and PNI

- System and Assembly & IDI Engineering Design Responsible with CAD-Designers shall tag to CAD Data with the FR's and/or the PNI's, so as that the CAD-UID's and the FR's and/or PNI's are correlated.
  Note that the CAD-Data is one of the critical source of data for the ITER-BOM related to the site-assembly work, namely the "Site-Assembly Drawing[7]."

All ITER Components shall be identified and tagged with FR's no later than FDR.

6.1.2 II. Manufacture/Procurement

II. a) Manufacturing Design (Control Gate: MRR)

II. 1 Manufacturer to generate all necessary MN's (linked with PNI's) [3]
The Manufacturer shall:

[7] Those to be controlled on PLM. At present, those are stored in SMDD[31].

- Generate Manufacturer Model/Part Numbers, MN's tagging to all concerned items, including Non-IDI's, under control of the Manufacturer;
- Generate a list of IDI's to correlate the PNI's, the MN's and the SN's.
  Note: Make reasonable groups of items in order to facilitate tagging with PNI's.

II. 2 Agree on Product Labels/Tags, Index Nums., other marks with Manufacturing Drawing

Manufacturer and IO-Eng-RO shall agree on Product Labels/Tags, Index Nums., other marks with Manufacturing Drawing, before the MRR.

II. 3 Ensure all IDI's are planned and registered on SPMAT

- The Manufacturer shall generate a list of planned IDI's to deliver;
- The IO-Eng-RO shall ensure all IDI's are planned and registered on SPMAT (SP Data Load-1)
  Note: Necessary quantities including spares shall be ensured.

II. b) Manufacture (Control Gate: DRR)

II. 4 Affix Product Label/Tag

- The Manufacturer shall affix the product labels/tags including the necessary data.

II. 5 Affix Shipping Label

- Manufacturer or transporter shall affix the shipping labels including the necessary data.

II. 6 Ensure DRR Readiness

- HS Process to specify in detail[23];
- Respecting the HS Process; verify the controlled item and that the identification provided on the labelling/tagging matches what is stated on the DRR documentation (Manufacturing Dossier, Release Note, Delivery Report, Packing List) per the DRR Working Instruction [23])

6.1.3 III. Construction

III. a) Preparation for Construction, e.g. Handover (Control Gate: CRR)

III. 1 Completion of ITER-BOM

- The IO-Eng-RO, in this case the "EWP Leader[8]," shall complete EWP-HOP including the completed ITER-BOM.
  Note: All attribute data required with the template shall be consistent with the source data

III. 2 Handover, HO

- Handover from IO-Eng-RO to Construction Team [7];
- If the ITER-BOM is loaded on SPMAT(/SPRD) before HO, a) reloading on SPMAT or b) re-verification on SPMAT with respect to the accepted HOP is needed.

[8] Construction Team is using this terminology, "EWP Leader."

III. 3 Load ITER-BOM on SPMAT

- Tag & Item-Data Admin shall load the fulfilled ITER-BOM on SPMAT (SP Data Load-2).

III. b) Construction (Control Gate: CCR)

III. 4 Affix Warehouse Label

- Once IDI's are received, the Construction Team shall affix Warehouse Labels for the site material control.

III. 5 Affix ITER Component Label

- At completion, e.g. installation of an ITER Component, the Construction Team or DA in charge of the construction shall affix the ITER Component Label.

III. 6 Fulfil As-Built Quality Control Records, in which FR's and SN's are linked

- Tag & Item-Data Admin shall load the as-built data on SmartPlant, in order to create the link between the FR, the PNI(s) and the SN(s).

Once Commissioning, Operation & Maintenance, and subsequent phases are specified in official MQP documents, this MQP-L2 should be revised. At minimum, any controlled items and data/documents used or generated in those phases shall be tagged with the Item-ID-Codes properly for full traceability purposes.

7 Responsibility

In this section, the general responsibility of each role is described first, then the specific responsibility assignments for all five types of PA's are explained in Paragraph 7.2 (Tables 1 to 5).

7.1 General Responsibilities

7.1.1 IO-Eng-RO (and Supervisor)

- Generate contractual documents and/or technical specifications, e.g. PA-Annexes A and B in compliance with this procedure and the associated MQP-L3 procedures
  Note: This MQP-L2 will be listed in the DA Applicable Documents in PA-Annex-A;
- Generate and validate specific templates of item lists, e.g. Equipment List, necessary for Engineering Design;
- Generate FR Code Schema per technical discipline;
- Generate ID-Code Schema for Item-Type-Descriptors (optional, see ref [3]);
- Determine and validate FR's with the diagram, the Equipment List, etc.[9];
- Request for PNI [9] and/or TTT [4] via the CAD-Ticket, then obtain and distribute to DA/Manufacturer;
- Generate specific Item Lists, e.g. Equipment List, BOM for Site-Assembly, then maintain them as source data of the ITER-BOM;
- Control all IDI's under his or her responsibility with item lists. For instance:

[9] Verification to be supported by CAD-Designers.

  - Record Non-Conformity during the transportation, etc. associated with the As-Built IDI;
  - Check if all physical labelling/tagging are done before the shipment;
  - Control status of the IDI's, e.g. Pass/Fail/Hold at a verification test; etc.
- IO-Eng-RO's and Document Controllers to check if documents tagged with key Item-ID-Code(s).

7.1.2 Construction Team

- Generate requirements, contractual documents and/or technical specifications for logistics, warehouse and/or construction, in compliance with this procedure and the associated MQP-L3 procedures;
- Generate and approve templates for ITER-BOM's and for other specific item lists necessary for Shipping, Warehouse and Construction, e.g. Packing List;
- Accept completed ITER-BOM's at EWP-HO.

7.1.3 DA/Manufacturer

- Respecting the Quality Plan [16] and the contractual documents, e.g. PA-Annex-B, implement item identification and full traceability;
- Any item-related documents shall be tagged with the concerned Item-ID-Code;
- Send the required item lists (in PDF format), and the original Excel file (Digital) to IO-CT. If it is requested by the IO-TRO then mutually agreed with the DA, it becomes a responsibility for DA/Manufacturer to provide it;
- Generate Manufacturer Model/Part Num., MN Code Schema, and submit it to IO-CT, as necessary;
- Generate and attach MN's, SN's, Lot/Batch Nums., etc. to items and the related data/ documents as necessary, respecting their procedure;
- Generate Item Lists, e.g. Packing List, BOM issue for manufacturing, List of As-Built IDI's;
- Receive PNI's from IO-CT, and attach to items for delivery and/or list them in the Item Lists, e.g. List of As-Built IDI's, Packing List, as necessary;
- MN and PNI shall be linked, e.g. described together, on a physical label and in data/documents, e.g. item list, regarding each IDI;
- For physical labelling, attach Product Label/Tag, engraving, laser marking, etc. (See Appendix-A and ref [8]);
- After delivery, provide support to IO-Eng-RO for the creation of the Handover Package (HOP), especially the ITER-BOM, if the IO-Eng-RO and the DA mutually agreed;
- Support to IO-CT in case of problems. For instance, find internal documents regarding a concerned item, as necessary.

7.1.4 Project Tagging and Item-Data Administrator (Tag & Item-Data Admin)

- Create and provide new PNI responding to a CAD-Ticket by IO-Eng-RO;
- Register and maintain PNI and the attribute data in SPMAT and ITER-Catalogue;
- Generate and control TTT-Codes [4] answering to the request by IO-Eng-RO;

- Regarding FR, support IO-Eng-RO to generate diagrams and the associated Equipment Lists, Line Lists, etc., in which ITER Components are tagged with FR's;
- Define general numbering system and Item-ID-Code schema for FR, PNI and TTT-Code, as MQP-L3 documents;
- Generate ITER-BOM template for data loading on SPMAT/SPRD, supported by IO-Engineers;
- Load data on SPMAT/SPRD, or support users to load data on the database;
- Maintain item-data on SPMAT/SPRD allowing access by users;
- Organize training for ID Process;
- Consultation and/or support for users;

Note: For example, ID-Process Owner to delegate part of his or her authority to:

- *Tag & Item-Data-Admin: Responsible and Accountable for the roles above;*
- *Status Accounting: Configuration Management Team to ensure the item-data and the process complying with MQP-Documents and other specific rules for ID Process;*

7.2 Responsibility Assignment for Five Types of PA's

Responsibility assignments for five types of PA's [17] are explained.
Regardless of the type of PA, the IO-TRO shall specify all necessary works to be carried out by the DA, with the PA-Annex-B in compliance with the MQP-L3 documents, [3] , [4], [8], [9], [10] and the one for SP Data Load-2 Process [36].

General responsibilities of DA's are described in Table 1.

Table 1 General Responsibility of DA per PA-Type

Activity	BtP-PA /Supply-PA	DD-PA	FS-PA
I-a. System Design	-	-	X
I-b. Assembly & IDI Engineering Design	-	X	X
II. Manufacturing Design and Manufacture	X (Only procurement for Supply-PA)	X	X
III-a. Preparation for Construction	As required, e.g. Integration PA		
III-b. Construction	As required, e.g. Integration PA		
IV. Commission and onward	As required		

7.2.1 B-t-P PA

Table 2 shows the responsibility assignment for B-t-P PA.

Table 2 Responsibility Assignment, RASCI Matrix regarding B-t-P PA

Phase	Step #	Work to be done	IO-Eng-RO	DA / Manufacturer	Construction Team
I. Engineering Desi	I.1	Generation of ITER-BOM Templates*	S	-	S, A
	I.2	Generate FR Numbering Schema for Discipline	R,A	-	-
	I.3	Ensure all ITER Components identified and tagged with FR's	R,A	I	C
	I.4	Identify IDI'S, Generate PNI's and Catalogue	R,A	-	C

	I.5	Tag to CAD-Data, i.e. CAD-UID with FR and PNI	R,A	C	I
II. Manufacture / Procurement	II.1	Generate all necessary MN's (linked with PNI's) [3]	A	R	-
	II.2	Agree on Product Labels/Tags, Index Nums., other marks with Manufacturing Drawing	A	R	I
	II.3	Ensure all IDI's are planned and tagged with PNI's	A	R	-
	II.4	Affix Product Label/Tag	A	R	-
	II.5	Affix Shipping Label	-	R, A	-
	II.6	Ensure DRR Readiness	A	R	C
III. Construction		N/A			
IV. Commission		N/A			

R: Responsible, A: Accountable, S: Support, C: Consulted and I: Informed

*) Tag & Item-Data Admin to generate ITER-BOM Templates. They also support IO-Eng-RO, DA, and Construction Team throughout the process steps.

7.2.2 Supply PA

- DA shall perform the same work steps and documentation as for B-t-P PA shown in Table 2, except for manufacturing related works and the document deliverables.

7.2.3 Detailed Design, DD-PA

Table 3 shows the responsibility assignment for DD-PA.
DA/Manufacturer shall:

- Complete the assembly design and the detailed IDI design, in addition to the contents for B-t-P PA (Table 2);
- Generate BOM for Site-Assembly and Preliminary Delivery List, etc., which will be reviewed at FDR.

Table 3 Responsibility Assignment, RASCI Matrix regarding DD PA

Phase	Step #	Work to be done	IO-Eng-RO	DA / Manufacturer	Construction Team
I. Engineering Design	I.1	Generation of ITER-BOM Templates	S	-	S, A
	I.2	Generate FR Numbering Schema for Discipline	R,A	-	-
	I.3	Ensure all ITER Components identified and tagged with FR's	R,A	C	C
	I.4	Identify IDI'S, Generate PNI's and Catalogue	(R,)A	R	C
	I.5	Tag to CAD-Data, i.e. CAD-UID with FR and PNI	(R,)A	R	I
II. Manufacture / Procurement		All the same as for B-t-P PA			
III. Construction		N/A			
IV. Commission		N/A			

(R) represents Co-Executor.

7.2.4 Functional Specification, FS-PA

Table 4 shows the responsibility assignment for FS-PA.

In addition to the works specified for DD-PA, DA/Manufacturer shall:

- Complete the system design and the deliverables, e.g. Equipment List, Line List;
- Request for necessary FR's, TTT-Codes [4], and PNI's to IO-Eng-RO.

Table 4 Responsibility Assignment, RASCI Matrix regarding FS-PA

Phase	Step #	Work to be done	IO-Eng-RO	DA / Manufacturer	Construction Team
I. Engineering Design	I.1	Generation of ITER-BOM Templates	S	S	S, A
	I.2	Generate FR Numbering Schema for Discipline	(R,)A	R	-
	I.3	Ensure all ITER Components identified and tagged with FR's	(R,)A	R	C
	I.4	Identify IDI'S, Generate PNI's and Catalogue	(R,)A	R	C
	I.5	Tag to CAD-Data, i.e. CAD-UID with FR and PNI	(R,)A	R	I
II. Manufacture / Procurement		All the same as for B-t-P PA			
III. Construction		N/A			
IV. Commission		N/A			

(R) represents Co-Executor.

7.2.5 Site-Assembly, e.g. Integration PA

Table 5 shows the responsibility assignments in the construction phase, regarding two cases, a) no requirement in PA Annex-B, and b) required in PA Annex-B, such as Integration PA. If required, DA/Manufacturer shall:

- Prepare HOP, then achieve the successful HO with IO-TRO (Steps III.1 and III.2);
- Control items and generate necessary documentation until the completion of the site-assembly/installation, i.e. CCR;
- At installation of the concerned items, as required, affix ITER Component Labels (Step III.5);
- Generate As-Built documentation, e.g. As-Built Equipment List filled up with SN's (Step III. 6).

Table 5 Responsibility Assignment, RASCI Matrix in Construction

a) No construction included

Phase	Step #	Work to be done	IO-Eng-RO	DA / Manufacturer	Construction Team
III. Construction	III.1	Assemble EWP Handover Package, HOP including completed ITER-BOM	R, A	S	C
	III.2	Handover	R	-	A
	III.3	Load ITER-BOM on SPMAT	C	-	R, A
	III.4	Affix Warehouse Label	-	-	R
	III.5	Affix ITER Component Label	-	-	R, A
	III.6	Fulfil As-Built Quality Control Records including completed Equipment Lists, etc., in which FR's and SN's are linked	I	-	R, A

b) With construction, e.g. Integration PA

Phase	Step #	Work to be done	IO-Eng-RO	DA / Manufacturer	Construction Team
III. Construction	III.1	Assemble EWP Handover Package, HOP including completed ITER-BOM	(R,) A	R*	C
	III.2	Handover	R	R*	A
	III.3	Load ITER-BOM on SPMAT	C	C	R, A
	III.4	Affix Warehouse Label	-	-	R
	III.5	Affix ITER Component Label	-	R	A
	III.6	Fulfil As-Built Quality Control Records including completed Equipment Lists, etc., in which FR's and SN's are linked	I	R	A

*) If required with the contractual document, i.e. PA-Annex-B.

7.2.6 Commission Onwards

To be defined later, once the process is developed by the Operation and Maintenance (OM) Process.

8 Link with Other Processes

The ID Process is a cross-cutting process linked with other MQP-Processes. The link with the Operation and Maintenance (OM) Process[10] to be specified in the future, as the process is defined.

Interactions with Configuration Management, CM Process

- Definition of "Controlled Items", which include temporary tools, consumables, etc., shall be consistent with the definition in [2];
- Relationship between an item and related technical documents are the common concern [2]. Methodology of document tagging to be consistent;
- PBS-Codes as parts of FR's and GBS-Codes as attribute data shall be provided by CM Process;
- EWP-Handover is under CM Process [7].

Interactions with Design Control, DC Processes

- Implement the requirement of ID Process in technical specifications, procedures, etc. in the Design Phase;
- Part of the source data for ITER-BOM's to be generated in this process.

Engineering Data/Document Management and Gate Reviews (CM and DC Processes)

References: Configuration Management: [2] and Design Control: [23], [19]

- Implement the requirement of ID Process in each gate (See Appendix-D);
- Ensure that Item Lists including the ITER-BOM have reached the appropriate level of maturity before processing to the next level/phase of the project;
- Generation of specific Item Lists shall be planned and executed according to the Document Production Plan, DPP [DPP Procedure (TBD)];
- PLM/Matrix to control Engineering data/documents, which is the source data of the ITER-BOM, is in the scope of CM Process.

[10] Necessary item-related data/documents on SP are transferred or linked to SAP Plant Maintenance (PM) for commissioning and the later.

Interactions with Quality Control, QC Process

- QC process, e.g. site inspection test, is closely related to this process, since the status of the items can be changed according to the results of tests, e.g. Factory Acceptance Test (FAT), for example "Pass," "Fail" or "Hold";
- Verify whether resultant reports, e.g. site inspection reports, are properly tagged with the key Item-ID-Codes.

Interactions with Software Control and Model Development, SW Process

References: CAD Manuals in the folder[11]

- CAD-Model is also tagged with Item-ID-Codes, i.e. FR and/or PNI. Ultimately, CAD-UID's, FR's and PNI's are linked together;
- Provide CAD-UID's to be included in format of PNI tagging to some IDI's;
- Part of the data in ITER-BOM's to be exported from the CAD-Systems.

Interactions with Documents and Records, DR Process

- The ID Process requests DR Process to add some IDM and/or PLM Document Metadata, i.e. key Item-ID-Codes, FR, PNI and SN, as "tags to document."

Manufacturing, Assembly and Installation, MA Process

References:[21] [22]

- Implement the requirement of ID Process in technical specification, procedure, etc.;
- Define the contents of the EWP-HOP [7];
- ITER-BOM is to be handed over by IO-Eng-RO, i.e. EWP-Leader ;
- Specify and request necessary attribute data included in ITER-BOM templates;
- Part of the source data for ITER-BOM's to be generated in this process.

Handling, Storage and Transportation of Materials (HS-Process)

References: [24], [25], and [26]. For DRR, [23].

- Implement the requirement of ID Process in technical specification, procedure, etc.;
- Responsible for tagging and item control, regarding logistics, warehouse and construction;
- Provide the definition of DRR and the necessary documentation [23].

Cross-Cutting Process (QA, PK and NS Process)

References: Quality Assurance: [1], [27]. Nuclear Safety: [28], [29], [30], [34] and Procurement in Kind (In-kind, i.e. PA) [17], [20]

- Define attribute data, i.e. important classification codes, e.g. PIC/SIC, PE/NPE, QC, including the selectable Code Masters, e.g. "QC-1, QC-2, QC-3";
- Requirements for 5 types of PAs shall be consistent with this MQP-L2.

[11] https://user.iter.org/default.aspx?uid=2FQDLM (to be updated consistent with this MQP-L2)

9 Outputs (Records, Deliverables, Implementation Plans..)

Any item-related data/documents and data set in the databases shall be tagged with key Item-ID-Codes, i.e. a) Item-Type-Ref-Num, e.g. PNI, MN, b) SN and/or c) FR as necessary. Respecting this source data, the ITER-BOM is generated and loaded on SmartPlant. Output documents within ID Process are as follows.

Type of output	Format (Template, form, checklist)	Location of output	Document type	Instructions for identification of the output	Responsible for managing the output	Retention period
Completed ITER-BOM	To be provided for each technical discipline by Tag&Item-Data Admin.	PLM/Matrix	List	Tagged with EWP Code, etc.	IO-Eng-RO	Over the project lifecycle
ITER Catalogue on SPRD	N/A	SPRD	Digital Data	N/A	Tag & Item-Data Admin	Over the project lifecycle
Item Data on SPMAT	N/A	SPMAT	Digital Data	N/A	Tag & Item-Data Admin	Over the project lifecycle

Appendix-A Contents of Physical Labels

Table A-1 Minimum contents of the label

Label	By whom	When	Mandatory contents	Additional information
Product Label	Manufacturer	Before DRR	1) Title of Product, 2) Manufacture Model/Part Number, MN, 3) PNI*3, 4) SN/Lot Number*4,, 5) Safety Classification*5, e.g. PIC/SIC, PE/NPE, 6) Quality Class.	1) Other Ref. Num., 2) Dimensions, 3) Weight, 4) Supplier, 5) Production Date (DD/MM/YY), 6) CE marking, as required.
Shipping Label*1	Manufacturer	Before DRR	1) Title of crate, 2) Purchase Order, PO, Contract Number, PA Code, etc., 3) Shipping/Crate Num., 4) Supplier Ref. Num., 5) MN, 6) PNI*3, 7) SN/Lot Number*4, 8) Safety Classification, e.g. PIC/SIC, PE/NPE, 9) From (Sender)/To (Receiver), 10) Net/gross weight, 11) Responsibility, 12) Packing Date (DD/MM/YY), 13) Shipping Date (DD/MM/YY).	1) Dimensions, 2) Other Ref. Num., 3) Quantity in the crate
Warehouse Label	IO/CST	At reception	See ref [8] (To be generated by Handling, Storage and Transportation (HS) Process)	Always generated and affixed to an item by IO-CT
ITER Component Label*4	Construction Team and Contractor	Before CCR	1) Title of ITER Component, 2) FR, 3) Safety Classification, e.g. PIC/SIC, PE/NPE, 4) QR Code implying relevant attribute data.	See the successful implementation by PBS-65 ref [5]

*1) Accompanying signs, e.g. sign of handling precaution during transportation.
*2) PNI can be accompanied by Item-Type-Descriptor (in parentheses).
*3) If fully traceable, SN/Lot Number is not always required to be included in a label.
*4) Dedicated PE/NPE label to be provided with [A1] in addition to the ITER Component Label. If the contents complying both the requirements, the physical labels can be merged.
*5) If over qualified component is installed as an ITER Component of the lower classification, then delete this from the Product Label at the installation, because the correct classification code is presented in the ITER Component Label. For example, a valve qualified as SIC-1 to be installed as a SIC-2 ITER Component.
[A1] Template for PE/NPE Name Plate [Y3AZ83]

Appendix-B Contents of Specific Item Lists

Table B-1 Contents in Specific Item List for Engineering Purpose

	1) Equipment List, Line List, etc. [13]	2) BOM for Site-Assembly [12]	3) List of As-Built IDI's in Quality Control Record	4) List of Deliverables [14]	5) Packing List[14], [15]
Contents in the list of items	• Title of ITER Component; • Functional Reference, FR; • PNI, if identified; • Importance Classification, e.g. PIC/SIC, PE/NPE, Quality Class; • Interface/Layout, e.g. GBS; • System/Plant Functional Property, such as Operation Pressure; • Reference Documents, Drawing, Diagram, e.g. GA, PFD. Additional fields, as required.	• Title of Item; • Part Number of ITER, PNI; • FR*, if already decided; • Quantity and the Units Of Measure, UOMs; • Physical properties, e.g. dimensions, weight and the UOMs; • Importance Classification, e.g. PIC/SIC, PE/NPE, Quality Class; • IDI functional properties, e.g. design pressure; • Reference documents, e.g. Technical Specification, Drawing. Additional fields, as required * FR shall be in the drawing.	• Title of Item ; • PNI ; • SN ; • Manufacturer Model/Part Number, MN, if any; • Quantity and the UOM; • IDI Physical Properties, e.g. dimensions, weight and the UOMs ; • Importance Classification, e.g. PIC/SIC, PE/NPE, Quality Class; • Reference documents, e.g. relevant NCR (as necessary). Additional fields, as required.	• Title of item; • PNI; • Quantity and the UOM; • Physical properties, e.g. dimensions, weight and the UOMs; • Importance Classification, e.g. PIC/SIC, PE/NPE, Quality Class; • Reference documents. Additional fields, as required	• Title of Item; • PNI ; • SN ; • Manufacturer Model/Part Number, MN , if any; • Quantity and the UOM ; • IDI Physical Properties, e.g. weight and the UOM's; • Importance Classification, e.g. PIC/SIC, PE/NPE, Quality Class; • Reference documents, e.g. relevant NCR (as necessary). Additional fields, as required
General data in the title block	(Sub-)System Name, PBS-Code, GBS-Code, RO, etc.	PBS-Code, GBS-Code, FR, PA / Contract-Code, RO, etc.	PBS-Code, PA/Contract-Code, RO, etc.	PBS-Code, PA/Contract-Code, RO, IPL, etc.	PBS-Code, PA/Contract-Code, RO, Inter-Project Links (IPL's), etc.
Note		Sub-set of a BOM for certain Construction Work Packages (CWP) is sometimes required. This BOM shall list all IDI's described in the Assembly Requirement Drawing(s) and (Multi-) Component Drawing(s) [11].	SN as necessary.	The contents of the Planned Delivery List at MRR can be different from the ones in the Preliminary Delivery List. For instance, items can be split for transportation reason. Planned Delivery List shall describe both PNI's and the corresponding MN's.	SN as necessary.

Appendix-C Summary of Requirements for DAs within the ID-Process

C-1 General Requirements common to all PA Types

#	General Requirement for DA	Remarks	At latest
RG1	Items and the related data/document shall be fully traceable respecting PA-Annex-B and the Quality Plan, QP.	At minimum, any document by DA/Manufacturer shall be tagged with MN (and SN). Tagging with PNI in addition to MN is preferred.	MRR (for Manufacturing Design) DRR (for As-Built)
RG2	Tag all the deliverables, e.g. hardware, software, data/documents, in MRR or DRR, as specified within this procedure and other PA documents.	All deliverables shall be properly tagged with Item-ID-Code,. BOM for Shop-Assembly to be generated. However, these are out of scope of ID-Process.	MRR(for Manufacturing Design) DRR (for As-Built)
RG3	Regarding any type of Item List as PA Deliverable, agree on the contents and the format with IO-TRO.	IO-CT should provide the templates to specify the requirement.	PA Signed
RG4	Submit MN Code Schema as FYI (optional)		MRR
RG5	Submit original Excel files of Item Lists in addition to the official deliverables, as necessary (as mutually agreed).	The Excel files are exception from responsibility	Any Time
RG6	Support IO-TRO in order to prepare EWP-HOP for construction. Consulted with IO-TRO, as the responsible for Manufacturing Design and the Manufacture.	As necessary	Any time

C-2 Specific requirement for B-t-P PA

#	Requirement for DA within ID Process	Remarks	At latest
RM1	Agree with IO-TRO on Product Labels/Tags regarding the locations, the materials, the methods of affixation, etc., on the Manufacturing Drawings.		MRR
RM2	Agree with IO-TRO on tagging to interface with index number, etc., on the Manufacturing Drawing		MRR
RM3	Submit Planned Delivery List in compliance with the items and the quantities specified in PA-Annex-B	To each item, i.e. IDI, both PNI and Manufacturer Model/Part Number (MN) should be tagged to. The quantity and other attribute data, e.g. PIC/SIC, PE/NPE, QC shall be described.	MRR
RM4	Acquire additional PNI from IO-TRO, if new IDI is identified in the Manufacturing Design, etc.	Request for PNI and Cataloguing via CAD-Ticket System is only entitled to IO-TRO [9].	MRR
RM5	Product Label: Physical labelling/tagging on each as-built (As-Manufactured) IDI.		DRR
RM6	Affix necessary marks/signs, e.g. CE Marking, lifting/handling, Centre of Gravity, to the product, as required.		DRR
RM7	Submit a list of As-Built IDI's as a part of As-Built Quality Control Records.	To each listed item, PNI, MN and SN/ Lot Num. shall be tagged and linked with. Other as-built data, e.g. Ref. Num. of relevant NCR, check for	DRR

		physical labelling, should be included.	
RM8	Submit Packing List.	PNI, MN and SN/Lot Num. and quantities and attribute data, e.g. Shipment, Crate shall be documented.	DRR
RM9	At the time of packaging, cooperate with IO-TRO for "kitting" taking into account of the material handling on site and the construction process.	For instance, instead of tagging small items, e.g. bolts, nuts, with the PNI's, affix one PNI to the Kit made up with all the necessary items.	DRR
RM10	Affix Shipping Labels to shipping crates.	Include all necessary information, e.g. PIC/SIC, PE/NPE	DRR

C-3 Specific requirement for Supply PA

Basically, the requirement is the same as for B-t-P PA. Manufacturer Model/Part Number (MN) is already determined at the Purchase Order (PO), DA to use PNI's in the physical labels, the documentation, etc., associated with the MN's.

C-4 Specific requirement for DD PA

In addition to the As-Built PA requirements, the following is required.

#	Requirement for DA within ID Process	Remarks	At latest
RD1	Identify all IDI's to deliver, and tag them with PNI's	Request PNI to the IO-TRO	FDR
RD2	Tag all the engineering data/documents with PNI and/or FR.		FDR
RD3	Tag to CAD-Data, i.e. CAD-UID with FR's and/or PNI's, as necessary.		FDR

C-5 Specific requirement for FS PA

In addition to the DD PA requirement, the following is required.

#	Requirement for DA within ID Process	Remarks	At latest
RF1	Generate FR Numbering Schema within the scope of the PA.		PDR
RF2	Identify all ITER Components and tag them with the FR's.	Request necessary TTT-Code to IO-TRO	FDR
RF3	Generate data/documents, e.g. diagrams, Equipment List, to validate the FR's upon their approvals.	Sign-off authorities are in [18]	FDR

C-6 Specific requirement for PA Including Site-Assembly, e.g. Integration PA

If site-assembly/installation by DA is included in the PA scope, the following is required.

#	Requirement for DA within ID Process	Remarks	At latest
RC1	Assemble EWP Handover Package (HOP) including completed ITER-BOM*.		HO
RC2	Handover*		HO
RC3	Support to load ITER-BOM on SPMAT.	[36]	HO (at latest CRR)
RC4	Affix ITER Component Label.	[8]	CCR
RC5	Fulfil As-Built Quality Control Records including completed Equipment Lists, etc., in which FR's and SN's are linked.		CCR

*) If required with the contractual document.

Commissioning onwards: TBD

Appendix-D Checklist at Each Control Gate/Point

Table D-1 shows a checklist associated with Control Gates/Points, where completeness, consistency and conformance of the tagged items and the data/documents are ensured.

Table D-1 Check List

	Gate	Questions	Check	Reference		
	General (at each Control Gate/ Point)	Are all item related data/documents tagged with Item-ID-Code and fully traceable? (Including items described in the data/documents, e.g. Drawing, Diagram, 3D Model)				
		Are all the deliverables of ID Process consistent with other data/documents, i.e. “the source data”?				
Before SP Data-Load-1	PDR	Are major ITER Components tagged with FR’s in Diagram, GA, Equipment List, etc., respecting the developed discipline ID-Code Schema?		[19]		
	FDR	Are all ITER Component tagged with FR’s?				
		Are all IDI’s identified and tagged with PNI’s?				
		Are IDI’s in CAD-Data tagged with FR and/or PNI?				
	B-t-P PA signed	Are all IDI’s to be delivered identified within PA-Documents (as the Preliminary Deliverable List)?				
	MRR	Are all items tagged with MN’s, then IDI’s, which are selected among the items, tagged with PNI’s in item lists, e.g. BOM, enclosed in the Manufacturing Dossier?		[21]	Quality Plan, QP [16]	
		Are necessary IDI-Types tagged with PNI’s loaded on SPMAT/SPRD? < SP Data Load-1 >				
Before SP Data-Load-2	DRR	Are all IDI’s identified and physically labelled/tagged?		[23]		Preservation Procedure [35]
		Are the check record of the physical labelling/tagging in the As-Built Quality Control Records?				
		Are all IDI’s to deliver identified in the Packing List?				
		Are physical labels affixed on all crates/packages?				
		Are all IDI’s to be delivered are registered on SPMAT?				
	Reception	Are physical labels/tags affixed properly?		[25]		
		Are actual crate/package, the Packing List and other the documentation consistent?				
	HO	Are all IDI’s and the related data/documents consistent?		[7]		
		Are all necessary IDI’s identified in ITER-BOM and other item lists?				
	CRR	Are all IDI’s tagged with the PNI’s loaded on SPMAT with ITER-BOM Template? < SP Data Load-2 >		[22]		
		Are all the items identified and tagged properly in the data/documents, regarding each CWP?				
	CCR	Are ITER Components physically tagged with the FR’s? Is the check record stored in the Quality Control Record?		[5], [8]	QP[16]	
		Are as-built data/documents including links between FR’s and SN’s loaded on SmartPlant properly?				

Appendix-E Instructions for Recovery from Contingency Cases

The basic principle of recovery is:

- Recovery action is under the responsibility of the IO-Eng-RO, namely the TRO for the PA deliverables. As necessary, DA is requested to support;
- When there is a non-conformity to the PA-Annex-B and/or the Quality Plan, e.g. missing identification, the DA is subjected to raise an NCR, and to respect the subsequent decision;
- If a problem is due to the insufficient requirement in the contractual document, e.g. PA-Annex-B, the IO-Eng-RO shall take all the responsibility to recover;
- Non-Conforming Items arriving on site are immediately isolated in "Quarantine" (a designated area in the warehouse).
  Note: This does not mean an accepted non-conformity, but newly detected one.
- Technical recovery work shall not be requested of the warehouse staff;
- IO-Eng-RO shall recover Item-Data problems supported by Tag & Item-Data Admin;
- Together with the recovery actions below, the related data/documents should be updated, so as that the consistency is maintained.

Four contingency cases are described below.

E1 Delivery without PNI

- Obtain PNI(s) via CAD-Ticket System respecting [9], then register the IDI in SPMAT;
  Note: The MN and the newly obtained PNI shall be correlated in SPMAT and/or in the list of As-Built-IDI's, in order to make the item-data/documents fully traceable;
- Recover Physical Labels/Tags as described in E2, below.

E2 Missing Physical Label/Tag or Missing Data on Label/Tag

- Produce Physical Labels including the PNI's, then affix them in the adequate positions in an appropriate manner;
- If mutually agreed between IO-Eng-RO and Construction Team, recovery with ITER Component Label including the information of the product, can take place at a later date, in which case a temporary label/tag is required.

E3 Inconsistency between Enclosed IDI's and Packing List

- To be decided by HS process;
- DA/Manufacturer shall recover the data/documents including ITER-BOM (if already loaded on SPMAT);
- If needed, the Product Label/Tag to be corrected respecting the decision of the NCR;
- Tag & Item-Data Admin to correct the data on SPMAT, as necessary.

E4 Imperfection of ITER-BOM for PNI Request and/or SmartPlant Data Load

- Submit the missing data via CAD Ticket system, then communication with Tag & Item-Data Admin, as necessary;
- Respect an instruction given by Tag & Item-Data Admin.
  Note: If discrepancies happen between ITER-BOM and the source data, they shall be promptly controlled and recovered by the IO-Eng-RO.

IDM UID
28QDBS
VERSION CREATED ON / VERSION / STATUS
27 Nov 2024 / 5.1 / Approved
EXTERNAL REFERENCE / VERSION

MQP Level 3

ITER Numbering System for Components and Parts

This document describes the numbering systems to be used to define the identifiers for components and parts in the ITER project, and thus rigorously ensuring the traceability of each item throughout the ITER Project life cycle.

Approval Process			
	Name	*Action*	*Affiliation*
Author	**Arzoumanian T.**	**27 Nov 2024:signed**	**IO/DG/SID/CID/CMS/DOC**
Co-Authors			
Reviewers	**Bartels H.- W.** **Lassueur F.**	**27 Nov 2024:recommended** **02 Dec 2024:recommended**	**IO/DG/SID/CID** **IO/DG/ESD/DO**
Approver	**Orlandi S.**	**03 Dec 2024:approved**	**IO/DG/CP**
Information Protection Level: Non-Public - Unclassified *RO: Khomutnikov Aleksei*			
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: [CCS] CCS-All for Ext AM, LG: [CCS...**		

#drn#

Change Log			
ITER Numbering System for Components and Parts (28QDBS)			
Version	***Latest Status***	***Issue Date***	***Description of Change***
v1.0	Approved	09 Oct 2007	This procedure specifies the structure of ITER numbering for parts and components.
v1.1	Signed	23 Jun 2008	This procedure specifies the structure of ITER numbering for parts and components.
v1.2	Signed	11 Jul 2008	This procedure specifies the structure of ITER numbering for parts and components.
v1.3	Approved	04 Sep 2008	This procedure specifies the structure of ITER numbering for parts and components.
v2.0	Approved	26 May 2011	Incorporated the definition of part number and revised ITER PBS document
v3.0	Revision Required	23 Aug 2018	v3.0 include : Detailing of Functional Reference usage Introduction of Additional Referencing Capability : Component in Component concept Instrumentation Referencing Naming of Interface locator/ Nozzle /Spool / Part Tag Detailing of Part Number of ITER : PNI Encoding of various Type of Part Number of ITER Classification of PNI within ITER Material Database Strategy for custom fit marking on Physical Items (SN) Relationship between FR/PNI/SN Guideline for Referencing
v3.1	In Work	11 Oct 2018	1) General, FR “System Component” tagged with FR. Note that the word “Component” was used for various meanings in the previous version. 2) General, TTT In Appendix-G, TTT-codes are grouped into 1) Process Functional and 2) Non Process Functional 3) Page 3, Foot note Definition of Individually Distinguishable Item, IDI is added 4) General Main context is shortened. Basic concept, formats, and flowchart are the main elements in it. All supplemental codes are shifted to Appendix-D 5) PNI Format, Page 6, Para. 6.1 Unified format of PNI, “IXXXXXXX” is only explained in the main context 6) Page 7 3BM-diagram associated with Control Gates is added. 7) Pages 7 to 10 Flowchart and the process steps are describes associated with the Control Gates 8) Page 11, Sec. 8 Responsibility Assignment is simplified associated with SOA [2EXFXU] 9) Appendix-A All instructive parts for FR are described in Appendix-A. The word “Implied Item” is discarded. In contrast, some explanations for PBS-codes, FR’s (parent & child) , allocation of delivered item to PBS-L3 or FR, etc. are explained. 10) Appendix-B All instructive parts for PNI are described in Appendix-B. PNI’s generated by CATIA/Enovia or Smart Plant are explained. Other Frequently Asked Questions (FAQs) are answered 11) Appendix-B, B2.3 (and D9) MN Manufacturer Part Number, MN is defined clearly

			12) B2.4 to B2.6 Granularity of PNI and grouping, i.e. Kitting taken into account of site-assembly process clarified. 13) B2.8 Spare Spare is moved to Appendix B 14) B2.9 Version control of design by PNI associated with Tech Spec (and/or Drawing) No. and the rev. num. is explained 15) Appendix-C Clear diagram for Tagging Construction Shite and Warehouse. Fig. 14 was difficult to understand in the previous version . 16) Appendix-D All supplemental codes are moved into this Appendix-D (respecting KBR's comment) 17) D10 The formula of "PNI = Commodity Code + Dimensions" is added. 18) Appendix-G TTT-code is explained in short. The detail is to be defined in [2FJMPY] at next revision. 19) Appendix-H All defined ID-codes are summarized in one page.
v3.2	Approved	11 Oct 2018	Some figures are broken at the previous IDM load.
v4.0	In Work	08 Sep 2020	As per approved MQP doc request https://user.iter.org/?uid=3JGHT5 there are no changes to the document but this review is to have DAs in the loop for impact assessment and make the documents Annex A PA AD through the MPA.
v4.1	Signed	15 Sep 2020	This version is simplified in order to be integrated into the Multi-Party agreement making this document applicable to all PAs: - Removal of the Roles and responsibilities and workflow for the sake of clarity, as they are completely described in the already applicable L-II procedure: U344WG - English polishing without changing any requirement / feature of the document
v5.0	Approved	16 Dec 2020	As per approved MQP doc request https://user.iter.org/?uid=3E9FEF the changes are: This document is aimed at becoming a PA-AD. Before doing so 2 issues were identified: - The workflow defined in this document is redundant and obsolete as opposed to the workflow described in the L2 procedure U344WG, which is already a PA-AD. - As a consequence to the workflow redundancy, the responsibilities are also redundant and obsolete. - Some improvement of the English (polishing) are required.
v5.1	Approved	27 Nov 2024	As per communication CQ6BZ9 and tracked changes version the changes are: - Reorg change: responsibility to generate PNI by ESD/DO - IO Eng. RO replaced by IO System RO - Minimum alignment with MQP template 438T76 - Some minor corrections

Table of Contents

1 Purpose

This document describes the numbering systems to be used to define the identifiers for components and parts in the ITER project, and thus rigorously ensuring the traceability of each item throughout the ITER Project life cycle.

2 Scope

This document is a Level-3 procedure under the Level-2 procedure for Identification and Controls of Items [U344WG]. This document is applicable to all components and parts designed and procured for the ITER project.

The scope of this document is to establish tagging notions for:

- **System Components** tagged with Functional Reference, FR
- **Type References** tagged with Part Number of ITER, PNI
- **Physical Items** tagged with Serial (/ Lot/ Batch) Numbers, SN

The ID-code schemes described in this document address the following identifiers (Three-Ball Model):

1. **FR**: to uniquely identify all **System Components** present in the ITER system physically, geographically, in diagrams and/or in 3D and control rooms on the ITER site.
2. **PNI**: to identify all **Type References** of items designed, manufactured (or procured), assembled, commissioned and subject to maintenance on the ITER site.
3. **SN**: to identify individual **Physical Items** manufactured and/or procured.

3 Definitions and Acronyms

3.1 Acronyms

Acronym	Definition
3BM	3-Ball Model
CCR	Construction Completion Review
COTS	Commercial Off-The-Shelf
CRR	Construction Readiness Review
DA	Domestic Agency
DRR	Delivery Readiness Review
EDB	Engineering Database
Eng	Engineering
FAQ	Frequently Asked Questions
FDR	Final Design Review
FR	Functional Reference
HO	Handover
IDI[1]	Individually Distinguishable Item
IEEE	Institute of Electrical and Electronics Engineers
ISA	International Society of Automation
MN	Manufacturer Part Number
MRR	Manufacturing Readiness Review

[1] IDI: Item (to be) delivered and/or handled by IO or any other item designated by IO-CT subject to control. All IDIs shall be tagged with PNIs

PBS	Plant Breakdown Structure
PDR	Preliminary Design Review
PIC	Protection Important Component
PID	Piping and instrumentation diagram
PLM	Product Lifecycle Management Software
PNI	Part Number of ITER
RE	Responsible Engineer
RO	Responsible Officer
SN	Serial Number
TTT Code	Commonly used for the Function Category Designator

4 References

4.1 Applicable Documents

1) Procedure for Identification and Item Control [U344WG]
2) Sign-Off Authority for Project Documents [2EXFXU]

4.2 Reference Documents

1) ITER Plant Breakdown Structure [28WB2P]
2) ITER PBS Structure [2FBMWF]
3) ITER Function Category and Type for ITER Numbering System [2FJMPY]
4) Function Category Designators [43WDW9]
5) ISA 5.1-2009: Instrumentation Symbols and Identification
6) IEC 81346-2:2009: Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations - Part 2: Classification of objects and codes for classes
7) Work Instruction for Creation of Part Number of ITER, PNI and Cataloguing [UYGU3S]
8) Procedure for Labelling on Physical Items [VYJ7U2]
9) Signal and plant system I&C Variable Naming Convention [2UT8SH]

5 General Principles

The ITER Numbering System follows several key principles:

- It is based on the concept of Three-Ball-Model [U344WG];
- An item in any situation, e.g. as-designed, as-delivered, as-installed, shall be tagged with one or more 3-Ball-Model (3BM) identifiers.
- The 3BM identifiers (FR, PNI and SN) of an item identify it 1) as a component in the ITER System called **System Component**, 2) as a design solution of the item called as-designed **Type Reference**, and 3) as a manufactured and/or procured item called **Physical Item**;
- In addition to each identifier 1) to 3), there may be supplementary identifiers as shown in Appendixes;
- The requirements for each identifier are as follows;
  FR (Functional Reference):
  - FR shall be used to identify a single System Component in a unique location in the ITER facility.

- FR shall be determined for items in accordance with the following criteria:
  - Functional items of a process appearing in a diagram and/or on the actual control monitor screens, e.g. control valves;
  - Items subject to regular inspection, maintenance, etc.;
  - Items that specifically need to be identified in their location of the ITER system, e.g. a custom-machined shim

PNI (Part Number of ITER):

- Any item or group of items (e.g. kit of items) delivered to the ITER site shall be identified and tagged with a PNI. They are called Individually Distinguishable Items (IDIs);
- An item without a PNI shall not be issued from the warehouse;
- All items identified with PNIs shall be registered in the "ITER Catalogue [UYGU3S]," from which design specification of an item of interest can be found;
- Physical Items tagged with the same PNI shall be interchangeable;
- PNI shall be controlled by IO-CT in a centralized manner to ensure the quality of this key identifier.
- PNI shall be always provided to, DA, Manufacturer, etc. by IO-CT.
- Since a PNI identifies a design solution of the item, the version of the design solution shall be controlled with version numbers of the Tech. Spec., the Drawing and/or even the Engineering Dossier;

SN (Serial Number):

- IDIs delivered to the ITER site shall be identified with SN (or Lot/Batch Num.);
- Items without SN shall not be delivered to the ITER site;
- SN, Lot Num., etc., are at the discretion of the manufacturer.

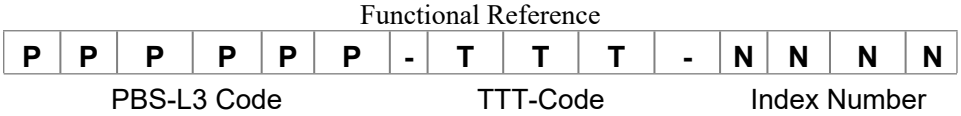
- All 3 identifiers shall be alphanumerical codes using uppercase letters and/or western style numbers.

For further understanding, detailed explanations of FR, PNI, and SN and other identifiers as well as the use cases and the Frequently Asked Questions can be found in the various Appendixes.

6 ID-Code Schema – Format -

6.1 Functional Reference, FR

FR is encoded with 12 or 13 alphanumeric uppercase characters, split into three fields separated by hyphens:



The three consecutive elemental-codes are described below.

6.1.1 PBS Code, PPPPPP

- It is the PBS Level-3 (L3) code without the dots (.).

6.1.2 Function Category Designator, TTT-Code

- This identification field is a short field build of 2 or 3 uppercase alphabetic letters (or, under specific conditions, 2 uppercase alphabetic letters and one digit);
- The possible values of the Function Category Designators (e.g for pumps, tanks etc.) are listed in [43WDW9], and shall strictly be used to define the FR;
- MQP document [2FJMPY] describes TTT-code and the creation process. (See Appendix-G, also.)

6.1.3 Index Number, NNNN

- This is a 4-digit western-style number between 0001 and 9999;

Depending on the nature of each system (process centric, mechanical centric or civil engineering centric), the system RO shall establish and document the numbering scheme.

6.1.4 Example

Functional Reference

3	1	C	R	C	P	-	P	K		-	0	0	1	2
PBS Code L3 for Cryostat Cryopump							TTT for Cryopump				Index Number, "12"			

6.2 Part Number of ITER, PNI

PNI identification shall be done as early as possible after the Preliminary Design Review (PDR) and it becomes mandatory before Manufacturing Readiness Review (MRR).

PNI format consists of the prefix letter "I" followed by 8 alphanumeric characters:

I	X	X	X	X	X	X	X	X
Prefix "I"	8 alphanumeric characters							

There are two IT systems (CATIA/Enovia and SPMAT) that can generate the PNIs depending on the nature of Type Referenced item:

PNI generated and catalogued by CATIA/Enovia (and CADENAS[2])

- The format of PNI for mechanically designed Type References (design solutions) is shown below;
- CAD-Uid consists of 6 alphanumeric characters following the prefix, "I00."

I	0	0	A	A	A	A	A	A
Prefix "I"	"00" (numeric)		CAD-Uid 6 alphanumeric characters					

PNI generated and catalogued by Smart Plant

- The format of PNI for Type References (design solutions) in SPMAT is shown below;
- For piping components designed with PDMS (AVEVA)[3], this format of PNI is mostly used too.

[2] https://www.cadenas.de/products
[3] https://www.aveva.com/en/Solutions/Product_Finder/AVEVA_Everything3D/

I	N	N	N	N	N	N	N	N
Prefix "I"	8 numeric characters							

The generation of the PNI and its delivery to the users are the responsibility of /ESD/DO. Therefore, users don't have to be concerned about the various formats. They just need to request the necessary PNIs via the CAD-ticket system and use them [UYGU3S] once obtained.

6.3 Serial Number, SN

- There is no imposed format. SN, Lot Num., etc., are at the discretion of the manufacturer;
- This identifier will be a SN, a batch number or a lot number, depending on whether a single individual product (SN) or a set of them (batch, lot) is being identified;
- The manufacturer will ensure traceability of the manufacturing with this SN and maintain associated records related to the manufacturing, the testing and the inspection (e.g. Mill certificates, Test reports, As-Built Drawings).

7 Flow Chart

The full flowchart for the creation of identifiers during the items lifecycle is defined in [U344WG]

8 Responsibilities for Tagging Timeline

The responsibilities for the creation of identifiers during the items lifecycle are defined in [U344WG]

9 Interactions with Other Processes

9.1 Outputs from Other Process

CM Process to provide the set of PBS codes:

1. ITER_D_28WB2P - ITER Plant Breakdown Structure (PBS)
2. ITER_D_2FBMWF - ITER Plant (PBS)

9.2 Inputs to Other Processes

Identification codes, the rules and the processes are applicable for any other MQP Processes.

For instance, for Software Control and Model Development, SW-Process refers to this document in following documents:

1. ITER_D_24SNC9 - CAD Manual 09 - Drawing Best Practices
2. ITER_D_35CY6V - CAD Manual 14 - Diagram Guidelines
3. ITER_D_R7SAGV - 1 - How to use SSD
4. ITER_D_3434CN - 07. SSD PFD Application Presentation
5. ITER_D_33JVK9 - 10. SSD P&ID Application Presentation
6. ITER_D_UHR2AY - Management of Functional References in CATIA for Plant Components
7. ITER_D_6T9JVL - How To FILL FUNCTIONAL REFERENCE (PPPPPP-TTT-NNNN)

10 Records

The execution of this document requires the following outputs:

Type of output	Format (Template, form, checklist)	Location of output	Document type	Responsible for managing the output	Retention period
FR	PPPPPP-TTT-NNNN	ITER Centralized Material Database Including CAD Authoring Tools	Diagrams, 3D Models, Drawings, Item Lists, etc.	CID and IO-System RO	historical meta data / till dismantling
PNI	IXXXXXXXX	ITER Centralized Material Database Including CAD Authoring Tools	3D Models, Drawings, Item Lists, etc.	CID, and IO-System-RO	historical meta data / till dismantling
SN	No specific format	ITER Centralized Material Database	Item Lists (As-Built)	DA / Manufacturer (IO-System RO)	historical meta data / till dismantling

Appendix-A Instruction for FR

A1 Examples and Use Cases of FRs

Example of FR is shown below. Combining PBS-L3 code, TTT and Index Number, necessary FR is created.

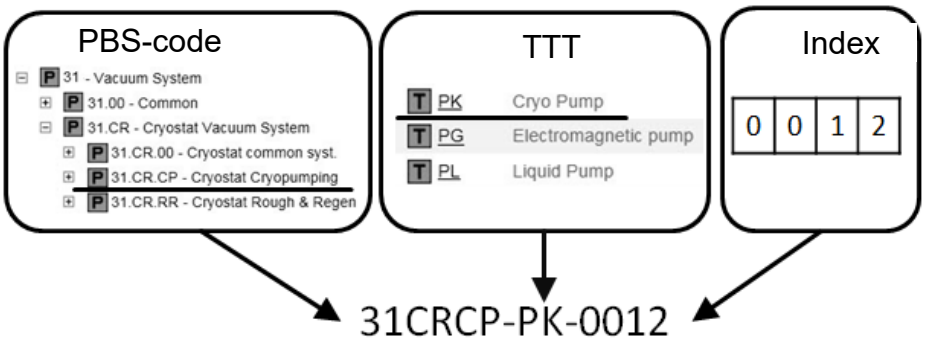


Figure A1 FR for Cryo Pump No. 12 of the Vacuum Cryostat Cryopumping sub-system

On Diagrams

The following snapshot shows a portion of a PID belonging to PBS level 3 76PHVV:

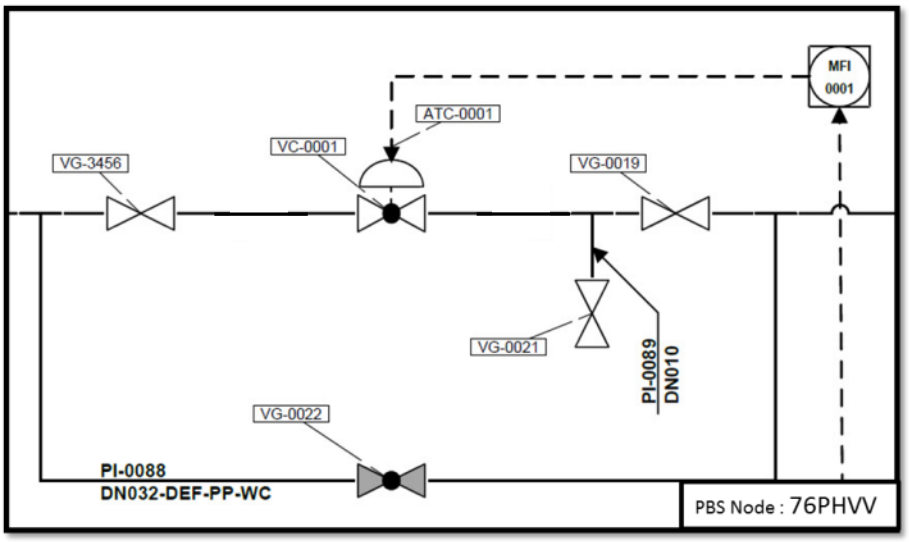


Figure A2 Label for FR on Diagrams

PBS level 3 is defined in the Diagram title block.

All System Components shown in the diagram belong to this PBS unless recalled from another PBS for interfacing. As such, all System Components in this diagram have a shortened label for their FR omitting the PBS Identifier. The label for the Piping Line, Ventilation Duct or Cable is made of the FR, followed by properties such as piping specification or fluid type.

On Layout Drawing and GA

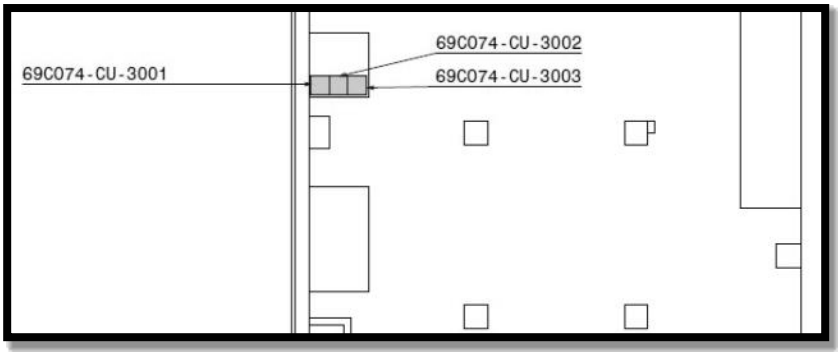


Figure A3 Label for FRs on Layout Drawing

The complete FR shall be displayed. A label with the complete FR followed by properties (such as PIC value) can also be used.

On Mechanical Drawings

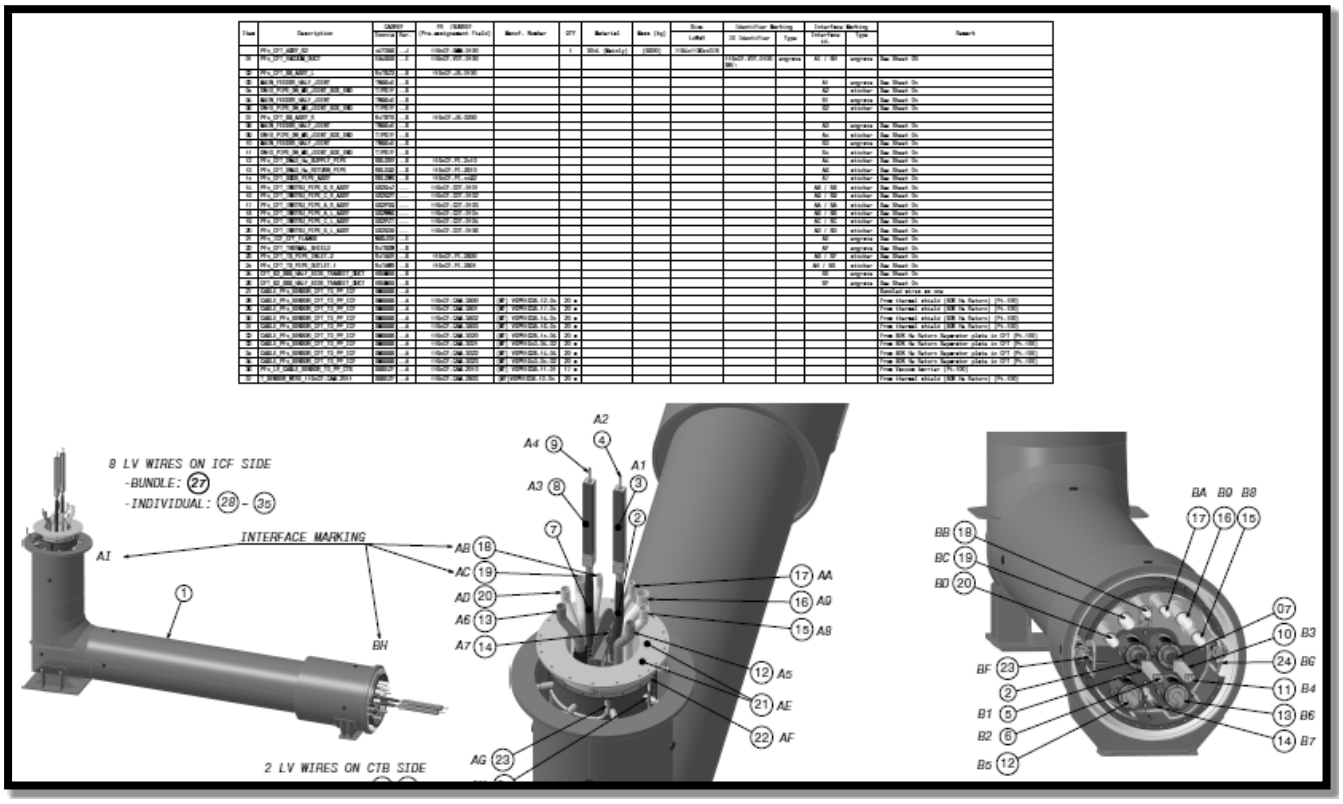


Figure A4 Callout for 3BM-Identifiers on Mechanical Identification Drawing

In a Mechanical Design, some Assembly Drawings shall be used to provide the FR, PNI, CAD part Name and Interface locators using call-outs and tables. In this example, since Cryostat Feedthrough (CFT) of PF4 Feeder is a unique Process-Functional Complex Component, several FRs are tagged to the items before installation.

Refer to Appendix-E for examples of identification.

A2 FAQ for FR

In paragraphs A2.1 to A2.4, additional explanations for FRs are given.

A2.1 Item Tagged with FR - Envelope of System Component -

- A System Component, which is a functional and/or component of interest to IO in the ITER System, is tagged with Functional Reference (FR). The FR is its unique "address" within the ITER System from functional (not geometrical) point of view;
- FRs appear in diagrams, e.g. P&ID, layout drawing, 3D CAD models, tagging pipe, valve, fluid equipment, instrumentation, cubicle, transformer, etc. ;
- Some non-process-functional components, e.g. Embedded Plates, Assembly Platform are also tagged with FRs;
- A FR can also tag System Component physically made, in 3D Model, in drawing, etc.;
- The envelope of FR is difficult to determine because FR may tag an "abstract" item on Diagram and/or Control / Monitor Screen. In addition, FRs do not exhaustively tag all items composing the whole ITER system. Finally, many assembled parts are not tagged with FR (See A2.2);
- Consistency between the Diagram, the 3D CAD design and the physical item is necessary but the envelopes of the 3D model and the actual item do not need to be determined accurately.

A2.2 PBS Level-1 to 3 Codes and FR

Relationship between PBS Level-1 to 3 Codes and FR is explained here.

- FR is equivalent to PBS-L4 code, therefore a System Component tagged with FR is associated with the parent PBS-L3;
- Figure A5 shows the hierarchy structure between PBS-L1 to 3 nodes and FRs;
- FR is recognized as PBS-L4 code, but its nature is not the same as PBS-L1 to L3;
- The summation of PBS-L1 nodes is equal to the "ITER System";
- Similarly, the summation of PBS-L2 nodes or PBS-L3 nodes is also equal to the "ITER System." Consequently, PBS-nodes are always "exhaustive" [4];
- In contrast, since FRs tag only selected "System Components," the summation of all FRs does not represent the "ITER System".

The boundary between PBS-nodes are clear because responsibility assignment shall be done with Interface Control Document and Interface Sheet (ICD/IS). In addition, each CAD model shall be tagged with PBS-code. On the other hand, FR is abstract, because it is extracted from a diagram as a "symbol". Therefore, to define an envelope of FR exactly is not a reasonable effort.

[4] The reality of the current PBS code tree is not the same as presented in this figure. Criteria for the individual levels are not always System / Sub-System / Loop or Assembly, at present.

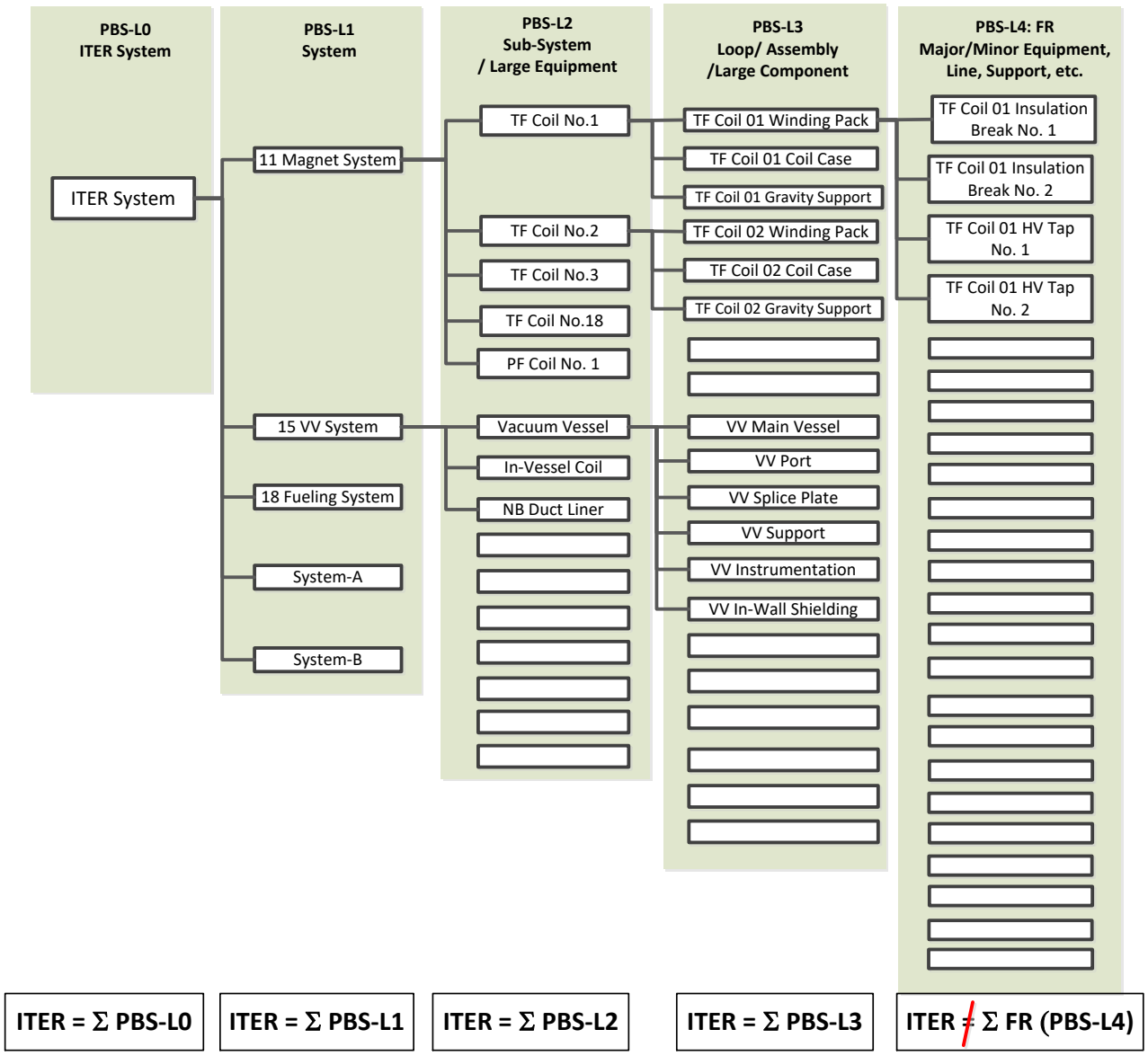


Figure A5 Hierarchy structure of PBS-L0 to L3 codes and FRs[5]

A2.3 Parent and Child FRs

An enclosure is identified with a FR as a single System Component which contains other System Components. Such Enclosing Component is called “Complex System Component”. The TTT-code entails the *Enclosure* function.

It is highly recommended to avoid deep parent-child hierarchy structure of FRs, except for complex cubicle infrastructure.

In Figure A6, the FR of the complex system component (26CVDL-SFU-1100) includes the beam structure and all the components attached to it (equipment, piping parts, etc.).

The complete skid will be tagged with the FR given to the enclosure. The components defined within the enclosure will also be tagged with their own FRs.

[5] Different logics of coding schema are mixed up. Some improvement without significant impact is required.

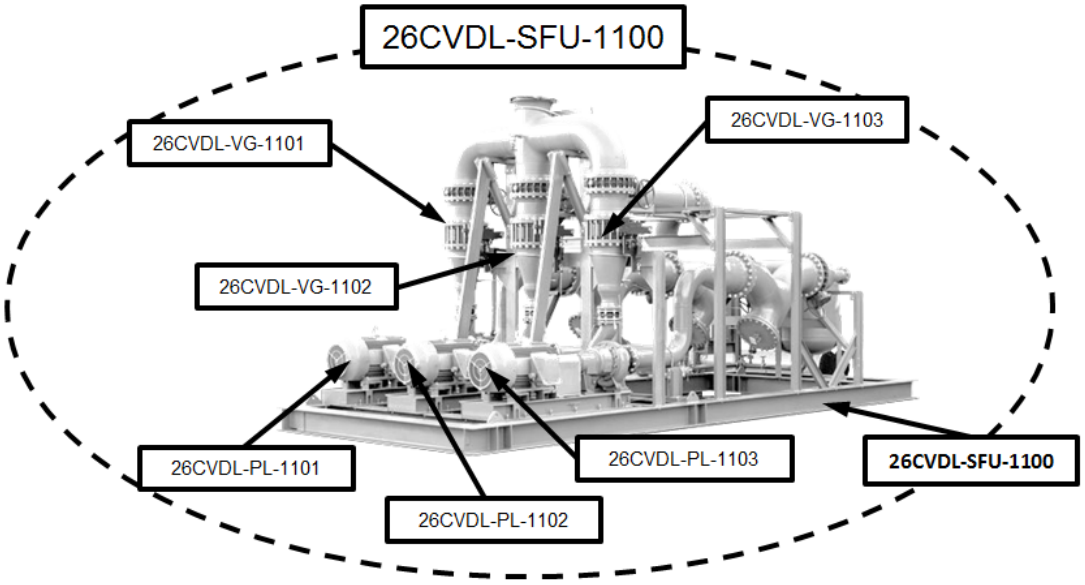


Figure A6 A Plant enclosure and its members in piping

Table A1 Sample list of TTT usable for Complex System (enclosure) Component

TTT	Title	Family	Description
GMM	General Mechanical Module	Mechanical	A mechanical structure either made of beams or panels which contain other equipment. Mechanical modules are used either to simplify logistics, or ease assembly or for constraint relative to protection of included components within.
SFU	Skid Fluid Unit	Fluid	A Skid Fluid unit is a secondary structure which embeds a set of fluid component to achieve a given function. It is delivered mounted.
GB	Glove Box	Fluid	Gas-tight box mostly made of transparent synthetic material in which certain radioactive substances can be handled by means of gloves reaching into the box.
CU	Cubicle	Electrical	

A2.4 Allocation of Delivered Item to FR – Installation -

In Figure A7, correlation between PBS-L1 to L3 nodes and FR (Equivalent to PBS-L4) is described. Items are delivered and then assembled or installed in a certain location of the ITER system (PBS-L0). This story can be named “As-delivered item is allocated to FR.”

Originally, FR is tagging an "abstract" item described in a diagram such as P&ID, hence there is neither outline nor interface definition. In addition, not all items constituting PBS-L3 are tagged with FRs, as mentioned before.

For example, there is no FR tagging interface components used to connect the pump and the pipe[6].

In Figure A7, five situations are presented individually.

[6] Sometimes, the interface components are delivered together with the main equipment, i.e. the pump, as a “kit” tagged with PNI. In that case, all those to be allocated to FR. In any case, it depends on the packaging/kitting strategy. See B2.4 and B2.5.

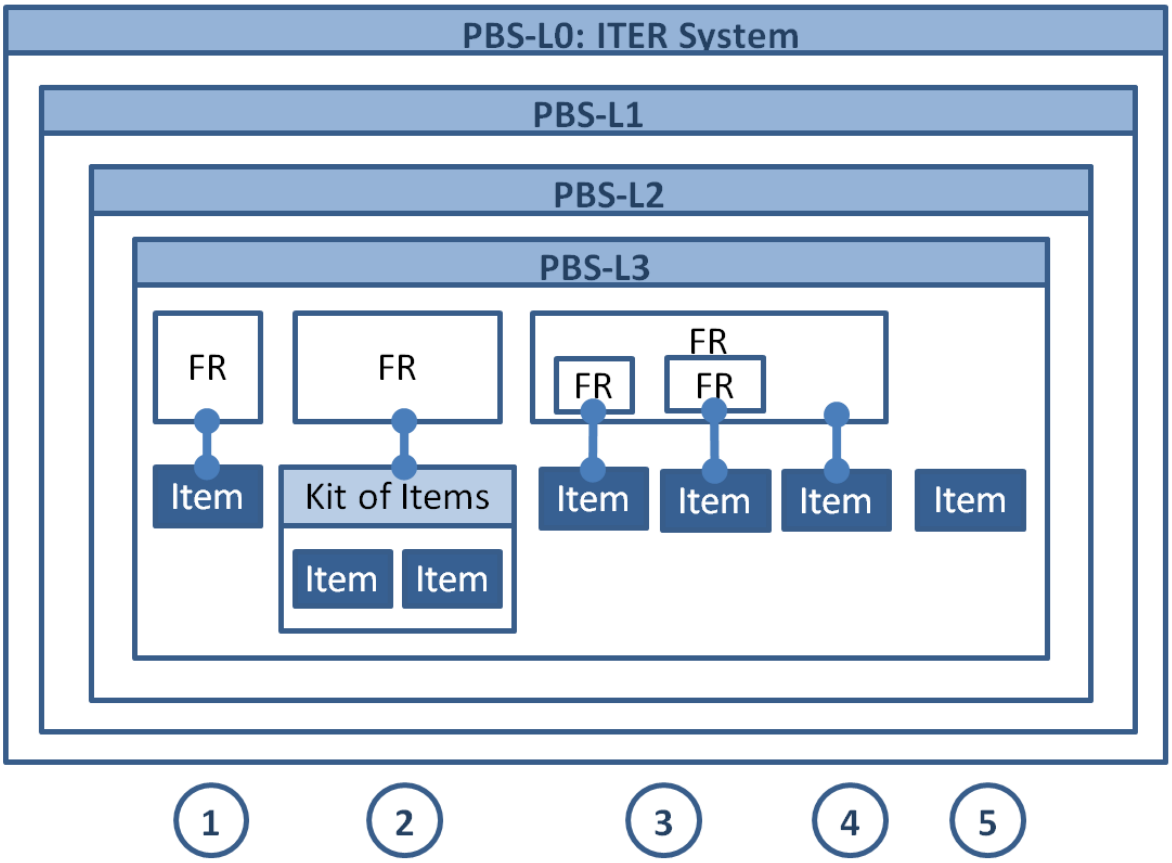


Figure A7 Allocation of delivered items to FRs within the ITER System.

1) One delivered item installed and tagged with FR;
2) One kit of multiple items assembled and tagged with FR. This can happen, for instance, for an equipment plus some interface components in a kit;
3) and 4) show a Complex System Component, e.g. pre-fabricated valve box. One FR enclosing some other children FRs. Allocation of delivered items to FRs are sometimes one to one, but not always (See Case-4) ;
5) Item delivered but not installed as a System Component tagged with FR. Finally the items without FR is just a component of certain PBS-L3.

Appendix-B Instruction for PNI

Additional explanations for PNI are given in this appendix.

B1 Examples and Use Cases of PNIs

There are two IT systems, i.e. CATIA/Enovia and SPMAT to generate PNI's, depending on the nature of Type Reference of the item:

PNI generated and catalogued by CATIA/Enovia (and CADENAS)

- Format of PNI tagging Type Reference of a mechanically designed item is shown below;
- CAD-Uid consists of 6 alphanumeric characters following the prefix, "I00."

I	0	0	A	A	A	A	A	A
Prefix "I"	"00" (numeric)		CAD-Uid 6 alphanumeric characters					

PNI generated and catalogued by Smart Plant

- Format of PNI tagging Type Reference of item in SPMAT is shown below;
- Regarding piping components designed with PDMS (AVEVA), this format of PNI is mostly used.

I	N	N	N	N	N	N	N	N
Prefix "I"	8 numeric characters							

Generation of PNI and the delivery to users are the responsibility of ESD/DO therefore users don't need to be concerned about the various in formats. They just need to request the necessary PNIs via CAD-ticket system and use them [UYGU3S (TBD)] once obtained.

B2 FAQ for PNI

B2.1 ITER Catalogue

- Type References of items i.e. Individually Distinguishable Items (IDIs) tagged with PNIs are registered in the ITER Centralized Material Database as "ITER Catalogue [UYGU3S (TBD)]";
- By referring to the PNI, all the item design related data can be extracted from the ITER Catalogue;
- Finally, PNI is the Primary Key code within ITER Centralized Material Database;
- PNIs of standard parts are controlled with SPMAT or CADENAS.

B2.2 CAD-Ticket to Request New PNI's

- PNI is generated and controlled by IO-CT in a centralized manner [UYGU3S (TBD)];
- Users request necessary PNI's via. CAD Ticket System whether the PNI generator is SPMAT or CATIA;

- Consumables of general usage such as paint shall be tagged with PNI too because they are also to be issued from the warehouse.

B2.3 Manufacturer Part Number, MN

- Manufacturer or supplier shall tag all manufactured or procured items with MN[7] respecting the Quality Plan, in order to ensure the traceability;
- If an IDI is custom designed and shop-assembled, the constituting parts also shall be tagged with MN, exhaustively;
- In contrast, Commercial Off The Shelf (COTS) items do not require any tagging of their constituting parts;
- One PNI for a COTS may be associated with one or several compatible Manufacturer Part Numbers (MNs);
- MNs will be recorded together with the related PNIs in the ITER Centralized Material Database;
- See Appendix-D9, also.

B2.4 Shipment of Items

- In case of unique item in the ITER system, the IDI can be tagged with FR before the shipping, in addition to the PNI;
- All physical items shall be labelled / tagged as defined in [VYJ7U2] prior to shipping where the label shall comprise the PNI;
- IO-CT and DA shall communicate the Planned Delivery List before MRR because the as-delivered configuration can be different from the one expected by IO-CT as listed in the Expected Delivery List. New PNIs shall be provided to DA/Manufacturer by IO-CT, as necessary;
- It is recommended to group as a kit ("Kitting") IDIs necessary for some construction Work Packages. When kitting, the item breakdown structure must take into account the construction process.

B2.5 Kitting

- Figure B1 shows an example of kitting. Taking into account the assembly process steps in the ITER site, delivered items are to be grouped as "Kits";
- Each kit is to be tagged with PNI and the enclosed items can be tagged with PNIs also;
- Each kit is associated with Component (or Assembly) Drawings;
- The packaging for shipment shall be systematically grouped accordingly.

[7] If PNI is used, MN is not always necessary.

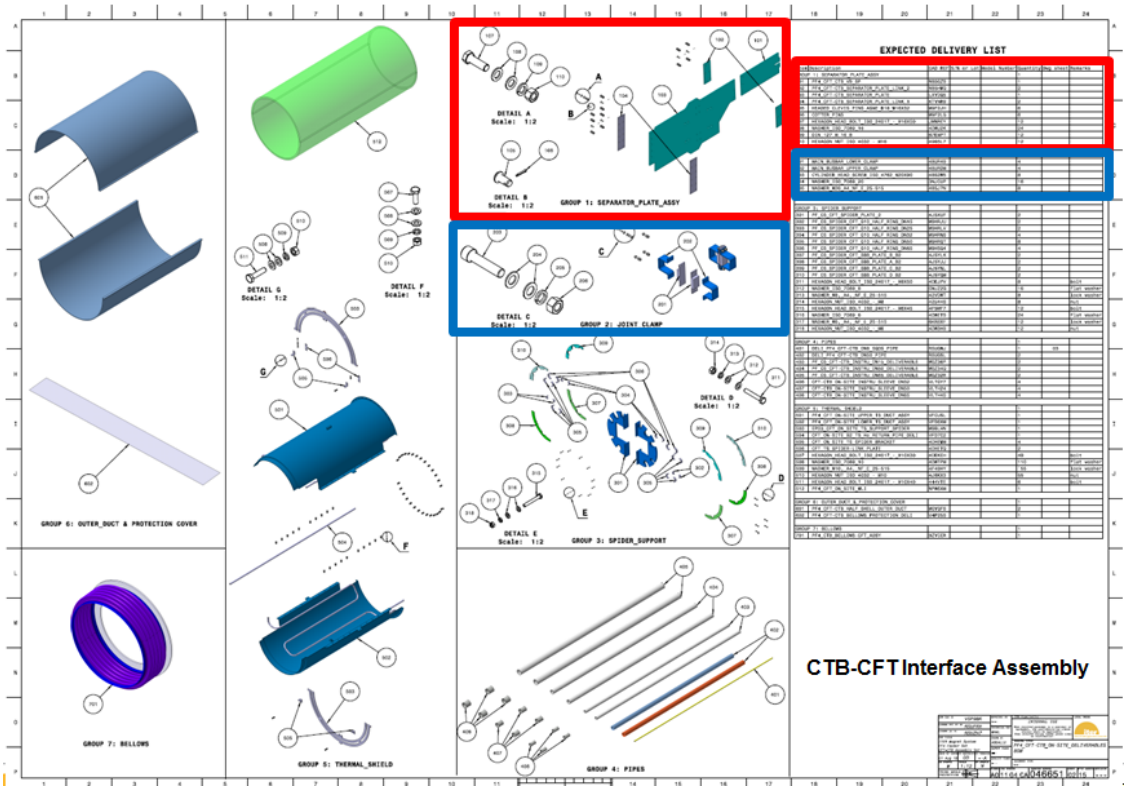


Figure B1 Example of Kitting for Magnet Feeder CTB-CFT Interface Assembly

B2.6 Parent and Child PNI's

All delivered IDIs shall be tagged with PNIs. However, frequently asked questions are related to the granularity or possibility of grouping. Figure B2 shows potential cases of delivered items tagged with PNIs.

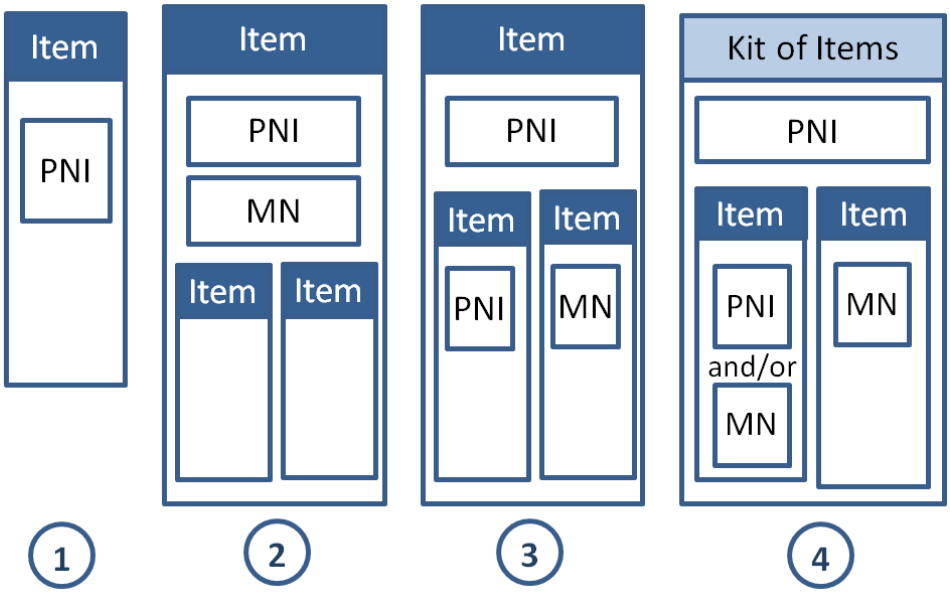


Figure B2 PNI's tagging of delivered items

1) Single item tagged with PNI. For instance, a motor;
2) A commercially available item (COTS) tagged with PNI, which consists of several parts, but identification of those constituting parts is not required. MN is also tagged as in the commercial catalogue.

Note: if the item is conforming to the specification, it is not necessary to tag each constituting part;

3) A custom designed and shop-assembled item consisting of shop-manufactured or procured items. The resultant item shall be tagged with PNI. Any part composing the resultant item shall be tagged with MN, at least. PNI can be used instead of MN;
4) A kit of items, which are shop-manufactured, is tagged with a PNI. The contents of items shall be all tagged with MN, at least. PNI can be used instead of, or in addition to the MN.

B2.7 Standard Parts and Bulk Item

Standard Parts :

- ITER Standard Type References are defined as any common type reference used more than 20 times and within various PBS Level-2's;
- An ITER Standard Type Reference can be either Commercial Off-The-Shelf (COTS) parts or an ITER specific standard, e.g. remote handling bolts.

Bulk Items

- Common parts can be managed as bulk items in the warehouse (e.g. stock of M16 Bolt (S304)) with dedicated PNI;
- Those items can be issued from the warehouse for replacement of a damaged part (in the "Kit") as a spare part;
- Bulk items are mostly "Standard Parts."

B2.8 Spares

- All Spare Parts shall be also tagged with PNIs;
- Spare parts with the same PNIs as the one of the installed item can be used for replacement;
- At shipment, spare parts shall be separated from the ones to be used for the construction. Those to be used for the construction are kitted and packaged systematically taking into account the construction process steps (so they are not treated as "bulk").

B2.9 Version Control (TBD)

- The design of an item is changed when a PCR or a DR is approved and implemented;
- The Item revision number shall be controlled with the revision number(s) of the relevant design documents, e.g. Tech Spec, drawings and/or the Engineering Dossier, which define the design solution;
- PNI is not a "self-talking" or random number without Rev. Num. included. Therefore for revision control of the item, relying on IT database, additional information shall be always displayed with PNI;
- For example, in the ITER Centralized Material Database, in order to control design changes, a certain version of the design solution can be found as:

- Similarly in the case of non-conformance, a Non Conformity Report, NCR, is issued, then approved or rejected by IO-CT. In case of approval, that NCR shall be associated with SN.

Appendix-C Tagging in Construction Site and Warehouse

- In Figure C1, correlation between PBS-L3 node, FRs (equivalent to PBS-L4) and delivered items is illustrated in the construction site or in the warehouse;
- Items are delivered and then assembled or installed in a certain location of the ITER system. This story can be mentioned “As-delivered item is allocated to FR”;
- In this diagram, all items or kits are tagged with both PNIs (or MNs) and SNs. Therefore, all 3BM identifiers are linked together at the moment of site-assembly / installation.
- FRs are abstract and not exhaustive so situation of 4) can occur. This is when the IDI is assembled just as a part of the PBS-L3 but not related to any FR tagging..

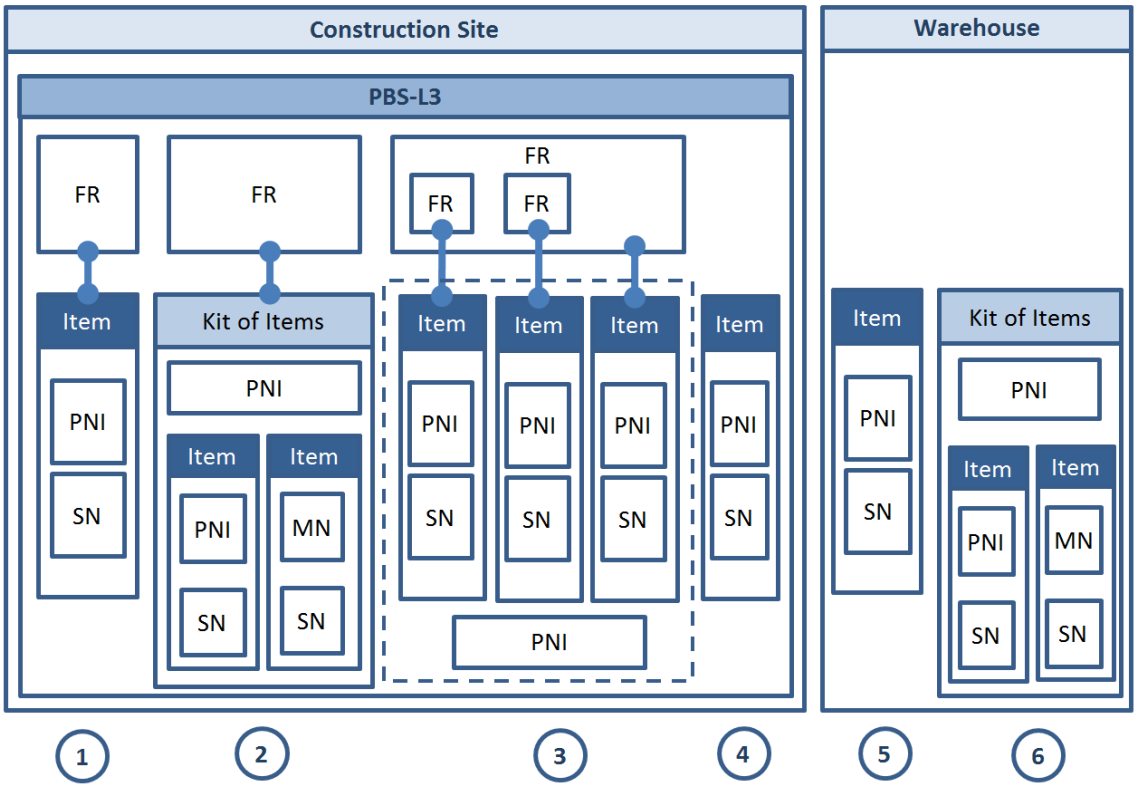


Figure C1 Correlation between PBS-L3 node, FRs and delivered items in the construction site or in the warehous.

1. The simplest case, an item, e.g. COTS, delivered and installed;
2. Multiple items packaged as a “Kit” which is tagged with PNI. All the items are to be assembled as a System Component tagged with FR;
3. Some items are allocated to individual FRs, those are enclosed in the parent FR. One item (on the most right) is assembled as a part of the parent FR. An example is a valve box. Individually enclosed valves and other parts, e.g. shims between the valve box and the Embedded Plates, are tagged with FRs and no identifier, respectively.
   The dotted line shows the Complex Component designated with the PNI in the design;
4. Assembled, but no tagging with FR;
5. One component as-stored in the warehouse (not yet on the construction site)
6. A kit stored in the warehouse as delivered.

Case 4) to be detailed in an other document from data management view point. Completion of the construction is confirmed with fulfilment of the related IFC-BOM and Assembly Drawing.

Appendix-D Supplementary ID-Code Schema

D1 Part Index

Within the detailed Diagrams or 3D models, there is a part as a specific member of a given System Component which should be identified.

The Part Index will be used for referencing:

- Items which may need to be located uniquely during mounting, inspection or for a maintenance procedure within a System Component.
- Custom fitted physical items, assembled at IO premises, within a System Component.
- Within very specific cases, a part which may require being identified for its specific function below the System Component itself as low voltage module within a cubicle.

In most cases, the Part Index should only need to be applied on drawings.

The Part Index syntax is:

A[A][N]NN

- An uppercase ASCII alphabetic code of 1 or 2 characters use to designate a type of part;
- An integer of 2 or 3 ASCII digits. 0 may be used in front to obtain proper alphabetic order in listing.

The total length of the Part Index shall not exceed 5 characters. A given order shall be established in the sequential number following position or assembly logic. The Part Index shall be unique within a given System Component.

Format and Example

If required, an absolute address of the part Index including the concerned System Component can be used and shall be of the following syntax:

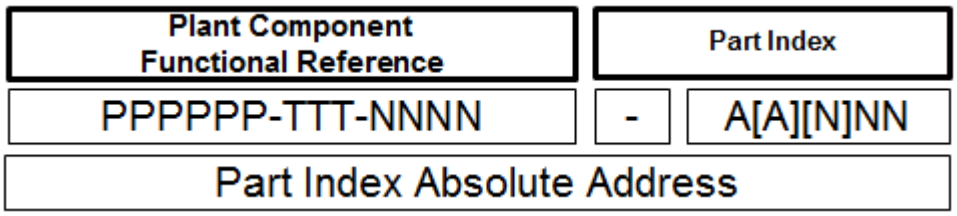


Figure D1 Absolute address of a Part Index

Note: Due to constraint over software, the "–" separator may be replace by "/" or ":" within these software but not on any physical marking.

D2 ISA Reference

The ISA Reference is an additional identifier which shall be used for all classes of process measurement and control instrumentation.

It is applicable to instrumentation falling under one of the following conditions:

- Instrumentation accessible during operation or maintenance.
- Instrumentation involved in Process Control or monitoring (for example a Pressure Transmitter, while the counter example would be a personal Dosimeter Reader)

- Instrumentation measuring or controlling variables of a given System Component (ex : Pressure associated to a tank)

Instrumentation function integrated within a System Component (example: on/off switches on a valve) may also be referenced using an ISA Reference and does not require a FR.

The ISA Reference of an Instrument uses the FR of the measured System Component. This enables the operator to first locate the measured System Component (generally of important dimensions) and then the related instrument, which is important for ergonomic and fast intervention.

The ISA Reference is built by application of "*ISA 5.1-2009: Instrumentation Symbols and Identification"* following the notion previously described of the PBS Identifier and Function Category.

Format and Example

The syntax of the ISA Reference and related loop is built as below :

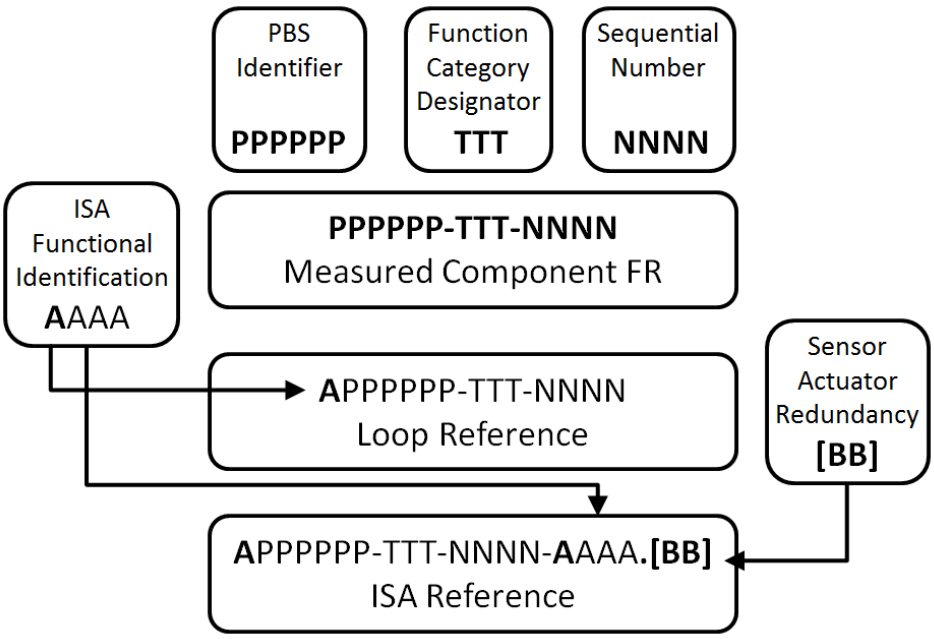


Figure D2 ISA Reference grammatical Schema

Table D1 ISA Instrument Reference Coding Table

Label	ISA Name	Description	Optional	Format
PPPPPP	System Prefix	PBS Level 3 of the Measured System Component and loop	N	6 alphanumeric uppercase ASCII characters
A	ISA Loop Variable	Measured or initialing Variable of the loop as per ISA 5.1-2009	N	1 uppercase ASCII Letter Measured or Initiating Variable
AAAA	ISA Functional Identification	functional identification of an instrument as per ISA 5.1-2009 (see AAAA Codes)	N	2 to 4 uppercase ASCII Letters including signal Level coding (H,L)
TTT	Loop Number Prefix	Main Controlled Component Function Category	N	2 or 3 ASCII uppercase letters or under specific condition 2 uppercase ASCII field and a ASCII digit
NNNN	Loop Number Counter	Main Controlled Component NNNN	N	4 alphanumeric uppercase ASCII characters
BB	Sensor Redundancy	Used for multipoint measure or a redundant sensor	Y	1-2 numeric for multipoint 1-2 ASCII uppercase letter(s) for redundant

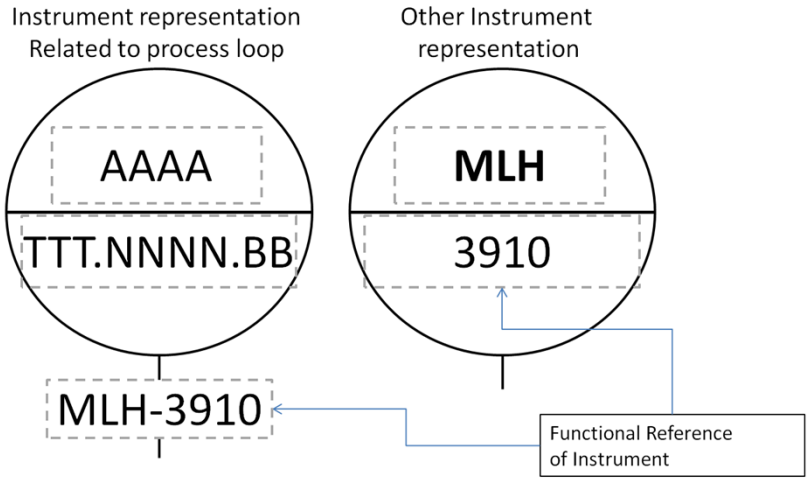


Figure D3 Instrumentation Representations

The representation of a process or function instrument in relation with a process loop is represented on left side of Figure D3. Concerning other instruments, either isolated or not directly involved in process control (earthquake measurement, analyser, etc.) this representation is shown on right side of Figure D3 shall be used.

The FR of the instrument, shown here as *PPPPPP*-MLH-3910, is required to be displayed below the symbol. An example of its application is given in Appendix-E.

The ISA Reference has common field with Signal Identification defined in Signal and plant system I&C Variable Naming Convention (2UT8SH).

D3 Trial Fit at Supplier's Premises

During trial fits of a specific component taking place at the manufacturer's premises, some part may be adjusted (or included electronics can be calibrated) in order to ensure preliminary qualification.

For logistical constraints, this component may be disassembled for shipping and re-assembled for installation at IO. If several components of the same type reference have been produced in the same above condition, it is needed to acknowledge which part of each trial fit goes together. Therefore, a trial fit marking will be used to differentiate them back on site.

The identification of items involved in a given trial fit will be done following the Keyword FIT- followed by an ASCII character as an identifier of the trial as shown in Figure D4.

Figure D4 Trial fit marking

A Trial Fit Marking shall be place on each part of the component delivered, directly on the part and also on packaging. The Trial Fit Marking shall be removable.

D4 Pre-Assignment Field

The Pre-assignment Field is a partially filled-in FR or Part Index using the ASCII underscore "_" as a wildcard (example: 11F1GS-ZJ-0_00, 11__GS-ZJ-0_00).

The wildcard can replace:

- One or several characters of the PBS (PPPPPP)
- One or several characters of the Differentiating Number (NNNN)
- One or several characters of the Part Index (A[A][N]NN)

The Pre-assignment Field shall not supersede any of the 3BM identifiers.

The Pre-Assignment Field enables identification of a group of items which are strictly identical in their design (meaning that they share the same 3D design, CAD UID reference, technical definition and have an identical Type Reference within Bill of Material.)

The Pre-assignment Field shall be visible at delivery on the component if used.

The following restriction of usage shall apply to the Pre-assignment Field:

1. The field will not over constraint the possible final location, i.e. shall not represent specific FR in order not to limit flexibility of placement during construction.
2. The field will only be used for items with limited number of occurrences (<100).
3. The field will not be used for any out-of-the box components like valves, bolts or for items used by several PBS or massively instantiated.

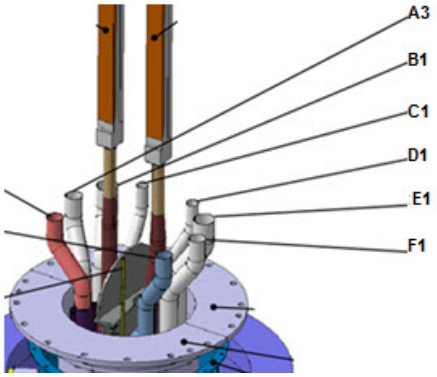
Application of Pre-Assignment Fields is given within Appendix-F

D5 Interface Locator

To ease assembly operations between components, an Interface marking or sticking on components shall be used.

The Interface locator shall be visible on the component areas that are to be assembled together, in order to identify a piece, area or edge that should be matched at assembly. The same short identifiers (example AC10, DC66…) are marked on each mechanical piece location that is supposed to be joined.

The following example shows how these locators should be specified in drawings and in the related table:



Locator	Component A	Component B	Description
A3	11G4CF-CT-1310	11G4CF-CT-2310	DN60 Schedule 10 BE
			Weld Spec : UDM4TR
B1	11G4CF-CT-1320	11G4CF-CT-0310	DN40 Schedule 10 BE
			Weld Spec : UDM4TR
H1	11G4CF-CT-1310		Lifting Ring (4 locations)

Figure D5 Example of Interface Locators and related specification

It is also to be noticed that several locations may get the same tag as for lifting ring.

General rules for the Interface Locator Identifier are as follows:

- The identifier will be the concatenation of an upper-case ASCIII alphabetic string and an integer, both optional;
- The total length of the identifier will not exceed 6 digits;
- String shall refer to a connection type and/or a grid 1st address;
- An Integer shall follow a comprehensive spatial logic to ease mounting.

D6 Piping Related Referencing

D6.1 Pipe Spool Address

The Piping line[8] is the breakdown for fabrication and installation into the segment call spool which can be manufactured in the shop-floor or on-field, following assembly feasibility check. All spools are welded together on-field to finalize piping line construction. The spool identifier is built as such:

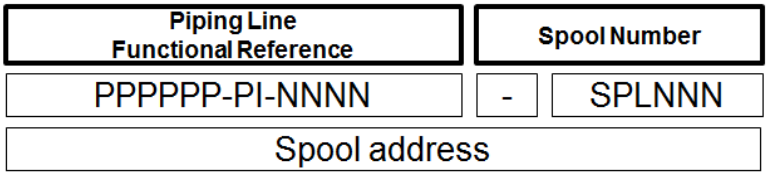


Figure D6 Piping Spool Address

[8] Pipe spool may also be recognized as “Process-Non-Functional System Component” tagged with FR. However, it also contains several pipes belonging to pipe lines tagged with different FR’s. Where those pipelines are recognized as “Process-Functional System Components” appear in the diagrams and in the Control Monitor Screen, in future. Note that many isometric drawings for pipe spools are already tagged by Process-Non-Functional FR codes, as the drawing numbers.

With: PPPPPP-PI-NNNN signifying the piping line FR

SPL signifying the abbreviation for Spool

NNN signifying a 3 digit integer: starting by 1 at one of the extremities of the pipe.

Each Pipe spool gets assigned a PNI.

D6.2 Piping Line Piece Index

Piping line Piece Indexes are unique for a given piping line and not to the whole plant.

The Piping line Piece Index is used on spool isometric drawings for fabrication and welding maps. It is generally automatically assigned during isometric generation and is built as such:

AAAANNN

With:

- The first four characters (AAAA) corresponding to an existing list of piece type codes used. It is using four ASCII uppercase characters.
- NNN being a 3 digit integer starting by 1 at one of the extremities of the piping line.

It is to be taken into account that:

- Piping line welds and gaskets will be identified on non-PIC piping line for inspection and qualification.
- Piping line pieces, welds and gaskets will be identified on PIC piping line for inspection and qualification.

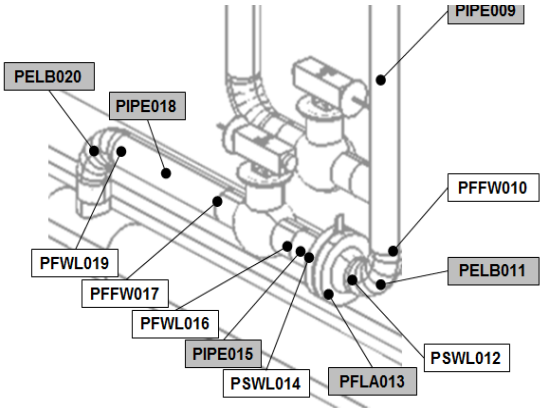


Figure D7 Piping Line Piece Index on a PIC line

The following keys will be used for naming the piping piece:

Table D2 Example of piping pieces

Key	Usage
PBRA	All Branches including the BOSS, CROSS, OLETS, LATERAL, TEE, WYE and THERMOWELL
PELB	All ELBOW and REDUCING ELBOW
PIPE	All STRAIGHT PIPE and PIPE WITH BEND
PFIT	All Fittings including the ADAPTER, CAP, PLUG, CONNECTOR, NIPPLE, REDUCER, STUB_END, SLEEVE, COUPLING, UNION, BUSHING, REDUCING INSERT, NUT, CLAMP, CLAW
PFLA	All FLANGES
PGAS	All GASKETS
PFWL	All FIELD WELD
PSWL	All SHOP WELD
PWLD	WELD (category unknown)

The following keys will be used for naming HVAC piece :

Table D3 Example of HVAC pieces

Key	Usage
HBRA	All Branches including the CROSS, LATERAL, TEE, WYE and TAP
HELB	All ELBOW
HOFT	All OFFSET
HTRA	All TRANSITION
HDUC	All ROUND DUCT AND RECTANGULAR DUCT
HFIT	All Fittings including the COUPLING, COLLAR, END CAP
HFLA	All FLANGES
HGAS	All GASKETS
HACC	All ACCESS COVER

D6.3 Nozzle Naming

Nozzle naming on a fluid System Component shall be used on diagrams, drawings and via permanent labels on physical components to secure mounting, maintenance and fulfil human engineering. Hereunder is the nozzle naming convention to be followed using one ASCII uppercase character and optionally an integer:

Table D4 Example of Nozzle Naming

Process Nozzle	Instrumentation Nozzle
FX for Inlet/Fill	**LX** for Level Measurement
EX for Outlet/Exit	**PX** for Pressure and Vacuum Measure
VX for Vent or Relief	**TX** for Temperature Measure
DX for Discharge and Drain	**RX** for Radiation Measure
PX for Rotating device (agitator/pivot)	**AX** for Analytical Measure
	KX for Leak Detection
MX for Maintenance and Man Hole	**SX** for Sight Glass

The Integer X following is optional and shall only be used if several nozzles of the same type exists.

Table D5 Example of Pping Nozzle Table for a Tank

Noozle	Noozle Description	Connected to	Description
T	Temp. Measure	76BDCF-MTS-1012	DN25 Pressure Rating 40
			EN1092-/11
I1	Nitrogen In	76BDCF-PI-1012	DN80 Pressure Rating 40
			EN1092-/11
I2	Water In	76BDCF-PI-1022	DN50 Pressure Rating 40
			EN1092-/11

D7 Referencing Electrical Enclosure

Electrical enclosure will be a System Component using (in most cases) the following TTT-codes:

CR	Cabinet, box
BJ	Box, junction or terminal
CU	Cubicle
BS	Board, switch or switchboard
CMC	Motor Control Cubicle
BP	distribution panel, Board
CUT	Cubicle, termination hardware
CX	box for radiological data treatment
BN	Board, terminal
BR	Board, relay
BD	Board, distribution

Cubicles containing any equipment playing a primary role in Instrumentation & Control System, such as PLCs, Remote I/Os, Plant System Hosts (PSHs), and Network Switches are considered as System Component. Therefore, the Cubicle acts as an enclosure for these System Components.

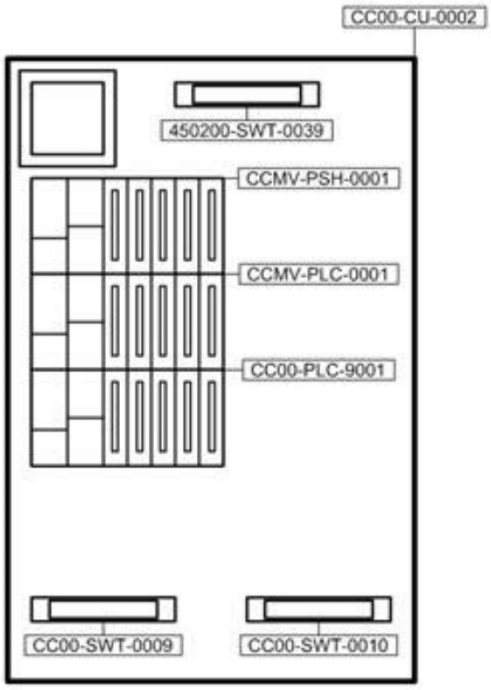


Figure D8 An electrical enclosure

Low voltage Electrical and Electronics Parts and Equipment within Electrical Enclosure such as the Low Voltage breaker, Contactor or Disconnector shall follow the following label format:

A[AA]NN

- The first one or up to three uppercase ASCII characters (AAA) shall follow designation given in Reference Designation Letter for Low voltage part Identification (WEZTST) following "IEC 81346-2:2009: Industrial systems, installations and equipment and

industrial products - Structuring principles and reference designations - Part 2: Classification of objects and codes for classes."

- The last two (NN) are Differentiating Numbers.

Within detailed electrical cubicle diagrams, the FR of the cubicle will be displayed on the title block and optionally together with the Part Index of the low voltage modules (See D1).

Figure D9 Label for FR and Part Index on Detailed Electrical Diagrams

D8 Referencing Wall Openings and Penetration

The Part Index shall be used to identify sub-assemblies having specific penetration and interface functions within opening. The Prefix SL for Sleeve is used and is followed by two integers.

The increment shall start from upper left to lower right by column.

Format and Example

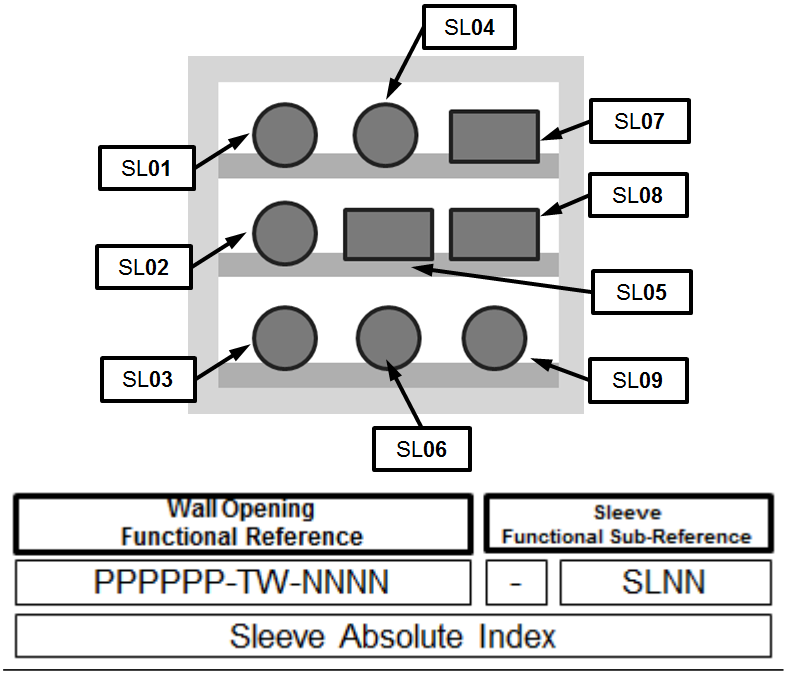


Figure D10 A Wall opening with multiple crossing sleeves

D9 Manufacture Part Number, MN

- MN is required for any item managed by manufacturer regardless of items to be delivered or of those constituting such items;
- Numbering scheme for MN is at the discretion of DA/Manufacturer;
- Any documentation, e.g. design document in manufacturing dossier, quality control records, shall be traceable with MNs;
- If PNI is affixed, MN is not always required. Both PNI and MN tagging the same item are allowed;
- MN includes Supplier Vendor Number; Universal Product Code, coded description according to an applicable industrial code, etc.

D10 Commodity Code

Commodity code is a default feature in Smart Plant Materials (SPMat), representing item family

Format and Example

For standard parts, a part family provides all possible dimensions of a given standard (ex: Screws - Countersunk Head, Hex, DIN 7991 SS316L from M1.6 x 4mm to M12 x 120mm), as shown in Table D6. This part family is reference by a Commodity Code, which is an alphanumeric ASCII code, and a Commodity Description.

Table D6 Commodity Code and PNI of Piping parts

PNI	Commodity Code	Commodity Description	DN	Schedule

I0155208	PPPABRBEATWAAG	15 x S-10S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	15	S-10S
I0155211		15 x S-40S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	15	S-40S
I0155213		15 x S-5S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	15	S-5S
I0155214		15 x S-80S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	15	S-80S
I0155219		20 x S-10S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	20	S-10S
I0155222		20 x S-40S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	20	S-40S
I0155224		20 x S-5S Pipe, ASME-B36.19, BE, ASTM A376-TP316, SMLS	20	S-5S

Commodity Code is generated respecting the Commodity Description as shown in Table D7.

Table D7 Elementary codes composing a Commodity Code and the description

	Group	Part	Dim System	Dim Standard	End Prep	Material System	Material	Alias
Commodity Code	P	PP	A	BR	BE	A	TW	AAG
Commodity Description	Pipe		ASME-B36.19		BE	ASTM A376-TP316		SMLS

In Smart Plant, PNI[9] is calculated from the Commodity Code, as follows:

"PNI" = " Commodity Code" + " Physical Dimensions (e.g. DN, Schedule)"

Regarding a specific custom-made mechanical item, Commodity Code can be a TTT-code, which represent a functional category of component.

D11 Lot / Batch Number and Heat Number

Discretion of DA and Manufacturer.

[9] In Smart Plant, PNI is called as "Ident code."

Appendix E Tagging Example for Instrumentation

The example in Figure E1 shows a tank, 26CVDV-TA-0040, with multiple level switches and a redundant measurement instrument for the maximum fill level. These level switches are all related to the control level loop of the tank. Their ISA References are all of the form **L26CVDL-TA-1540-LS***XX.Y*, thereby clearly referencing the System Component being measured.

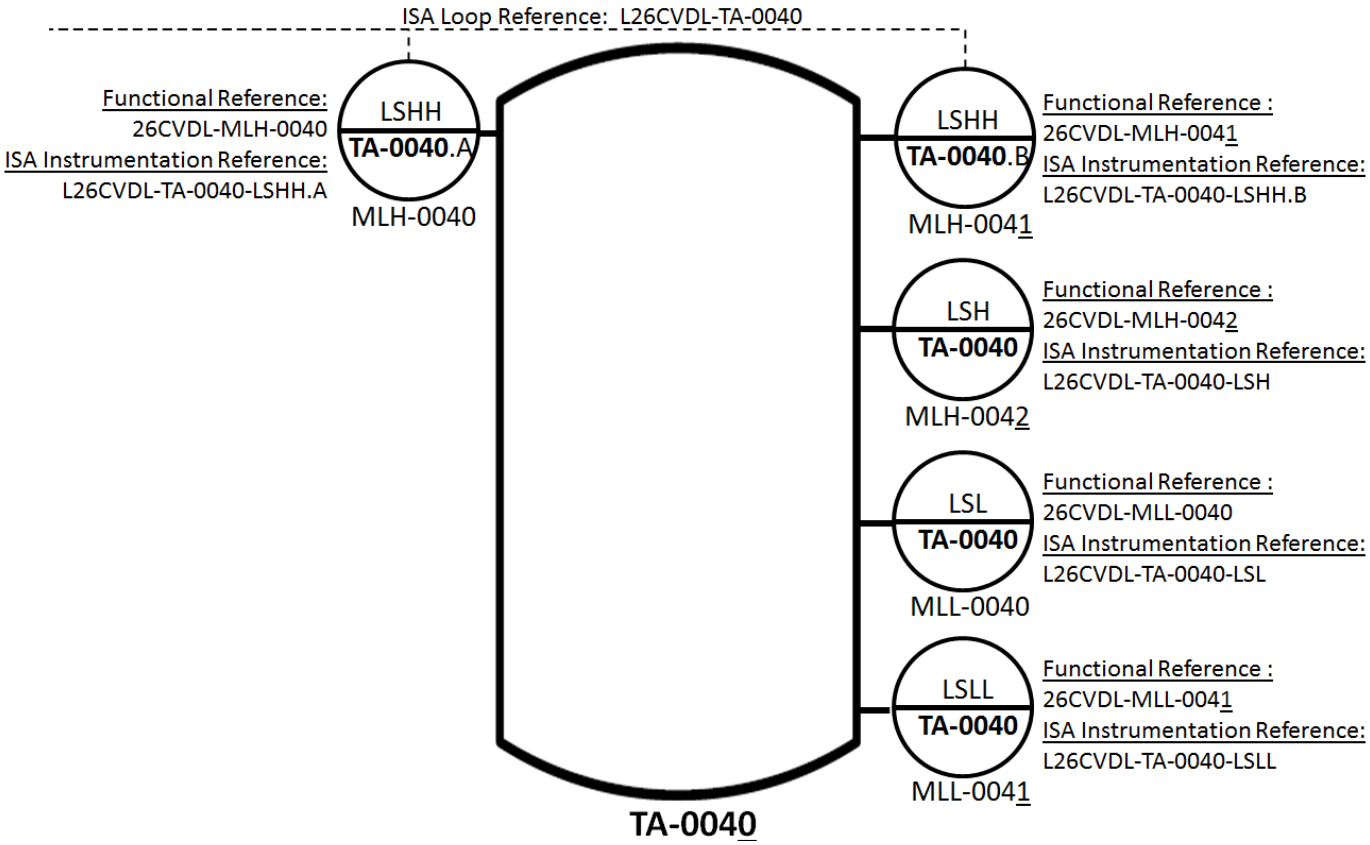
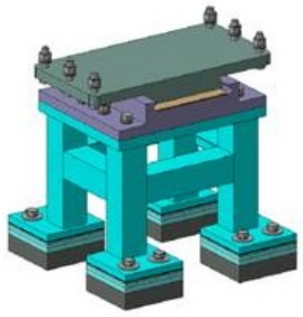


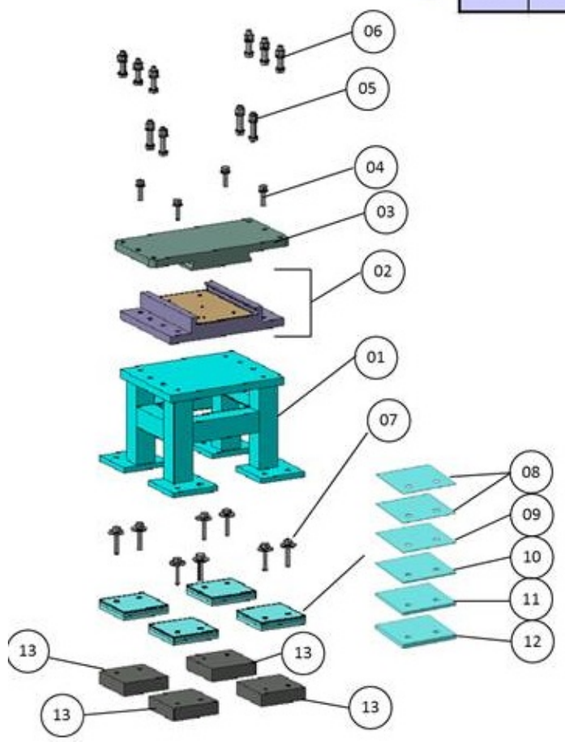
Figure E1 Example of ISA codes with FR's

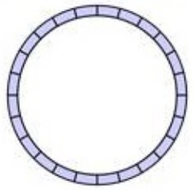
Appendix F Tagging Examples for Mechanical Cases

Sample Identification using Pre-Assignment and Part Tag Field



Item	DESCR	CADREF Enovia	CADREF Ver.	Pre-assignment	PNI	Commodity Code	QTY	Material	Identifier marking: ID identifier	Identifier marking: Type
	CFT_GRAVITY_SUPPORT_STR3_3RD	4F7BE2	- - E	11__CF - ZJ - 0300	I004F7BE2	BCAPABNBEAS5ABAZ	1		11__CF-ZJ-0300 PNI: I004F7BE2 SN :	engrave
01	GRAVITY_SUPPORT_FRAME_STR3_3RD	42DW4B	--F				1	304L		
02	DOVE_TAIL_ASSY	42DW4E	--G				1			
03	G_SUPPORT_SLIDING_CONNECTION_UPR	4F593X	--C				1	304L		
04	BOLT_NUTS_M20X65	6TKYXS	--A				4			
	HEXAGON_HEAD_BOLT_ISO_24017_-_M20X65	6VQ75K	---		I9841254 8	BE4LABNBEAS5ABAZ	1	316LN		
	WASHER_W20_A4_NF_E_25-515	UOK45Y	---		I9841257 9	OEBLAP2SSWAWEZZZ	1	316LN		
	WASHER_ISO_7091_20	4F45MK	---		I9841289 4	GSWAB9DRFAZHA1MZ	1	316LN		
...	...									
08	SUPPORT_SHIM_1MM_L	4F4NKF	--E				8	Q235B		
09	SUPPORT_SHIM_2MM_L	4F4NPH	--E				4	Q235B		
...	...									
13	CARBON_STEEL_BASE_PLATE	6FR38D	--D	11__CF - ZJ - 0300 /00_	I004F7BE8	GSWAB9DRFAZHA1MZ	4	Q235B	11__CF-ZJ-0300 /00_ PNI: I004F7BE8 LOT #:	engrave





Introduction:

20 identical Gravity supports are used within a circular pattern.
A single BOM is used to describe them using Pre-assignment.
The supports are to be delivered assembled except for the Carbon Steel Base Plate (13) which will be custom fitted according to civil engineering.
BOM as designed (shown), BOM as build and BOM as installed will be unique for each Gravity support with SN and FR mark-up.

Line by line explanation:

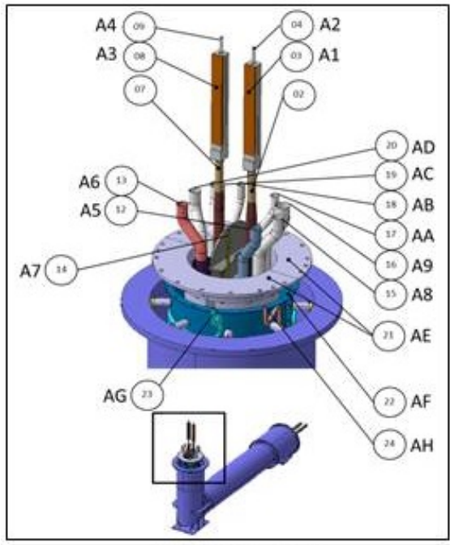
- Top node representing one of the 20 supports with 20 possible FR values and a PNI to identify at delivery.
- Part or assembly of the gravity support; no PNI is required as the supports are delivered assembled.
- Standard Part coming from CADENAS Software. A PNI shall be provided automatically. It is not mandatory as it is delivered assembled in this case.
- Carbon steel plate is custom fitted, thus it requires a Part Tag to follow the exact final location, where once installed is no more interchangeable. As it is delivered separately, a PNI is needed.

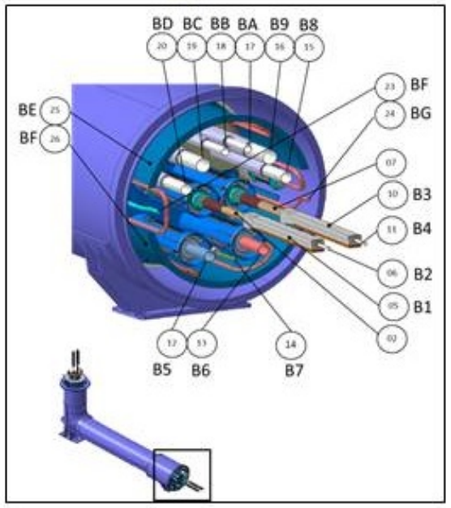
Notes:

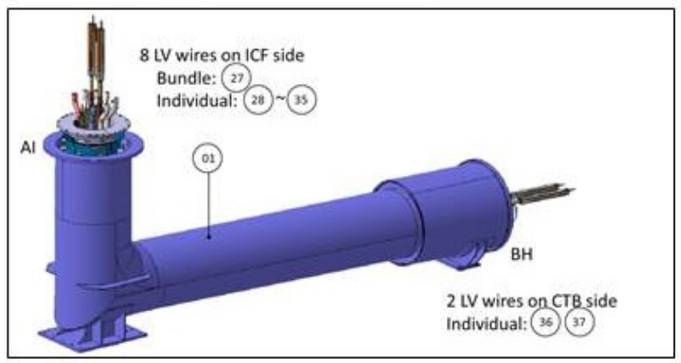
- Pre-assignment is optional, its marking shall not supersede PNI or FR one.
- Gravity support (top node) and Carbon Steel Base Plate (13) are Non-Standard type references – CAD UID used as PNI.

PF4 feeder is the unique item in ITER system, therefore FR can be added to the BOM

Sample Identification using Enclosure and Interface Marking







	Item	Description	CADREF		Functional Reference	PNI	Commodity Code	QTY	Material	Identifier marking		Interface marking	
			Enovia	Ver.						IO identifier	Type	Interface ID.	Type
○	00	PF4_CFT_ASSY_B2	45Y396	--J	11G4CF - VDT - 0100	I0045Y396	MECH	1	304L (Mainly)	11G4CF-VDT-0100 PNI:I0045Y396 SN :	engrave	AI / BH	engrave
●	01	PF4_CFT_VACUUM_DUCT	EA5GUG	--E									
●	02	PF4_CFT_BB_ASSY_L	R4TBZ3	--B	11G4CF - JB - 0100								
●	07	PF4_CFT_BB_ASSY_R	R4TBYK	--B	11G4CF - JB - 0200								
●	08	MAIN_FEEDER_HALF_JOINT	TN964E	--B								A3	engrave
●	09	DN10_PIPE_ON_MB_JOINT_BOX_END	T7PD7F	--B								A4	sticker
●	12	PF4_CFT_DN50_He_SUPPLY_PIPE	RBLXRV	--B	11G4CF - PI - 2410							A5	sticker
●	13	PF4_CFT_DN50_He_RETURN_PIPE	RBLXQD	--B	11G4CF - PI - 2610							A6	sticker
●	14	PF4_CFT_SQDS_PIPE_ASSY	RBLXWG	--B	11G4CF - PI - 4492							A7	sticker
●	15	PF4_CFT_INSTRU_PIPE_B_R_ASSY	US2Q4Z	---	11G4CF - CDT - 0101							A8 / B8	sticker
●	16	PF4_CFT_INSTRU_PIPE_C_R_ASSY	US2Q2Y	---	11G4CF - CDT - 0102							A9 / B9	sticker
●	22	PF4_CFT_THERMAL_SHIELD	R4TB6W	--B								AF	engrave
●	23	PF4_CFT_TS_PIPE_INLET-2	R4TAUV	--B	11G4CF - PI - 2800							AG / BF	sticker
●	24	PF4_CFT_TS_PIPE_OUTLET-1	R4TAWS	--B	11G4CF - PI - 2801							AH / BG	sticker
●	25	CFT_B2_SBB_HALF_SIDE_TRANSIT_DUCT	HSUMGG	--B								BE	engrave
●	26	CFT_B2_SBB_HALF_SIDE_TRANSIT_DUCT	HSUMGG	--B								BF	engrave
●	27	CABLE_PF4_SENSOR_CFT_TO_PP_ICF	SM999B	--A									
●	28	CABLE_PF4_SENSOR_CFT_TO_PP_ICF	SM999B	--A	11G4CF - CAM - 3800	I14636685	BRECABNBEAS5	20 m		11G4CF-CAM-3800 IDENT: I14636685 SN:	Laser		

Introduction:

A Cryostat Feed Through modified BOM for example.
The Feed Through is considered as an enclosure hosting crossing-through routed components with FR.
The Feed Trough is delivered assembled reducing PNI management.
This Feed Through design is unique.

Line by line explanation:

○ Top node representing both the vacuum duct parts and the various components within the duct (Junction Box, Pipe and Electrical conduit). This design solution is unique, so the manufacturer can be requested to engrave the FR.

● Component within the Feed Through, normally declared on Diagrams; no PNI is required as delivered assembled.

● Mechanical Part of the Feed Through, no PNI is required as delivered assembled.

● Cable may be subject to replacement, therefore a PNI must be assigned.

PF4 feeder is the unique item in ITER system, therefore FR can be added to the BOM

Appendix-G Function Category Designator, TTT-Code

TTT-codes can be categorized into two types, i.e. 1) Process-Functional and 2) Non-Process-Functional as illustrated in Figure G1. TTT-codes are also classified per disciplines, e.g. Fluid, Instrumentation, Mechanical. MQP document [2FJMPY] describes more in detail.

Process Functional

- If a System Component is related to a process or a network, it shall be tagged directly on a diagram, with a Process Functional TTT code. For example, a Tank, a piping line, an Instrument, a cubicle, a cable;
- Those appears in a diagram, control monitor screen, etc.

Non-Process Functional

- If a System Component is not involved in a process, it shall be tagged only in the 3D model, with a Non-Process Functional TTT code;
- Pipe spool, special shims are in this category.

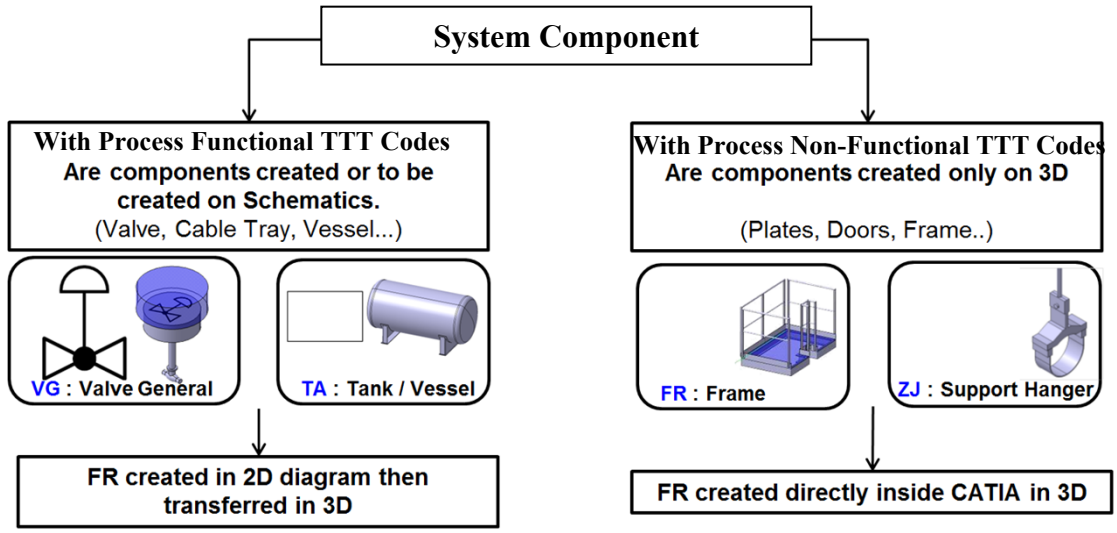


Figure G1 Function Category Designator, TTT codes

Request for New TTT

The criteria of TTT codes, which are exactly the same as for FR, are as follows:

- System components appear in diagram, operation console;
- Any other component on which IO-CT has interest, e.g. Item to be maintained, replaced.

- Requests for new TTT-codes shall be performed via IO CAD Ticket System:
  - Queue: ITER NUMBERING SYSTEM,
  - Service: TTT code request.
- Within a request, a description of the wished TTT-code (example: PC - Compressor) shall be provided;
- The Request will have to follow MQP procedure [2FJMPY] and will be checked if it corresponds to a function which can be given to a component and does not overlap with the existing TTT codes.

Appendix-H Summary of Identifiers in [28QDBS]

	3-Ball-Model ID-code			Supplementary ID-code and/or sub-ordinate code		
	Type of ID-code	Format	Description	Type of ID-code	Format	Description
Plant Component	FR (Functional Reference Number [Sec. 6.1]	PPPPPP-TTT-NNNN	ID-code on a System Component which locates in certain position within the ITER system having certain functionality	ISA Loop Reference [Sec. D2]	APPPPPP-TTT-NNNN	-
				ISA Reference [Sec. D2]	APPPPPP-TTT-NNNN-AAAA.[BB]	-
				Part Index [Sec. D1]	PPPPPP-TTT-NNNN-A[A][N]NN	For constituting parts
				Pipe spool address [Para. D6.1]	PPPPPP-PI -NNNN-SPLNNN	Spool to be in a line
				Piping Line Piece Index [Para. D6.2]	PPPPPP-PI -NNNN-AAAANNN	For fitting, weld, etc.
				Reference electric enclosure and/or part [Sec. D7]	PPPPPP-TTT-NNNN-A[A][A]NN	Small switch in a cubicle, etc.
				Reference wall opening and penetration [Sec. D8]	PPPPPP-TW-NNNN-SLNN	For pipe sleeves within a wall opening
				Pre-Assignment Field [Sec. D4]	e.g. PP__PP-TTT-____ (* This is not ID-code)	Temporary description to be fulfilled after the installation.
Item Type Reference	PNI (Part Number of ITER [Sec. 6.2]	IXXXXXXXX	Primary key ID-code on a Type Reference of individual item.	MN (Manufacturer Part Number) [Sec. D9]	Supplier to decide	Any part or product shall be designated with MN.
				Commodity Code [Para. D10]	SPMAT default code for item family	Mainly for Smart Plant
				Type code for pipe, valve, etc.	User to decide	As necessary
				Function Category Code, TTT [Sec. G]	TTT	[2FJMPY], [43WDW9]
Physical Item	SN (Serial Number) [Sec. 6.3]	Manufacturer / Supplier to decide	ID-code on physically realized item. If it is unique, SN is used. If multiple, lot num., etc. are used.	Lot (or batch) number [Sec. D11]	Supplier to decide	Produced as a group of items
				Heat number	Supplier to decide	Metallic item melt at once

Index numbers to be added to some ID-codes above:

- Trial fit index [Sec. D3] <Example of ID-code> **-FIT-X**
- Interface Locator index [Sec. D5] < Example of ID-code> **-XN**
- Nozzle Index [Para. D6.3] < Example of ID-code> **-XX** (Regarding the digits, respect the main context)

IDM UID
VYJ7U2
VERSION CREATED ON / VERSION / STATUS
06 Jul 2020 / 1.4 / Approved
EXTERNAL REFERENCE / VERSION

MQP Level 3

Procedure for Labelling on Physical Items

This MQP Level-3 document provides procedure for physical labelling complying the MQP Level-2 Procedure for Identification and Controls of Items [U344WG].
This MQP Level-3 procedure describes necessary four types of labelling on hardware (to be) manufactured, delivered, stored and installed in the ITER project.

Approval Process			
	Name	*Action*	*Affiliation*
Author	**Mittag D.**	**08 Jul 2020:signed**	**IO/DG/CNST/CMO/SPC**
Co-Authors			
Reviewers	**Agostini A.** **Butterfield J.** **Chiocchio S.** **Cordier J.- J.** **Elbez-Uzan J.** **Narducci L. *** **Neagu S. *** **Olcese M.** **Wu S.**	**08 Jul 2020:recommended** **27 Jul 2020:recommended** **27 Jul 2020:recommended** **08 Jul 2020:recommended** **20 Jul 2020:recommended** **16 Jul 2020:reviewed** **09 Jul 2020:recommended** **22 Jul 2020:recommended** **21 Jul 2020:recommended**	**IO/DG/CNST/CMO/SPC** **IO/DG/CNST/CMO/SPC** **IO/DG/ENGN/CIO/CMD** **IO/DG/ENGN/CIO** **IO/DG/SQD/EPNS** **IO/DG/ENGN/DO/CIS** **IO/DG/SQD/QMD** **IO/DG/ODG/SA** **IO/DG/CNST/MCD**
Approver	**Salamon B.**	**28 Jul 2020:approved**	**IO/DG/ENGN/CIO/CMD/DCC**
Document Security: Internal Use *RO: Khomutnikov Aleksei*			
Read Access	**LG: SQD Managers, LG: Quality Control Group, AD: ITER, AD: External Collaborators, AD: IO_Director-General, AD: External Management Advisory Board, AD: OBS - Quality Management Division (QMD) - EXT, AD: OBS - Quality Management Division (QMD), AD: Auditors, AD: ITER Management Assessor, project admi...**		

Change Log			
Procedure for Labelling on Physical Items (VYJ7U2)			
Version	***Latest Status***	***Issue Date***	***Description of Change***
v0.0	In Work	04 Jan 2018	
v1.0	In Work	04 Jul 2018	First issue - Document created as per MQP Doc Request https://user.iter.org/?uid=WEYWHH .
v1.1	Signed	04 Jul 2018	A duplicated sentence is deleted from the section, "Scope"
v1.2	Revision Required	04 Jul 2018	PDF error corrected (a blank page eliminated)
v1.3	Approved	26 Jul 2018	Reference document [4ALJEU v2.4] is added. Wording were corrected respecting the reviewer's comments. Suggestion for specific information, e.g. font size is currently declined respecting the guideline given by QMD. All evidences justifying the fast track process are attached.
v1.4	Approved	06 Jul 2020	As per approved MQP doc request https://user.iter.org/?uid=YWE8UC the changes are: 1. Figure 1 at page 7 has been updated to the new warehouse label layout 2. Table 1 at page 8 has been adapted to the new layout of the warehouse label

Table of Contents

1 Purpose

Labelling physical items is indispensable to control them through design, manufacture, storage, and installation and to realize the ITER plant. This MQP Level-3 document provides general definition and procedure for physical labelling, complying the MQP Level-2 Procedure for Identification and Controls of Items [U344WG]. Detailed requirement shall be specified in Technical Specifications, Annex B of Procurement Arrangements, etc., respecting this MQP L-3 procedure.

2 Scope

The scope is the physical labelling on Individually Distinguishable Items, IDIs to be assembled and/or installed in the ITER plant. Following types of items and the labels are in the scope:

- Physical product, e.g. equipment, component (Product Label)
- Shipping container or crate (Shipping Label)
- Stored product or package in the warehouse in the site (Warehouse Label)
- Product installed at IO as a plant-component (Plant Component Label)

The following are explained in this procedure:

- Environmental durability and convenience,
- Material of label or tag,
- Methodology,
- Dimension, font size, and language,
- Location,
- Contents and format.

2.1 Out of Scope

All others are out of scope, especially:

- Any other labelling / signs not related to control of items
  - Labels for safety waring, lockout-tagout (LOTO) ,
  - Sign for operation and maintenance,
- Labels on followings are out of scope:
  - Supply or properties, e.g. personal computers,
  - Chemical substances,
  - Measuring instrument.
- Maintenance labelling after the installation.[1]

[1] Maintenance Label is affixed to an item in addition to Product and Plant Component Labels. To be specified in Operation and Maintenance, OM process.

3 Definitions and Acronyms

3.1 Definitions

Terminology	
Individually Distinguishable Item, IDI	1) IDI is: • Item of as-delivered configuration • Item to be assembled, e.g. kit of interface components • Item to be dismantled and re-assembled • Sub-assembly in the site may be an IDI 2) Non-IDI is, for instance, an item assembled before shipping, e.g. interior of IDI, even those may be listed in Manufacturing BOM and/or As-Built BOM. 3) Depending on Purpose • Items assembled and/or enclosed before shipping and to be physically integrated at the site, e.g. signal conditioner, are not IDIs for logistics or warehouse, but IDI's for construction. Because the connections to be done.
Tagging	Affixing only identifier(s) to an item is called "Tagging." Tagging instead of labelling can happen, when 1) full set of information is not required and/or 2) area for labelling is not large enough. See examples for cabling [4H5DW6], [UD7GFX].

3.2 Acronyms

	Description	Reference
BOM	Bill Of Material	
CON-C	Contractor for Construction	
CON-M	Contractor for Manufacture	
CRR	Construction Readiness Review	
CST	Construction Department	
DRR	Delivery Readiness Review	
ESP	French Order concerning Pressure Equipment	
ESPN	French Order concerning Nuclear Pressure Equipment	
FR	Functional Reference Number	[28QDBS]
GRR	Goods Receipt Report	[QZ4UEK]
IDI	Individually Distinguished Item	
IRR	Assembly and Installation Readiness Review	
MN	Manufacturer Part Number	[28QDBS]
PA	Procurement Arrangement	
PBS	Plant Breakdown Structure	
PNI	Part Number of ITER	[28QDBS]
RO	Responsible Officer	
SN	Serial Number	[28QDBS]

4 Applicable and References Documents

4.1 Applicable documents

[1] Procedure for Identification and Controls of Items [U344WG v1.2]
[2] Sign-Off Authority for Project Documents [2EXFXU v4.0]
[3] ITER Numbering System for Components and Parts [28QDBS, Latest]
[4] Article 30 of EU Directive 765/2008

4.2 Reference documents

[5] Procedure for Cataloguing Type References [UYGU3S]
[6] IO Cabling Rules [335VF9]
[7] I&C Cubicle Internal Configuration [4H5DW6]
[8] Specification for Labelling of Equipment on ITER Project [TL25DK]
[9] Identification of Parts, Components and Physical Items within PBS11 Magnet Systems [UD7GFX]
[10] Procedure for the Import and Export of Goods [LF4QST]
[11] Procedure for Transportation of Components to ITER Site [RY5C6Q]
[12] Procedure for Reception of Components at the ITER Site [RXCTBZ]
[13] Procedure for the Storage and Preservation of ITER Components at the ITER Site [RWYED5]
[14] Procedure for Issue of Components from IO Storage [RW25TC]
[15] ITER Site Signage & Graphics Standards [4ALJEU v2.4]

5 Basic Principles

Labelling is necessary:

- For “Right item in right place”
- No mixing up and no missing item
- To allow people working effectively and communicating with each other, in order to handle items properly.

This section describes general requirements, which shall be specified in each Technical Specification of IDIs to be assembled and/or installed in the ITER plant , e.g. [TL25DK], [UD7GFX], Annex B of Procurement Arrangement, PA.

Firstly, general requirement for all types of labels is described. Then individually 4 types of labels, i.e. 1) Product Label, 2) Shipping Label, 3) Warehouse Label and 4) Plant Component Label are explained.

5.1 Environmental Durability and Convenience

The labelling contents shall be clear enough for users over the necessary period, e.g. throughout the IDI lifecycle. Since quality of labeling will degrade, attention should be paid to materials and methods in particular. Typical requirements, as applicable for each specific case, are as follows:

- Visibility
- Adhesion retention
- Chemical resistance
- Outdoor durability
- Fire safety characteristics

- Temperature resistance (high-temperature and cryogenic)
- UV resistance
- Flame retardancy
- Moisture resistance
- Flexibility

Depending on the purpose and/or the environment of the label to be used, attention should be paid in

- Considering environment and technical feasibility to be ensured,
- Selection of material and method of labelling,
- Considering on if the label is permanent or temporary.

5.2 Materials of Label or Tag

- Material shall be selected taken into account of environmental durability and the duration,
- Respect vacuum handbook [2DVBF7], when applicable.

5.3 Methodology

- Typical types of labelling are handwriting, stamps, labels, engraving, ink jet printers, laser markers, and hanging tags,
- Tagging instead of labelling can happen, when 1) full set of information is not required and/or 2) area for labelling is not large enough,
- Tagging, namely only identification code to be allowed as IO-CT and DA/CON-M agreed on the Tech. Spec., etc.

5.4 Dimension, Font Size, and Language

- English and European Number (Translation to mother language can be added for domestic purpose)
- Human readable sizes of characters
- QR or bar code shall be scannable
- Shall be specified in the drawing and/or the Tech. Spec.

5.5 Location

- Labels shall be located visible areas after the production, packing, storage and installation,
- Labels shall not pose any risks in the performance of the IDI (e.g. engraving a label onto a weld),
- Shipping Label is the upper left corner of the largest face of the carton, at least,
- Cables labelling/tagging shall be carried out in one of the following ways [335VF9] and [4H5DW6]

5.6 Contents and Format

There are four types of labelling:

1) Product Label: it is affixed to a product and provides the minimum information to identify the Individually Distinguishable Item, IDI;

2) Shipping Label: it is a temporary label providing necessary information for delivery;

3) Warehouse Label: it is a temporary label to handle the item properly in a warehouse of the ITER site; it is affixed to either a single IDI or to a package;

4) Plant Component Label: it is affixed to IDI installed in the ITER plant.

Fig. 1 shows examples of four types of labels. Note that necessary contents in each label is specified with the Technical Specification.

Fig. 2 shows the schematic illustration for the generations and the attachments of those labels within the project life cycle. Regardless status of item, PNI is always attached to the item.

The content of each label is summarized in **Table 1.** Regarding Product and Shipping Labels, the minimum information shall be discussed and agreed between IO-CT and DA/CON-M. Since all relevant data is available in the database with identifier(s), it is not necessary to put full information into a label. Additional explanation for each type of label is as follows:

Product Label

- DA and/or CON-M shall specify Product Label in the product technical specification, the manufacturing drawing etc. for approval by IO-CT, respecting the contractual document taken into account of all the considerations afore mentioned.

Shipping Label

- No additional remarks

Warehouse Label

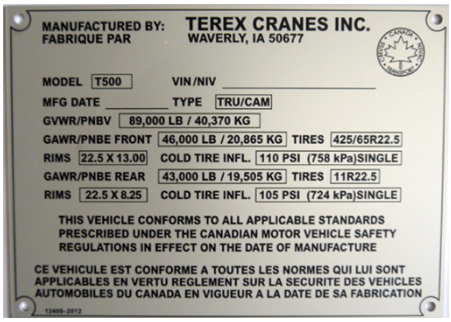
- For a package enclosing multiple items, not necessary to describe individual PNI's, MN's, etc. Packing List Ref. Num. is the critical data to retrieve all relevant information about those items,
- The warehouses mean those in the ITER Site and off-site storages warehouse, e.g. Port Saint Louis, France.

Plant Component Label

- Technical specification applicable in the construction site is [TL25DK] and according to section 4.5 of [4ALJEU],
- As another accompanying sign is, for instance the location of the electric power shut-off button.

5.7 Others

- For identical products, materials, methods, formats and locations shall be the same.
- Warehouse and Plant Component Labels are entirely managed by IO-CT with CON-C.
- Multiple types of labels, e.g. Product Label and Plant Component Label, can be attached to the same item throughout its lifecycle.
- Since PNI and SN are already included in the Product Label, only FR comprised in the Plant Component Label is finally added at the installation.



1) Product Label

2) Shipping Label

PO	4200002484 Rev:2		
Supplier	SHULTZ		
GRR	GRR-02263	Date	04-Nov-19
RN	25FD2G-PL011162	Date	30-Oct-19
PCK	25FD2G-PL011162-01		
PO Item	1600-1-1-4	Qty	5.6460 m
CC	PPPABRBEA7APDBAA	TAG/ FR	---
PNI/ Ident Code	I15901900 250 x S-40S PIPE, ASME-B36.19M, BE , ASTM A312-TP304L-SML (S30403), MAX.		
SR/HN/Ref	722409_SO2.TCWS.9		
HN 2	004709-014	PIC / SL	YES / C
Certif/IDM	CS177551-022-1 / 23B4F8	ESPN / Hazard	YES / N
		Preserv	SOP / Y6SDPP

3) Warehouse Label

4) Plant Component Label [TL25DK]

Fig. 1 Four Types of Labelling (Examples)

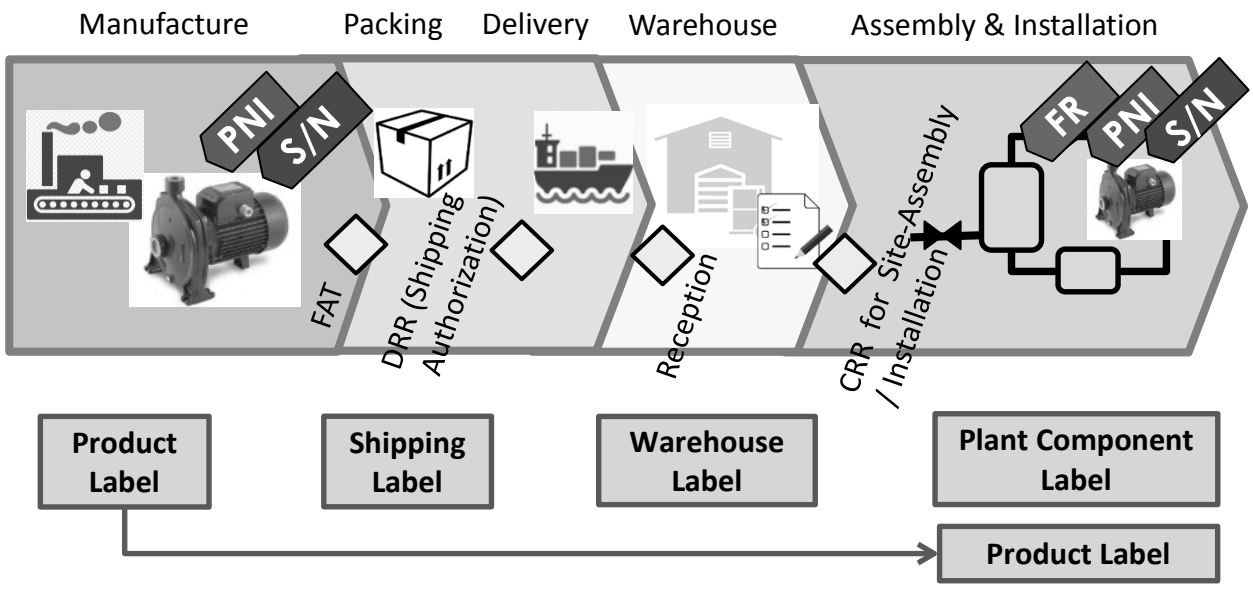


Fig. 2 Four Types of Labelling within Project Lifecycle

Table 1 Summary for Physical Labels

Label	By whom	When	Lifecycle	Mandatory contents	Additional information may be specified in Tech. Spec., etc.	Note
Product	CON-M	After production	Permanent	1) Title of Product, 2) Manufacture Part Number, MN, 3) PNI, 4) SN, 5) Safety Classification, e.g. PIC/SIC, ESPN, 6) Quality Class.	1) Other Ref. Num., 2) Dimensions, 3) Weight, 4) Supplier, 5) Production Date (MM/YYYY), 6) CE marking, as required [4].	PNI to be provided by IO-CT [28QDB5], [UYGU3S].
Shipping	DA and/or CON-M	After packaging	Temporary	1) Title of crate, 2) Purchase Order, PO, Contract Number, PA code, etc., 3) Shipping/Crate Num., 4) Supplier Ref. Num., 5) MN, 6) PNI, 7) SN, 8) Safety Classification, e.g. PIC/SIC, ESPN, 9) From (CON-M) / To, 10) Net / gross weight, 11) Responsibility, 12) Packing Date (MM/YYYY).	1) Dimensions, 2) Other Ref. Num., 3) Quantity in the crate	For PNI as mentioned above. Accompanying signs, e.g. sign of handling precaution during transportation.
Warehouse	IO-CST with CON-C	After the reception	Temporary	1) PO, Supplier 2) GRR No &Reception Date, 4) 3) Release Note Number & Date 4) Packaging Number 5) PO item & quantity 6) Commodity Code or TAG number(FR) 7) IdentCode/PNI and description of the PNI 8) SN (field SR/HN/Ref.) 9) HN 2 (heat number field 2 in SMat) 10) PIC (Yes/No/SOP) 11) SL (storage level) 12) Certif/ IDM (certification number for qualified material & IDM UID) 13) ESPN	1) SN, Lot/Batch Num. and/or Heat Num., 2) Ship Load, 3) Delivered Dock, 4) Commodity Code, 5) Intentional FR to install, 6) Export License Num., 7) Other Ref. Num., etc.	Accompanying signs, e.g. sign of handling precaution.

				14) Hazard (dangerous goods material) 15) Preservation (Yes/No) and IDM UID		
Plant Component	IO/CST with CON-C	At assembly and/or installation	Permanent	1) Title, 2) FR, 3) Safety Classification, e.g. PIC/SIC, ESPN, 4) QR Code.		Tech. Spec. [TL25DK]. Accompanying signs, e.g. safety labels for hazardous materials, high pressures and/or temperatures.

6 Workflow

Timing of affixation of a label is listed in **Table 1**.

7 Responsibilities

Responsibility assignments are specified in **Table 1**.

8 Link with Other Processes

MQP Processes	Uid	Descriptions
Configuration Management, CM	TZV743	• Identify items and ensure the installation to the right positions.
Design Control, DC	U34DDZ	• Designate designed items and design physical identification taken into account of the environment.
Handling, storage and transportation, HS	LF4QST, RY5C6Q, RXCTBZ, RWYED5, RW25TC	• Generate Tech. Spec. or specific procedure respecting this MQP procedure. • Identify items in transportation and storage.
Inspection and Testing, IN	TVL3Y5	• Ensure a label at each inspection or test. • Describe results of inspection in the Maintenance Label.
Manufacturing, Assembly and Installation, MA	ECBZWE	• Perform manufacturing design, e.g. manufacturing drawing, Tech. Spec. ensuring physical items are properly labelled. • Affix Plant Component Label at the installation.
Nuclear Safety, NS	9KAZ8T, 347SF3	• Ensure all PIC/SIC components are clearly labelled with Plant Component Labels.
Operation and Maintenance, OM	VH9LAB	• Utilize labels and tags attached to physical items for operation and maintenance.
Quality Assurance, QA	24VQES	• Quality classification

9 Outputs (Records, Deliverables, Implementation Plans….)

Not Applicable, N/A.

ITER • QA	RELEASE NOTE	*Note number:*

Section 1 *To be completed by the performer*

1-	**ITER PA Number / Contract Number:**
2-	**PA/Contract title:**
3-	**Performer:**

Section 2 *Conformity statement to be completed by the performer*

1- With the exception of the deviations listed below (point 6), we certify that the following equipment/service: (describe)

No	*Equipment / services description*	*PNI**	*SN**	*Quality class / Safety class*	*PE/ NPE**	*Quantity*
1.						
2.						
…						
…						

PE/ NPE – Pressure Equipment / Nuclear Pressure Equipment

2- Has been manufactured/performed, inspected and tested in accordance with the requirements described in the following documents: (technical specification and/or drawings and/or diagrams specifying requirements *as per Annex 1 see point 3)*

3- That the equipment/service is complete.

4- That all relevant verifications, inspections and tests are complete and satisfactory (*as per documentation indicated in Annex 1 see point 5).*

5- That the following documents are those required by the contract: *(*detailed list)
(Example / typical content of Manufacturing Dossier is presented in the Annex 1)

6- List of any deviation request and non-conformance report: *(see Annex 1 – point 6)*
*Further actions/ remain points to be addressed in the next stages of the project *:*

Performer's Responsible Officer			Performer's Quality Officer		
Name	*Date*	*Signature*	*Name*	*Date*	*Signature*

Section 3 *To be completed by ITER*

ITER Responsible Officer Decision:			ITER Quality Management Division (QARO) Comments:		
Name	*Date*	*Signature*	*Name*	*Date*	*Signature*

**Note:* *ITER Part Number (PNI) and Serial number (SN) shall be agreed with IO before delivery. In case the information (regarding PNI, SN or different others sections) is not available at the delivery time, this shall be mentioned in Section 2, point 6 of present Release Note as a further action / remaining point to be addressed on the next stage of the project. In case the information is not applicable, the respective section will be filled with N/A.*

Annex 1 of Release Note:

Manufacturing Dossier (provided as example/ typical content):	**IDM link**
1 – Description of delivery: Description of equipment / component / spare part Description of services Main spare parts list / Bill of Materials – BoM (if applicable)	
2 – Conformity: Certificate of conformity (conformance) / Declaration of conformity as per applicable directives, regulations and contractual requirements.	
3 – Design documentation; Manufacturing drawings/ diagrams; Design reports / Design calculations (if required); Technical specifications (if applicable).	
4 – Management Documents 4.1 Procedures: ○ Functional test procedures / Final acceptance tests and inspections procedures; ○ Pressure Test Procedure (if applicable); ○ Helium Leak test procedure (if applicable); ○ Non-Destructive Examination procedures - VT, PT, MT, RT, UT (if applicable); ○ Destructive examination procedure (if applicable); ○ Welding/Brazing Documents - WPS, PQR, WPQ etc.(if applicable); ○ Electrical and Insulation Tests procedures (if applicable); ○ Cleaning and packaging procedure. Surface Treatment Specification 4.2 - Qualification documents ○ Welders and NDE inspectors qualification (if required). ○ Other qualifications (if required). 4.3 Operational and functional documents: ○ Operation manual. Installation instructions. ○ Maintenance (preservation) instructions (if applicable). ○ Manufacturer handling instructions (if applicable).	
5 - Assembly, inspections and test documents: Completed Manufacturing and Inspection Plans (MIP) / Inspection and Test Plans (ITP) / Control Plans, Inspection and test reports and records (Visual Examination, Non-Destructive Examination, Destructive examination, Electrical and Insulation Tests, Leak Tests, Pressure Test, Certification of Cleanliness, etc.). Drawings marked “As Built” accepted by IO.	
6 – Deviations and Nonconformities; Deviation request approved by IO; Nonconformity reports - NCRs (close status); NCRs conditionally released	
7 – Raw materials; Material Certifications traceable to components (Certificate type 3.1 as per EN 10204);	

Note 1: The manufacturing dossier (MD) content may be changed considering the specificity of each delivery, following the contractual requirements. The MD content shall be agreed with IO before delivery.

Note 2: For construction, installation and assembly activities, Manufacturing Dossier is replaced by Mechanical Completion Dossier (MCD) prepared as per ITER_D_UYUSEE - Working Instruction for Completion Dossier Preparation.

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User Manual

ITER Dimensional Metrology Handbook

This Metrology Handbook outlines the mandatory requirements for dimensional control of the components, assemblies and systems for the ITER machine. In addition this handbook provides significant guidance and helpful information on best practise for large volume metrology applications which can be used in the production of procurement specifications. The handbook also provides information on the ITER metrology infrastructure and the provision of alignment and metrology services during assembly of ...

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Change Log				
Title (Uid)	***Version***	***Latest Status***	***Issue Date***	***Description of Change***
ITER Dimensional Metrology Handbook (46FN9B_v2_1)	v2.1	Approved	08 Mar 2012	Reference to Design Authority Policy removed Hyperlink to SRD 62-13 corrected
ITER Dimensional Metrology Handbook (46FN9B_v2_0)	v2.0	Signed	25 Jan 2012	Version for senior management approval after internal review.
ITER Dimensional Metrology Handbook (46FN9B_v1_4)	v1.4	Signed	20 Jun 2011	M Kondoh and D Sands added as reviewers at the request of K Blackler
ITER Dimensional Metrology Handbook (46FN9B_v1_3)	v1.3	Signed	15 Jun 2011	Following technical review, document issue raised to add reviewers/approver for sign off Authority.
ITER Dimensional Metrology Handbook (46FN9B_v1_2)	v1.2	Signed	16 May 2011	references to Manual replaced with Handbook +/- 1mm value removed Reference to temperature control requirements added note on MQP requirements added
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ITER Dimensional Metrology Handbook (46FN9B_v1_0)	v1.0	Signed	04 Mar 2011	

Table of Contents

1 Purpose

The purpose of this document is to supply information relating to dimensional metrology to all Departments of the ITER Organisation and Domestic Agencies. To define strategies and infrastructure provision, identify requirements and best practises and provide a standardised approach to dimensional control and alignment processes.

2 Scope

The Dimensional Metrology Handbook (DMH) outlines the mandatory requirements for dimensional control of the components, assemblies and systems for the ITER machine. In addition the handbook provides significant guidance and helpful information on best practise for large volume metrology applications. The handbook also provides information on the ITER metrology infrastructure and the provision of alignment and metrology services during assembly of the machine and its ancillary components and systems.

The DMH is issued as a supplement to project requirements documents, since it is necessary that the requirements contained in this handbook are followed by the ITER Organisation, the Domestic Agencies and industry to ensure the successful construction and operation of ITER.

3 Definitions

Abbreviations and Acronyms

3D	Three Dimensional
A&M	Alignment and Metrology
AIMS	Advanced Integrated Mathematical System
ASCII	American Standard Code for Information Exchange
CAD	Computer Aided Design
CBD	Cryostat Base Datum
CCL	Current Centreline
CCR	Corner Cube Reflector
DA	Domestic Agency
DCM	Design Compliance Matrix
DMH	Dimensional Metrology Handbook
DMIS	Dimensional Measurement Interface Standard
GD&T	Geometric Dimensioning and Tolerancing
GPS	Geometrical Product Specifications
ICD	Interface Control Document
IDM	ITER Document Management System
IGES	Initial Graphics Exchange Specification
IO	ITER Organisation
IS	Interface Sheet
LVM	Large Volume Metrology
MIP	Manufacturing Inspection Plan

MQP	Management and Quality Program
MRP	Mandatory Requirements for Procurement
NRK	New River Kinematics
PA	Procurement Arrangement
PF	Raw 3D Scan data Format
PIF	Parametric Image Format
PIT	Pit Datum
POL	InnovMetric's Binary Format
RO	Responsible Officer
SA	Spatial Analyzer
SAT	Standard ACIS Text
SMR	Spherically Mounted Reflector
SRD	System Requirements Document
STEP	Standardised Exchange of Product
TAD	Tokamak Assembly Datum
TRO	Technical Responsible Officer
TF	Toroidal Field
TFGS	Toroidal Field coil Gravity Support
TGCS	Tokamak Global Coordinate System
VVGS	Vacuum Vessel Gravity Support

4 Communications and acceptance

To satisfy the requirements of this handbook, processes and procedures relating to alignment and dimensional control must be clearly documented and where stated: approved or accepted by the Metrology RO or nominated representative.

Section 11 and its sub-sections "Process control and best practise" identify areas that will be reviewed prior, during and on completion of the activity and will require IO acceptance at predefined stages. *Acceptance/Approval* is to be a positive and recorded action, either by signature or by electronic means.

A possible route of communication and acceptance could be:-

Supplier (Contractor) ↔ Domestic Agency Contract Responsible Officer ↔ ITER Technical Responsible Officer ↔ ITER Metrology Responsible Officer.

5 Alignment and Metrology (A&M) Classifications

Machine components and plant systems requiring alignment and/or dimensional control shall be given an A&M classification by the applicable TRO. The classification shall reflect the importance placed on A&M for the system to function and the consequence of failure on the project. This classification shall be reviewed with the Metrology RO and accepted

Alignment & Metrology (A&M) Class 1

Components or assemblies requiring alignment and/or dimensional control, where failure to comply in these areas will significantly impair or prevent machine assembly and/or operation and could potentially cause schedule delay in excess of one month or cost risk in excess of 1M€.

A&M Class 2

Components or assemblies requiring alignment and/or dimensional control, where failure to comply in these areas will significantly impair or prevent machine assembly and/or operation and could potentially cause schedule delay in excess of one week or cost risk in excess of 0.1M€.

A&M Class 3

No dimensional control oversight by IO is required through the supply chain or on receipt at the ITER site. No component alignment requirements however; setting out points/lines will be required from the IO metrology team to facilitate the installation.

Unclassified

No IO infrastructure required or support from the ITER metrology team

Note: It is the responsibility of the Technical RO to make an assessment of the A&M requirements for his system following the processes in this document in order to determine the A&M class, which is be reviewed by the metrology RO.

6 Mandatory requirements for A&M Tasks

For the ITER machine to operate to specification it is essential that the supply of its constituent parts is controlled throughout their life cycle from raw material through manufacture, assembly commissioning and operation. From a metrology perspective this means that dimensional control processes must be qualified and traceable.

The Metrology RO shall be available to provide technical advice to system ROs during preparation of PAs and Technical Specifications, reviewing metrology related documentation and providing support where necessary during manufacture, assembly/installation and acceptance.

In the following sections, information is provided on best practise guidance for metrology related processes and will be used as the basis for reviewing process documentation relating to dimensional control activities.

Within this section are the mandatory requirements relating to A&M for the supply and assembly/installation of the systems for ITER. If an exceptions to a mandatory requirement is requested it must be agreed by the IO MAI section through a deviation request.

Mandatory requirements relating to A&M are dependent on the A&M classification applicable (section 5) to the component or assembly concerned. These requirements are detailed in the following sub-sections:

6.1 Mandatory Requirements for Site (MRS) based A&M Class 1 activities

A&M Class 1 activities are critical to the successful assembly/installation and operation of the ITER machine and as such require the highest level of qualification and control. Listed below are the mandatory requirements, as applicable for the system concerned, identifying responsibilities for their delivery and acceptance. The Metrology RO or his delegate shall review all key documents pertaining to A&M tasks within this classification.

[MRS1] The System Requirements Document (SRD), Interface Control Document (ICD) or other document, shall define the alignment and/or dimensional control requirements. These shall be included in the DCM and the methods to achieve them shall be reviewed and approved as part of the ITER Design Review Procedure with the Metrology RO accepting the process for the A&M tasks.

[MRS2] The ITER RO shall identify all A&M quality documentation that will form part of the supply for the applicable system. The dossier of documents shall be certified compliant with the requirements of the technical specification or shall be supported by a non-conformance report. This shall be in place prior to any A&M work commencing at the ITER site.

[MRS3] For items requiring goods inwards, in-process or final inspection, a list of key characteristics shall be compiled by the RO to identify the scope of the inspection. Datums and tolerances shall be identified in a drawing or other medium acceptable to the inspection team carrying out the task. A method statement or procedure shall be prepared by the party responsible for the inspection which shall be accepted by the Metrology RO or his delegate.

[MRS4] For items requiring setting out, pre-alignment and/or final alignment at the ITER site, a procedure shall be prepared detailing the requirements, process description, reference data, output data together with reporting and acceptance criteria. This procedure shall be accepted by the Metrology RO or his delegate prior to task commencement.

[MRS5] The coordinate/datum systems used during inspection and alignment tasks on the ITER site shall be clearly defined in the A&M procedure for the task and applicable drawings. Where datums evolve to reflect as-built variation in the assembly/installation process the logic shall be traceable back to the nominal requirement.

[MRS6] Inspection reports shall identify the nominal dimensions, applicable tolerances and the dimension achieved for the feature, with non-

complying values flagged in red on the report. These features shall be the subject of rework or a non-conformance report.

[MRS7] All metrology equipment used for A&M tasks shall hold a current calibration certificate issued by an accredited laboratory (Reference standard BS EN ISO/IEC: 2005). The equipment selected by the supplier shall be fit for the requirements of the measurement process considering areas such as: measurement uncertainty, speed of data acquisition, measurement geometry, local environmental conditions etc.

[MRS8] Measurement uncertainty shall be calculated for all reported measurements at a confidence level of 2σ. As a general rule, the uncertainty value shall not exceed 20% of the tolerance applicable to the feature measured. Maintaining an uncertainty of 10% or less is recommended to optimise the available tolerance applicable to the feature concerned.

[MRS9] The IO drawings specify dimensions at the reference temperature of 20˚C. The environmental conditions for A&M will depend very much on the location in which the activity is to be carried out. The RO shall make an assessment of the impact of thermal expansion/contraction on the A&M task and specify controls to be put in place as necessary to compensate. Consideration shall be given to the thermal inertia of the components being measured, where necessary allowing sufficient soak time in the measurement environment to ensure thermal stabilisation. For critical items Temperature measurements (better than ± 1°C) shall be recorded throughout the measurement task of both the component and the environment, logged against time and saved with the measurement file. For large components, multiple measurements shall be required to enable the detection of thermal gradients.

[MRS10] For measurement surveys utilising multiple instrument stations, bundle adjustment algorithms shall be utilised to ensure error propagation, via multiple best-fit alignments, does not occur.

[MRS11] All “as-built” drawings/3D models/electronic data shall be supplied in a format agreed with the IO to demonstrate compliance with the design. The IO does not prescribe which software should be used however; it is critical that measurement data can be easily transferred been all parties requiring access to it.

[MRS12] All inspection/dimensional control and alignment reports shall include, as a minimum, the following information:

- Identification of measuring instruments used including calibration certificate number
- Identification of ancillary equipment, as applicable, used including type, make unique identifier and calibration certificate number i.e.
    - Test unit
    - Probes (dimensions, frequencies)
    - Targets and tooling

- Scale bars
- Identification of the part examined
- Reference drawing or CAD model identification defining the tolerances, datum etc. which the part has been inspected to, including issue status
- Time and place of the inspection plus signature of the operator
- Name and qualification of the operator and his employer.
- Procedure followed and issue status
- Meteorological data (temperature, humidity, pressure)
- Identification of all computer files generated during the inspection, all raw and processed data must be in a format acceptable to the IO
- Written values tabulated to provide: nominal dimensions, applicable tolerances and the dimension achieved for the feature, with non-complying values flagged in red on the report. Graphical data may be used if agreed by IO.
- Interpretation of results, including an explanation for any readings considered invalid.
- Identification of any non-conformity reports raised.

[MRS13] All drawings and/or electronic data used for A&M activities shall be issued through the ITER document control process and certified at the status to which they shall be used.

6.2 Mandatory Requirements for Site (MRS) based A&M Class 2 activities

Components or assemblies with an A&M class 2 will require a significant amount of dimensional control on the IO site. They may need to go through a pre-alignment process to provide references (fiducials) for assembly/installation and may also need inspections during and on completion of assembly/installation.

A&M class 2 tasks however have a reduced impact on cost and schedule in the event of failure therefore requiring a reduced level of input by the Metrology RO.

The A&M class 1 mandatory requirements [MRS1] through to [MRS13] shall be maintained for this classification, as applicable to the task, but the requirement for review/approval by the Metrology RO is removed.

6.3 Mandatory Requirements for Site (MRS) based A&M Class 3 activities

A&M class 3 activities only require setting out points/lines to facilitate their installation therefore the mandatory requirements for these activities are [MRS4], [MRS7] and [MRS13].

6.4 Mandatory Requirements Procurement (MRP) for A&M Class 1 activities

A&M Class 1 activities are critical to the successful assembly/installation and operation of the ITER machine and as such require the highest level of qualification and control. Listed below are the mandatory requirements, as applicable for the system concerned, identifying responsibilities for their delivery

and approval. The Metrology RO or his delegate shall be given the opportunity to review all key documents pertaining to A&M tasks within this classification.

[MRP1] The System Requirements Document (SRD), Interface Control Document (ICD) or other document, shall define the alignment and/or dimensional control requirements relating to the subject of the procurement. These shall be included in the DCM and shall be reviewed as part of the ITER Design Review Procedure.

[MRP2] The A&M requirements for the procurement shall be included within the Technical Specification (Annex B for PA's) with design drawings and associated design documents defining the fundamental design dimensions and tolerances. The supplier shall produce shop floor documentation that demonstrates how the manufacturing and/or assembly process shall be controlled throughout the production cycle. This shall include tolerance requirements for relevant stages of the manufacturing process that shall be agreed with the IO prior to commencement of manufacture.

[MRP3] Prior to contract commencement the supplier shall produce an implementation plan defining all quality related activities to be carried out during the contract. Elements relating to A&M shall include:

- Reference standards
- Design change control procedures – Drawings and CAD models
- Document control
- Instrument calibrations and test procedures
- Control of non-conformities
- Data management procedures
- Measurement procedures- data acquisition, post processing and validation
- Reporting procedures

The Metrology RO shall be given the opportunity to review the implementation plan and any documents referenced within it, prior to contract commencement.

[MRP4] Inspections shall be carried out at all crucial stages of the manufacturing process to guarantee adherence to final tolerances and set as early as possible corrective measures where necessary. The frequency and details of these inspections shall be defined by the supplier in the MIP for the procurement which the IO will be given the opportunity to witness at their discretion.

[MRP5] The coordinate/datum system used during inspection and dimensional control processes shall be as defined in the design drawings. Inspection reports shall identify the nominal dimensions, applicable tolerances and the dimension achieved for the feature with non-complying values flagged in red on the report.

[MRP6] All metrology equipment used for A&M tasks shall hold a current calibration certificate issued by an accredited laboratory (Reference standard BS EN ISO/IEC: 2005). The equipment selected by the supplier shall be fit for the requirements of the measurement process considering areas such as: measurement uncertainty, speed of data acquisition, measurement geometry, local environmental conditions etc.

[MRP7] The supplier shall draft a dimensional control plan (DCP) that shall include all inputs and outputs relating to the measurement process, see section 9. The DCP shall be supplied to the IO for acceptance, prior to commencement of manufacture.

[MRP8] Measurement uncertainty shall be calculated for all reported measurements at a confidence level of 2σ. As a general rule, the uncertainty value shall not exceed 20% of the tolerance applicable to the feature measured. Maintaining an uncertainty of 10% or less is recommended to optimise the available tolerance applicable to the feature concerned.

[MRP9] The IO drawings specify dimensions at the reference temperature of 20˚C. Dimensional control for factory acceptance shall be carried out in a controlled environment with a maximum temperature variation of ± 2˚C. Key dimensions shall be measured at the reference temperature or corrected to this temperature therefore temperature stability during the measurement process is critical. Raw measurement data and corrected values shall be made available to the IO. Consideration shall be given to the thermal inertia of the components being measured allowing sufficient soak time in the measurement environment to ensure thermal stabilisation. Temperature measurements (better than ± 1°C) shall be recorded throughout the measurement task of both the component and the environment, logged against time and saved with the measurement file. For large components, multiple measurements shall be required to enable the detection of thermal gradients.

[MRP10] For measurement surveys utilising multiple instrument stations, bundle adjustment algorithms shall be utilised to ensure error propagation, via multiple best-fit alignments, does not occur.

[MRP11] The supplier shall produce “as-built” drawings/3D models/electronic data, in a format agreed with the IO demonstrating compliance with the design. The IO does not prescribe which software should be used however; it is critical that measurement data can be easily transferred between the parties to the ITER agreement. During manufacture this data may be required to qualify measurement processes, address non-conformance issues, and consider concession requests. In addition, the data may be used to construct a configuration model representing the true geometry of the item concerned.

[MRP12] Deviations from the design requirements shall be the subject of a non-conformance (NCR) report with corrective measures involving geometric or material property changes requiring the prior approval of

the IO. To enable a decision to be made the supplier shall furnish the IO with documents justifying their proposal delivered within the NCR system.

[MRP13] All inspection/dimensional control reports shall include, as a minimum, the following information:

- Identification of measuring instruments used including calibration certificate number
- Identification of ancillary equipment, as applicable, used including type, make unique identifier and calibration certificate number i.e.
  - Test unit
  - Probes (dimensions, frequencies)
  - Targets and tooling
  - Scale bars
- Identification of the part examined
- Reference drawing or CAD model identification defining the tolerances, datum etc. which the part has been inspected to, including issue status
- Time and place of the inspection plus signature of the operator
- Name and qualification of the operator and his employer.
- Procedure followed and issue status
- Meteorological data (temperature, humidity, pressure)
- Identification of all computer files generated during the inspection, all raw and processed data must be in a format acceptable to the IO
- Written values tabulated to provide: nominal dimensions, applicable tolerances and the dimension achieved for the feature, with non-complying values flagged in red on the report. Graphical data may be used if agreed by IO.
- Interpretation of results, including an explanation for any readings considered invalid.
- Identification of any non-conformity reports raised

In order to avoid unnecessary duplication, some of the information listed above can be provided in documents identified by the supplier and attached to the report.

6.5 Mandatory Requirements Procurement (MRP) for A&M Class 2 activities

Components or assemblies with an A&M class 2 for procurement will require a significant amount of dimensional control during manufacture, overseen by the IO. They may need to go through a pre-alignment process to provide references (fiducials) for assembly/installation at the ITER site and may also need some form of inspection during factory acceptance or on receipt by the RO.

The TRO for the system involved shall need to consider the level of control to be applied during the procurement process and identify the mandatory requirements in the technical specification applicable to the procurement.

As a minimum the following mandatory requirements from A&M class 1 shall be applied: [MRP1], [MRP2], [MRP3], [MRP4], [MRP5], [MRP6], [MRP7] and [MRP12]. Other requirements may be added at the discretion of the RO.

Note: Components of A&M Class 3 or below require no specific dimensional controls of alignment activities during the procurement process.

7 Standards

There are a large number of standards relating to dimensional metrology which can broadly be grouped under the scope of two Technical Committees within the International Standards Organisation (ISO) namely:

TC 213 - Dimensional and geometrical product specifications and verification

Standardisation in the field of geometrical product specifications (GPS), i.e. macro- and microgeometry specifications covering dimensional and geometrical tolerancing, surface properties and the related verification principles, measuring equipment and calibration requirements including the uncertainty of dimensional and geometrical measurement. The standardisation includes the basic layout and explanation of drawing indications (symbols).

TC 176 - Quality management and quality assurance

Standardization in the field of quality management (generic quality management systems and supporting technologies), as well as quality management standardization in specific sectors at the request of the affected sector and the ISO Technical Management Board.

Note:

ISO/TC 176 is also entrusted with an advisory function to all ISO and IEC technical committees to ensure the integrity of the generic quality system standards and the effective implementation of the ISO/IEC sector policy on quality management systems deliverables.

Non ISO standards useful for reference:

Guidelines for the Evaluation of Dimensional Measurement Uncertainty (Technical Report) (B89.7.3.2 - 2007)

Performance Evaluation of Laser-Based Spherical Coordinate Measurement Systems (B89.4.19 - 2006)

8 Infrastructure - Survey Networks and datums

All measurement tasks need a fixed reference base (the datum) from which measurements can be made and calculated. For large volume metrology (LVM) applications this reference

typically takes the form of a survey network consisting of a collection of target nests and/or instrument stations of known geometry and computed uncertainty.

The accuracy and precision of the survey network(s) directly affects the measurement accuracy that can be achieved for subsequent alignment tasks. Accuracy and precision are terms that often get confused therefore for the purposes of this document their definitions are as follows:

Accuracy:	The degree of conformity of a measured or calculated quantity to its actual (true) value
Precision:	The degree of repeatability achieved when the same quantity is measured a number of times

The survey network design process starts with a specification detailing how the network will be utilised and defining the ultimate measurement tolerances to be achieved. A perfect measurement does not exist therefore it is important to be able to determine the measurement uncertainty for each stage of the measurement process and thus create a tolerance budget.

Measurement uncertainty:	The parameter, associated with the result of a measurement (e.g. a calibration or test) that defines the range of values that could reasonably be attributed to the measured quantity. When uncertainty is evaluated and reported in a specified way it indicates the level of confidence that the value actually lies within the range defined by the uncertainty interval.

The survey networks for ITER will cover the whole of the site, providing a global coordinate matrix for survey instruments to reference against. The accuracy requirements for each network will vary, dependent on the alignment tasks for which they are being supplied. As such, interface control documents need to clearly define the alignment requirements of ITER components, assemblies and systems.

8.1 Primary Survey Network

The first survey network installed was the Primary Survey network which defines the site reference system for buildings construction, provides the datum for monitoring stability and is the global datum for dedicated secondary networks installed throughout the site.

The network consists of a collection of geodetic pillars, spread around the site and tied into foundations designed to optimise stability. A common interface for force-centring survey instruments and survey targets is embedded in the top of each pillar.

The network was installed and measured in the summer of 2010. A least squares adjustment was made to optimise the network and determine the co-ordinate and uncertainty values for each survey monument. The measurement uncertainty for the network was calculated to be ~1mm when initially measured. The network will be periodically monitored for stability.

The coordinates of the primary survey network are reported within the Lambert III mapping projection with elevations relative to sea level. The Tokamak Global Coordinate System (TGCS) is an orthogonal system with the gravity vector defining the Z-axis at machine centre, the Y-axis points towards site north (37˚ counter-clockwise from geographic north) with the X-axis mutually perpendicular to Z & Y in an easterly direction. The origin of the

coordinate system is at the nominal tokamak centre. For more information on ITER co-ordinate systems refer to document ITER_D_2A9PXZ.

8.2 Tokamak Pit Network

Machine assembly activities within the tokamak pit shall require accurate and precise alignment of components. The design specification for the network is to achieve an uncertainty no greater than ± 0.2 mm within a temperature controlled environment of ± 2˚C (ref. SRD 62-13), this requirement is achievable if the environment remains stable. However, it is clear that with the immense transfer of loads occurring during construction that the network will move and distort to a certain extent. This distortion will need to be monitored and modelled during machine assembly to ensure that the final machine is aligned to specification. Both dynamic and passive measurement systems are being considered to provide an efficient system for monitoring the network movement and thus enable adjustments to be calculated and employed.

The initial network shall consist of many targets, or target nests, distributed around the pit wall covering the full height of the pit and extending into the adjacent port cells. The best fit centre of the pit shall be derived from the pit wall targets defining the vertical datum axis for machine assembly. The datum for toroidal position and elevation will be derived from the best fit position of the port cells.

Once the lower cryostat cylinder is installed, lines of sight to the lower pit wall targets will be blocked however, lines of sight from the pit into the port cells and vice versa shall be maintained. The pit wall targets above the cryostat lower cylinder shall remain visible throughout the vacuum vessel construction, only becoming obscured when the cryostat upper cylinder is installed. The port cell targets are very important to the pit network as they provide the link to systems external to the pit within the adjacent galleries.

It is likely that a number of different instrument types will be used during the tokamak build process such as photogrammetry cameras, laser trackers and total stations. Laser trackers and total stations measure to similar spherically mounted reflectors called SMRs or corner cube reflectors CCRs, different names for the same item. Photogrammetry uses retroreflective however, common targeting mounts are readily available from suppliers such as Hubbs and Brunson enabling interchangeability of instruments utilising the network.

8.3 Tokamak Galleries Networks

Survey networks shall be installed external to the bio shield wall within the port cells and galleries. These multi-level networks shall provide the dimensional control for all systems external to the tokamak pit within the tokamak building and will be linked to the Tokamak Pit Network via the port cells. The network shall consist of a collection of wall and floor mounted target nests distributed throughout the galleries. These will be a standardised design as used for the pit network thus allowing flexibility of instrument selection for measurement tasks.

Provision shall be made to link the tokamak hall network to the primary network. This will be carried out with a total station and level and will be periodically checked for stability whist lines of sight remain available.

8.4 Generic Buildings Networks

There are various buildings around the site having different requirements for dimensional control. Users of these buildings need to consider their requirements at an early stage so that fit for purpose networks can be installed and measured in a timely manner.

Where required, building networks shall be linked to the primary survey network thus providing a global position for all setting out, alignment and measurement tasks. Where a local reference is required co-ordinate transformations into the building co-ordinate system can be made (ref. ITER_D_2A9PXZ).

8.5 Assembly Datums

During assembly of the ITER machine it will be necessary to adjust the build datum to optimise the assembly process with respect to the as-built geometry of key machine components. Each build datum shall define the position and orientation of a coordinate frame within which the coordinates of the targets/target nests of the Tokamak Pit Network shall be valued.

The pit datum (PIT) as described in section 8.2 will be the initial datum used to align the following components:

- Cryostat Column Baseplates
- Cryostat Columns
- Cryostat Base Section assembly

The as-built position of the cryostat base shall be used to define the cryostat base datum (CBD) this shall be used to align:

- Cryostat lower Cylinder
- TF Coils

The key characteristics on the cryostat base that are used to establish the CBD are the gravity support interfaces for both the TF coils (TFGS) and the vacuum vessel (VVGS).

The key characteristic of the coils to be aligned is the current centre line (CCL) of the winding back, its position defined with respect to fiducials on the coil case.

When the 18 TF Coils are in place, the Tokamak Assembly Datum (TAD) shall be established representing the Least Square best Fit of the 18 TF Coils. This datum shall be used for final alignment of the vacuum vessel, remaining magnet systems and the internal vacuum vessel components.

9 Survey and Alignment during buildings construction

During the construction phase of the ITER buildings there will be many requirements for accurate alignment. ROs need to carefully consider the alignment requirements of their systems especially in areas of restricted access where opportunities to define reference points may be limited.

The alignment path of systems that will ultimately be separated by physical barriers, such as concrete walls, may not be restricted at an early stage of the project. Providing the alignment references at this early stage may be the only opportunity to carry out the task and therefore guarantee the success of the installation.

Some large or heavy pieces of plant and equipment may have to be installed during the construction process if access to deliver such component will not be possible once construction is complete. In these instances, alignment references will need to be established in advance to facilitate the setting out and alignment as required.

Generally speaking; if a piece of equipment needs to be installed accurately to a global co-ordinate i.e. not positioned to local features like adjacent walls, building columns etc., then access to a survey network or pre-defined and established reference points will be required. Local alignment tasks need clear lines of sight or a network or dedicated reference points to facilitate the task.

The installation of the primary survey network is complete however the addition, pace and sequence of secondary networks will be driven by the requirements defined by the various system ROs on the project and should be clearly defined in the project schedule.

10 Design for Alignment and Metrology

The ITER machine is made up of many complex components and assemblies which need to interact in specific ways for the experiment to be successful. The design process will identify the optimum configuration for these systems identifying key characteristics to be focussed on with realistic parameters for manufacture and assembly, achieving a fit for purpose design.

From a metrology perspective, measurement uncertainty is a key contributor to the overall tolerance budget and as such needs to be carefully considered. For example; if a component can be manufactured to a perceived tolerance of +/- 1 mm but the measurement process can only deliver to +/- 2 mm then the overall process is clearly out of control.

It has already been identified that survey networks can be designed and installed to provide the datum for alignment activities. This however is only part of the requirement; the components themselves also need to be equipped with alignment features, designed to interface with the most appropriate measurement instruments and positioned to deliver the required alignment accuracy. In addition, the survey features need to be positioned with due consideration to the kinematics of the alignment system. There is no point in having an accurate and precise measurement system if the alignment mechanism cannot respond efficiently to the data provided by the measurement survey.

The list below identifies areas for consideration when designing components for alignment:

Alignment tolerances

- Position
- Elevation
- Angle: Roll, Pitch,
- Yaw

Datum references

- PIT
- CBD
- TAD
- Local to component

Alignment features

- Target nests
- Tooling Ball
- Retroreflective targets
- Scribed reference lines

Adjustment Mechanisms

- Screw threads
- Jacks
- Cams

Alignment Geometry

- Plane
- Line
- Centre of rotation
- Coupled or decoupled

Metrology Instruments

- Laser Trackers
- Total Stations
- Theodolites
- Articulated measurement arms
- Photogrammetry
- Laser Scanners
- Levels

During the design and planning stages for ITER and in support of the procurement arrangements (PAs), the Metrology RO is available to give advice on aspects relating to geometrical and dimensional control for the project. Inspection and alignment surveys can be simulated at the design stage enabling qualification of measurement processes and the determination of uncertainty values for measured points and features within the survey.

11 Process control and best practise

The control of dimensional measurement is an essential part of the supply chain for the ITER components and the subsequent assembly activities to be carried out at the ITER site. For all critical inspections/surveys the measurement process needs to be clearly defined, controlled and accepted by the IO.

Inputs to the process may include:

- design specifications, drawings, CAD models
- quality plans, procedures, method statements
- measuring instruments, calibrations, reference artefacts
- components and assemblies
- plant and equipment
- personnel, skills, training
- computer software, simulations, uncertainty analysis

With outputs such as:

- raw measurement data
- Meteorological corrections
- Scale adjustments
- co-ordinate frame transforms
- quality control inspection reports
- best-fit analyses and transformation matrices
- aligned component / assemblies
- fiducially referenced components / assemblies
- survey uncertainty analyses
- signed off method statements, procedures, quality plans
- Survey Report

The measurement process needs to be fit for purpose; delivering the required outputs in an efficient manner and providing assurances that the process is under control. The IO shall be given the opportunity to review the process documentation prior to commencement and to witness inspections/surveys during manufacture, hold points shall be specified in the Manufacturing and inspection Plan (MIP) as required. In exceptional circumstances the IO reserves the right to carry out its own dimensional control measurements utilising its own personnel or a third party supplier.

The IO shall identify key interfaces which must be inspected during manufacture and monitored during assembly operations, such as welding, which may affect the fit, form or function of the assembly. The control of such operations shall be clearly defined in the process documentation with measurement data recorded in an appropriate format.

11.1 Large volume portable measurement systems

For large volume metrology it is often necessary to bring the measuring instrument to the job. Portable co-ordinate measurement systems such as Laser trackers, total stations, theodolites and photogrammetry, enable the surveyor/inspector to carry out the measurement task in the workplace however, with this flexibility comes added variables that must to be controlled.

The workshop environment is unlikely to be as rigorously controlled as a dedicated metrology lab. Changes in temperature, humidity and pressure all contribute to measurement variance and therefore need to be recorded and compensated for.

Measuring a large component or assembly will often require the use of multiple instrument stations. This may be due to line of sight constraints or as a means of reducing observation lengths within the survey to minimise measurement uncertainty. Whatever the reason, if the results are to be considered within a single coordinate system then a network solution to the fit will be required. Best practice is to carry out a bundle adjustment of the network; this iterative process will optimise the network by minimising the combined pointing errors of the measurements. With the instrument stations optimised the uncertainty of the measured points within the network can be calculated through a variance algorithm.

Minimising the potential for error will come from a good understanding of the technical specification, consideration and compensation for the working environment and by applying best practice processes.

11.2 Best-fit analysis and alignment transformations

Initial measurements taken during a survey will be valued within the measuring instrument’s local co-ordinate system. Their relationship to each other will be clearly defined but they will require aligning to the part or assembly to which they relate.

The alignment can be defined by geometry measured within the measurement session i.e. points, lines and planes or by referencing measured points to features within the CAD model such as faces, surfaces etc.

Unlike the CAD model, the measured points will not fit perfectly to the design nominal therefore a series of weighted best-fits will need to be applied to optimise the alignment. The IO shall identify the key characteristics to be used for the alignment and prioritise their importance. This information shall either be provided within engineering drawings, annotated to the CAD model or as written instructions.

The supplier's measurement procedure shall identify best fit processes to be carried out including any data filtering that will be applied. In general, all raw data shall be maintained and stored for ease of recall and review by the IO.

11.3 Control of inspection measurement and test equipment

All measuring equipment must be fit for purpose to deliver to the tolerances specified. A documented calibration system must be in operation traceable to national standards and certificated through an accredited body. A calibration schedule must be in place with all calibrations logged within a register and all calibration certificates filed for ease of recall.

A Quality document shall clearly identify where and when measurement equipment has been used. Each piece of equipment shall be uniquely identified and must only be used when its calibration status is within date.

For critical measurements it may be necessary to calibrate a measuring instrument more frequently than the suppliers recommended interval. Where the IO deems this necessary it shall mark up the quality plan accordingly.

11.4 Coordinate systems and measurement units

In general, when conveying results of a survey/inspection the co-ordinate system used shall be coincident and of the same type as that used to specify the design. The measurement units shall be as defined in the drawing or model and the deviation from nominal of the as-built dimensions shall be reported in the same manner as they are toleranced.

Results from an inspection shall be expressed in quantative terms when a design characteristic is expressed in numerical units. Attribute data may be used (e.g. go/no-go) if no inspection technique resulting in a quantative measurement is feasible. Where this is the case the gauge used for the process shall be traceable to an appropriate national standard.

11.5 Metrology software and data formats

The ITER organisation has adopted Spatial Analyzer (SA), supplied by New River Kinematics (NRK), as its preferred metrology software. The software interfaces with the vast majority of measurement instruments; its architecture maintains full traceability of the measurement process storing all raw measurement data and environmental monitoring corrections.

The software has been specifically designed for large volume metrology applications; its optimisation algorithms for network configurations, computes measurement uncertainty by default and analyses instrument performance in the process. The system can be used offline for measurement simulations by utilising constructed geometry within the application or by directly importing Catia V5 models, complete with embedded GD&T if required.

The IO does not prescribe which software should be used however; it is critical that measurement data can be easily transferred between the parties to the ITER agreement. During manufacture this data may be required to qualify measurement processes, address non-conformance issues, consider concession requests and certainly to build up as-built models of the supply.

The following data formats can be read into SA:

ASCII, STEP, IGES,VDA, SAT, DMIS, AIMS-TDF, Polyworks (POL, PIF, PF, DPI), Direct Catia V4 V5 *.CGR process, Direct UG process, Direct ProE process, VSTARS .xyz file, VSTARS Cameras (outstar.txt), xyz ijk File (IJK), Digital network levels, IMETRIC, 1-D data (Datamyte).

In all cases measurement data must include uncertainty values, see following section.

11.6 Measurement uncertainty

Measurement uncertainty is the parameter, associated with the result of a measurement (e.g. a calibration or test) that defines the range of values that could reasonably be attributed to the measured quantity. When uncertainty is evaluated and reported in a specified way it indicates the level of confidence that the value actually lies within the range defined by the uncertainty interval.

No measurement is complete unless its uncertainty can be quantified. In a similar way that a tolerance relays the acceptance specification for a given dimension, the measurement uncertainty must be considered when determining whether a measured characteristic meets the design criteria.

For example: if the distance between 2 points is required to be 10m +/- 0.003m then a measurement returning a value of 10.0025m appears to be acceptable however; if the measurement uncertainty for each point is +/- 0.001m then the reality is that the measured dimension could be out of spec by up to 0.0015m.. Figure 1 demonstrates this pictorially

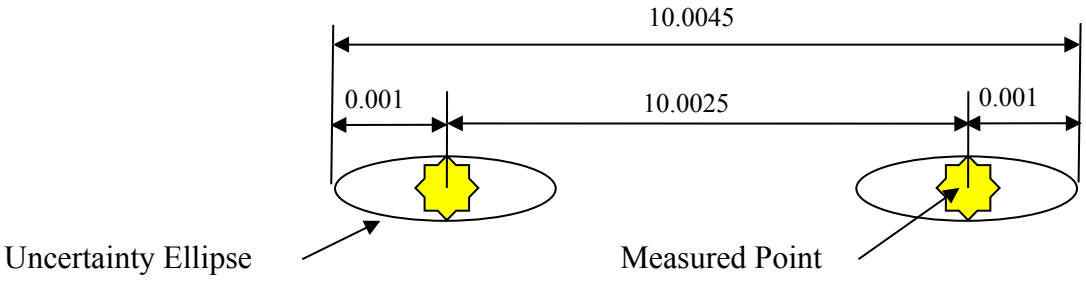

Figure 1: example of an uncertainty analysis for a linear dimension

11.7 Measurement scale

Components for the ITER machine are dimensioned nominally at 20˚C. For large objects the effects of temperature change on the physical size of the object can be considerable and as such must be taken into account during the measurement process.

Measurements, especially those carried out over a prolonged period, must be carried out in thermally stable conditions. The measuring instrument and component must be given time to acclimatise to the environment and the temperature must be monitored throughout the measurement task.

Where the measurements cannot be taken at 20˚C a scale factor will need to be applied to the measurement job. In consideration of the components orientation and fixturing, the scaling vector(s) shall be identified in the measurement plan for acceptance by the IO.

When using optical measuring systems such as laser trackers or total stations consideration needs to be given to distance measurements from these instrument's interferometers or absolute distance meters. Environmental factors such as changes in atmospheric pressure, temperature and humidity will affect the wavelength and as such need to be corrected. All environmental monitors used for this process must be calibrated in line with the manufactures recommendations and traceable to national standards.

Intersecting theodolite systems and photogrammetry rely on defined calibrated length measurements to scale the measurement job. Scale bars, interferometer measured distances or a controlled and traceable network of stable points can all be used to introduce scale. The important factor is that the scale system is controlled, fit for purpose and traceable.

11.8 Component orientation and fixturing for measurement

There are many large and heavy components which are assembled together to make the ITER machine. These components will distort to varying degrees depending on how they are supported during manufacture and assembly therefore it is essential that these parameters are considered and clearly defined within the measurement procedure.

Where a component is to be supported, machined and inspected in one orientation but put into service in another, the effects of the transformation need to be established.

By default, CAD models describe a components shape and size in a state of equilibrium, unaffected by external influences such as gravity. Computer added manufacturing and inspection systems often use the CAD model to drive the manufacturing and inspection processes therefore the CAD model either needs be morphed to reflect the geometric condition for inspection or offset values need to be supplied for the specific areas of interest.

11.9 Fiducialisation

Fiducialisation is the process used to define reference points (fiducials) on a component or assembly with respect to a reference coordinate frame. The position and orientation of the frame is constructed from as-built measurement data and reflects the optimum alignment achievable from the data set measured.

To define an object's 3D position and orientation, a minimum of 3 fiducials are required however, utilising more fiducials will add redundancy to the survey and provide a better representation of the measurement volume. The quantity and position of the fiducials will be driven by the design specification and qualified through tolerance assessment and uncertainty analysis.

Where fiducials are required to facilitate an alignment at the ITER site, their design, position and orientation will be defined by the IO. Fiducials used by the supplier shall either be permanently attached to the object or fitted temporarily during the measurement via a standard interface as descried in section 11.10.

11.10 Targets and tooling

Laser trackers and total stations measure to similar spherical targets called SMR retroreflectors or corner cubes. Photogrammetry also uses retroreflective targets but of a different type however, interchangeable targeting mounts are readily available.

A typical interface for these mounts could be an H7 hole of diameter 6, 8, or 10 mm reamed perpendicular into a reference face. The important thing to note is that whilst the mount will position the target coincident with the axis of the hole, the target will be offset from the reference face by a defined amount.

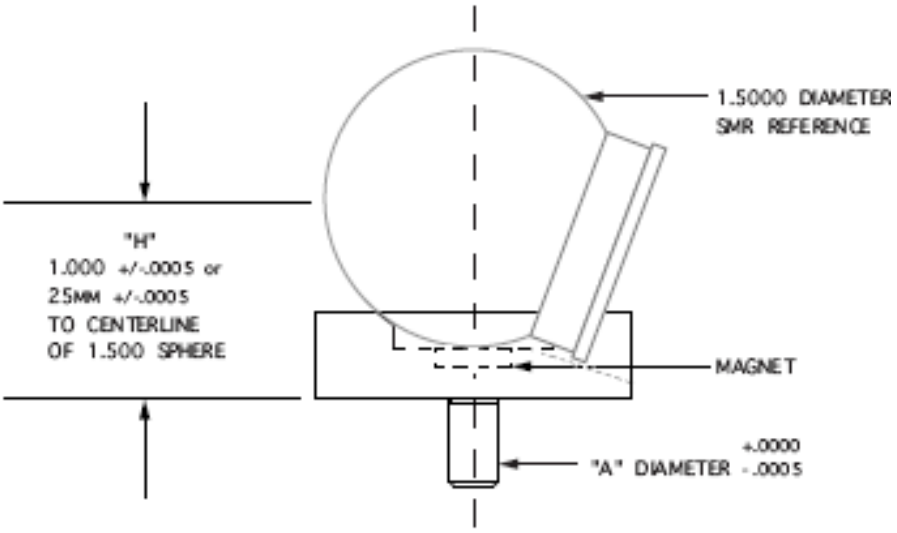

Fig. 1 Example of an SMR mounted in a pin nest

The example above shows a laser tracker SMR retroreflector mounted within a target mount. Dimension “H” identifies the offset applied and the manufacturing tolerance.

All targeting mounts or generically speaking tooling, that contributes to the measurement process shall be controlled within the supplier’s calibration system and shall be uniquely identified. The measurement process shall specifically record when such tooling has been used defining the offset applied and its direction.

12 Coordination for metrology activities

Many of the components for the ITER machine have extremely demanding tolerances with respect to alignment and dimensional control. Their installation locations are often very constrained and their large size makes adjustment all the more difficult. These components may be standalone items or an embodiment of constituent parts combined to deliver a specific function. Whatever the requirement, if metrology is a contributor then it is an interface that needs to be resourced and managed.

The Metrology RO is available to give technical advice during the design phase of the project and is tasked to put in place and manage the requisite infrastructure to support the machine build and its associated systems. This will include the design and realisation of survey

networks (section 8) development of alignment strategies, procurement of equipment and the day to day management of the metrology team.

The ITER metrology team shall be assembled to support the programmed metrology requirements of the ITER project therefore it is important that these needs are identified as early as possible to optimise the resourcing with respect to equipment and personnel.

12.1 Interface control

ROs for components, assemblies and systems requiring support from the ITER metrology team shall specify their requirements in an appropriate technical document i.e. SRD, ICD, dedicated IS.

Typical details required shall include:

- General description of the measurement task detailing processes and required outputs
- Reference datum systems to be used i.e. site primary datum system, pit datum system, locally defined system etc.
- Tolerance requirements for dimensional control and or alignment i.e. position angularity, elevation, level etc.
- Fiducialisation requirements (section 11.9)
- Location where the survey / inspection is to be carried out
- Scheduled date for the task and sub-tasks
- State of plant during the task(s); component orientation, supporting structures, scaffolding, adjacent work activities etc.
- Environmental controls envisaged during the survey

From the above information the Metrology RO will elaborate a measurement plan, detailing the work scope, equipment and tooling requirements, estimated task duration and manpower allocation. Any inputs required from the customer such as drawings, CAD models etc. will be identified and their required delivery dates included in the metrology schedule.

The ITER 'Assembly and Installation Management Manual' details the processes and procedures to be followed in preparation for and during implementation of assembly and installation activities. Reference 3 of the document details the 'System Assembly Compatibility Assessment Procedure' this procedure will be used by the Machine Assembly and Installation Section to assess compliance with assembly methodologies and standards and to determine readiness for development of assembly operating procedures. Appendix 1 to the document 'ITER System Assembly Compatibility Assessment Form' includes an input table specific to metrology activities; 'Table 6: Dimensional control and Alignment'. This table shall be completed by the Metrology RO in conjunction with the RO for the system applicable providing information, as applicable, relating to the following requirements:

- First article inspection
- Goods inwards inspection
- Datum references and setting out
- Pre-alignment (fiducial measurement)
- Final alignment

- Data processing
- As-built measurements
- Measurement simulation

12.2 Design reviews

Alignment and metrology requirements and processes will typically be reviewed at the design reviews for the system to which they apply. Design reviews will be carried out in accordance with ITER Design Review Procedure (2832CF) current at the time.

The conceptual design review shall demonstrate that the alignment requirements and tolerances for the system under review have been identified and included in the Design Compliance Matrix (DCM). Specific details shall be included in the interface sheet of the appropriate interface control document as they are developed and must be in place before the final design review.

At the preliminary design review the outline processes for alignment should be presented to provide an overview of the scope of the task including an indicative schedule. At this time it should be clear where responsibilities lie for the various stages of the installation be it with the IO the DA(s) or as a combined effort.

Alignment and Metrology activities could include:

- Goods inwards dimensional inspection of system components
- Fiducialisation of components for assembly (section 11.9)
- Provision of reference datums, network points, elevation lines (section 8.0)
- Setting out for enabling activities: marking out for location systems, stillages etc.
- As-built reconstruction for customisation of interfaces
- Alignment of components: position, orientation, elevation….

Following the preliminary design review the alignment and metrology processes will be elaborated by the responsible officer(s) concerned. The level of elaboration will be dependent on a number of contributors such as the uniqueness of the task, the complexity of the process, access restrictions, required accuracy etc. The preliminary design review will define the scope of this elaboration which will subsequently identify the metrology input for the final design review.

The final design review shall demonstrate that dimensional control and alignment processes have been sufficiently addressed to ensure that the system under review can be successfully manufactured and subsequently installed at the ITER site. The Metrology RO will use the metrology handbook as reference for the review process and the DCM to assess compliance with the design requirements, contributing to the overall acceptance process.

13 QA and documentation

All components, processes, documents and data within the scope of this handbook shall be subject to the ITER Quality Assurance Program (IDM Ref; ITER_D_22K4QX) and its related Management and Quality Programme (MQP) (IDM Ref; ITER_D_2NS3UH).

IDM UID
2LZJHB
VERSION CREATED ON / VERSION / STATUS
17 Dec 2024 / 9.1 / Approved
EXTERNAL REFERENCE / VERSION

MQP Level 3

Procedure for the management of Deviation Request

The purpose of this document is to describe the Deviation Request (DR) processes to be followed for the ITER project. This procedure defines the requirements and provides the detailed workflows for management of DRs project wise addressed to and generated by the ITER Organization.

Approval Process			
	Name	*Action*	*Affiliation*
Author	**Redon T.**	**17 Dec 2024:signed**	**IO/DG/ESD/DO/ICAS**
Co-Authors	**Clochard V.**	**17 Dec 2024:signed**	**IO/DG/SID/CID/CMS**
Reviewers	**Bartels H.- W.** **Cortes P.** **Jung C. Y.** **Khomutnikov A.** **Perrier G.**	**07 Jan 2025:recommended** **07 Jan 2025:recommended** **19 Dec 2024:recommended** **06 Jan 2025:recommended**	**IO/DG/SID/CID** **IO/DG/SID/CID/NSI** **IO/DG/SQD/QMD** **IO/DG/SQD/QMD** **IO/DG/SQD**
Approver	**Orlandi S.**	**15 Jan 2025:approved**	**IO/DG/CP**
Information Protection Level: Non-Public - Unclassified *RO: Khomutnikov Aleksei*			
Read Access	**LG: Quality Control Group, AD: ITER, AD: External Collaborators, AD: IO_Director-General, AD: External Management Advisory Board, AD: IDM_Controller, AD: OBS - Quality Management Division (QMD) - EXT, AD: Nuclear Safety Inspectors, AD: OBS - Quality Management Division (QMD), AD: DA, AD: Auditors, A...**		

#drn#

Change Log			
Procedure for the management of Deviation Request (2LZJHB)			
Version	***Latest Status***	***Issue Date***	***Description of Change***
v1.0	Signed	02 Jun 2009	
v1.1	Approved	10 Jun 2009	Minor change in para 4.1.2 at the request of SAS DGG
v2.0	In Work	26 Oct 2010	- General revision showing IDM review & approval for Deviation Requests - Incorporated Domestic Agencies in review process for Deviation Requests
v2.1	In Work	27 Oct 2010	New lay-out through IDM auto-generated covering page.
v2.2	Approved	22 Dec 2010	Changed from "DDG/Directorate Head" to "Directorate Head" on para. 4.1.3 , 4.2.2 and Appendix A.
v3.0	Signed	22 Sep 2011	Introduction of a filter for deviations affecting Regulatory Files
v3.1	Approved	22 Sep 2011	Minor change to tidy up role activity chart
v4.0	Approved	04 Sep 2013	- modification of title - modification of the flow chart for DR - addition of a flow chart for NCR - addition of the following steps for NCR: root causse analysis, corrective action (if needed) and closure of NCR
v4.1	Approved	25 Jul 2014	- Scope: include addition of a requirement - WBS RO and TRO change to IO RO and acronym with definition added - Responsibilities: addition of any dispute solved by Head of QA - Flow chart: refer to paragraph listing the reviewer 7.1.4 for DR and 7.2.1.4 for - Flow chart: addition of root cause analysis for NCR - Addition of "Send a link of the signed form to DAs if they are impacted" for DR and NCR - Modification of the paragraphs of the text to be coherent with the flow charts
v4.2	Approved	12 Mar 2015	Changes according to MQP doc Request - QV6CHN: - Update of title “Procedure for IO Deviation Request and Non-conformance Report” - Addition of an explanatory footnote for PIC and PIA - Addition of PIA with PIC - Addition of details for the steps in IDM for the closure of NCRs
v5.0	In Work	01 Sep 2017	The purpose of this document is to specify the Deviation Request, hereinafter DR, processes from the initiation to the implementation. The processes for following two types of DR’s are described: - Deviation Request issued by DA, (Sub-)Contractor and/or Supplier, hereinafter “DA/CON-DR,” and - Deviation Request issued by IO, hereinafter “IO-DR” Roles and/or responsibilities of each stakeholder are also specified.
v5.1	Signed	01 Sep 2017	Compared to the Version 4.2: - DR and NCR processes are separated. - IO technical change request is out of scope. - Work flow and responsibilities are specified clearly. - Criteria for the escalation is specified. - Added all required contents in the new template, MQP Document Template (ITER_D_438T76 v2.5)
v5.2	Signed	20 Sep 2017	Implemented QA Process Owner's comment regarding the approvers. In this version, the approvers are as specified in; Sign-Off_Authority_for_Project_Documents_2EXFXU_v3_3
v5.3	Approved	25 Sep 2017	As commented by CIO/CMD head, rev. nums. of the latest approved versions of the applicable documents are added.
v5.4	Approved	15 Dec 2017	Revision of the flowcharts The flowcharts are revised back into the ones in [2LZJHB v4.2], which had

			been accepted by ASN The specific changes are: 1) “IO-SRO” is replaced by “EPNS-DH” 2) Logic in the flowcharts, e.g. explicit description for escalation to PCR, safety pre-assessment first. Revised user-friendly 1) Basic principle (definition, rule, criteria), process flow and responsibility assignment are separated clearly by section. 2) Deleted needless and/or non-mandatory contents, e.g. some foot notes, KPI. 3) Flowcharts, description of the process steps, and responsibility assignment (RACI matrix) are correlated by paragraph number, #.#.#. 4) Some TYPOs are fixed.
v5.5	Approved	14 Mar 2018	1) "Approval with condition is not allowed" is changed into more realistic statements: • Regarding DA/CON-DR, all conditions shall be documented and agreed between the DA officer representing the initiator and the approver via exchanges in IO-IDM metadata. In case of direct contract between IO and CON, the initiator and the approver shall agree on. • Regarding IO-DR, all conditions shall be documented and agreed between the approver and the accepter, who are IO-CT and DA/CON, respectively. 2) Mandatory and optional reviewers are specified as in Section 7.2. Added some statements telling "SOA [22F4E5] to be consistent later."
v5.6	Revision Required	11 May 2018	As per MQP doc Request - WK73BR Includes Module H needs
v6.0	Revision Required	07 May 2019	Chapter 2.1 to clarify the scope of DR in relationship with MQP procedures changes. CMA audit finding (NC 02) regarding DR scope ITER_D_XYKVBE - Quality Audit Report_IO-QMSA-18-08-CMA Audit Chapter 3.1 - add definition of Equipment, Manufacturer, PE/ NPE and ESPN – maintained as per previous revision of procedure in the scope of PE/ NPE network. Chapter 3.2 – add abbreviation PT- project team Chapter 4.2 – add references - maintained as per previous revision of procedure in the scope of PE/ NPE network. [11] French Order dated 30 December 2015 concerning Nuclear Pressure Equipment [12] Implementation plan for design & manufacture of PE/NPE [VE2DSP] Chapter 5 - add reference to other specific Sign-Off Authority related to PT and construction and PE / NPE responsibilities - maintained as per previous revision of procedure in the scope of PE/ NPE network. Chapter 6.2.2 – add reference to other specific Sign-Off Authority related to PT and construction Chapter 6.3.3 - add reference to other specific Sign-Off Authority related to PT and construction Chapter 7 add reference to other specific Sign-Off Authority related to PT and construction and PE / NPE responsibilities - maintained as per previous revision of procedure in the scope of PE/ NPE network. Table of Mandatory or Optional Reviewers improved - add PT staff review and PE/ NPE review - maintained as per previous revision of procedure in the scope of PE/ NPE network. Eliminate RACI tables.
v7.0	Signed	14 Jun 2019	New version according to additional MQP doc Request - YPKLTV and and essential data YTKAKK, which are documenting list of changes as per reviewers comments.
v7.1	Signed	16 Jul 2019	Revision required for implementation of reviewer comments.

			The following changes/ clarifications are applied: - Chapter 2 - Scope of procedure - add clarifications to allow IO to raise DR for technical deviations with no impact on cost, schedule and without changing the PAs documentation - Main, annex B , annex A) - Chapter 2.1 - add clarifications to eliminate the discrepancies with DR definition - Chapter 3.1 - Chapter 3.1 - clarify definition of "Equipment". Add clarification for Deviation request definition to eliminate conflicts with chapter 2.1 requirements. - Chapter 5 - first bullet - add clarification regarding deviation to IO requirements. - Chapter 6.2.10 - Confirmation of DR implementation. add clarification regarding criteria for "required" DR implementation confirmation. - Chapter 9 - correction chapter numbering (9.1, 9.2 9.3 and 9.4) - F4E comments regarding interface with Supply process / application of PA change notice are implemented in the chapter 2.1 and chapter 9.
v7.2	Signed	18 Jul 2019	The following minor changes are applied: - Chapter 5 - Basic principle - eliminate 7th bullet regarding IO DR. - Fig 6.2 - Work flowchart of IO -DR - add clarification: Not applicable in the scope of PA changes - Chapter 6.3.3 - IO -DR Decision - Eliminate DA / CON responsibilities for decision since IO-DR is not applicable for PA changes. - Chapter 7 - Mandatory or Optional Reviewers - for IO-DR the responsibility for DA-RO review is Optional instead of Mandatory (IO-DR is not applicable for PA changes)
v7.3	Approved	18 Jul 2019	New version according to additional MQP doc Request - YPKLTV and and essential data YTKAKK, which are documenting list of changes as per reviewers comments The following minor changes are applied: - Chapter 5 - Basic principle - eliminate 7th bullet regarding IO DR. - Fig 6.2 - Work flowchart of IO -DR - add clarification: Not applicable in the scope of PA changes - Chapter 6.3.3 - IO -DR Decision - Eliminate DA / CON responsibilities for decision since IO-DR is not applicable for PA changes. - Chapter 7 - Mandatory or Optional Reviewers - for IO-DR the responsibility
v8.0	In Work	25 Nov 2019	As per approved MQP doc request https://user.iter.org/?uid=27JZVH the main changes are: - Clarification of the DA/CONT DR and IO-DR workflows (even though no major steps were added or removed); - Clarification of the roles of approvers for the DA/CONT DR and IO-DRs; - Inclusion of the IO supplier DR to IO, that follows the same process as the DA DR; - Clarification of the text, notably sects. Main principles and main requirements; - Editorial changes, which make the procedure much easier to understand and implement;
v8.1	Approved	25 Nov 2019	Minor update due to technical problem with pdf conversion. All changes are listed for the previous version 8.0
v9.0	Signed	10 Dec 2024	In accordance with CSAJJV the changes are: - Update due to the ASN Decision 2017-DC-0616 of November 30, 2017 amended by Decision 2023-DC-0770 on noticeable modifications to INBs (C58DCJ): any DR that is categorized as a Noticeable Modification shall trigger a PCR - Update due to the NCR-IO.NCR-0171 - SRO review of Deviation Request (8TZQDH): clarification that the DR review by the SRO is mandatory only

			when PIC/PIA are impacted - New mandatory field introduced: Impacted Requirement Document - Approver for DR purely related to MQP process is changed from the MQP Process Owner to the approver of the MQP document from which the DR requests to deviate. The MQP Process Owner is now a mandatory reviewer - CID Head removed as mandatory reviewer - SIROs added as mandatory reviewers - CMS Section Leader added as observer - The DR Database, which today is used for IO Supplier DR only, is recommended to be used as well for DA-DR and IO-DR - Addition of the section 8.4 Interactions with MQP Process Management Process: it is recommended, but not mandatory, to apply the DR procedure to track any deviation to MQP requirement - Use of the MQP Document Template 438T76 v5.0 - Integration of various needs consolidated in CAT-4915
v9.1	Approved	17 Dec 2024	Changes compared to the last approved version v8.1 are those described in the Version Change Description of the v9.0, plus the following additional changes from v9.0 to v9.1: - In accordance with the MQP Process Management Process, for DRs related to the MQP process, impacted original document's stakeholders are mandatory reviewers of the DR - For IO-DRs related to the MQP process, the first check (step 4) can be done by the MQP Process Representative instead of the MQP Requirement Document Approver

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1 Purpose

The purpose of this document is to describe the Deviation Request (DR) processes to be followed for the ITER project. This procedure defines the requirements and provides the detailed workflows for management of DRs project wise addressed to and generated by the ITER Organisation.

2 Scope

This procedure is a MQP Level-3 document within the process of Configuration Management (QAP sect. 3.1, ref. [1]), as shown in the Management and Quality Programme (MQP) map:

https://portal.iter.org/qa/SitePages/Home.aspx.

This procedure shall be applicable for managing the following DRs:

- **Deviation Requests from DAs to IO:** e.g. deviations from the PA baseline. To be noted that DAs follow their internal processes to manage the first steps of this procedure as well as their Supplier Deviation Requests;
- **Deviation requests from IO suppliers to IO:** e.g. deviations from IO supplier contract baseline for In-Cash contracts;

  Note: Hereby, the deviation requests from DA to IO, and IO suppliers to IO, are commonly defined as the DA/CONT-DR process, see sect. 6.3.1.
- **IO Deviation Requests**: deviations from defined requirement(s) or punctual departures from the authorized high level configuration documentation belonging to the ITER Technical and/or Management baselines (e.g. ASN approved safety files, Project Requirements (PR)).

  Note: This DR process is known as IO-DR, for the remaining of the document, see sect. 6.3.2.

3 Definitions and acronyms

The definitions of the configuration management terms used in this procedure are given in the Configuration Management Glossary, ref. [2].

Acronym	Definition
ANB	Agreed Notified Body
CID	Central Integration Division
CONT	Contractor (i.e. supplier of IO, excluding DAs)
CMS	Configuration Management Section
DA/CONT-DR	Domestic Agency/Contractor – Deviation request
DA PA TRO	DA Procurement Arrangement Technical Responsible Officer
DR	Deviation Request
ESR	Essential Safety Requirement
IO Contract RO	ITER Organization Contract Responsible Officer
IO-DIRO	IO Design Integration Responsible Officer
IO-DR	ITER Organization Deviation Request
IO-PARO	IO Procurement Arrangement Responsible Officer
IO PA TRO	ITER Organization Procurement Arrangement Technical Responsible Officer
IO-QARO	IO Quality Assurance Responsible Officer

IO-SIRO	IO System Integration Responsible Officer
IO-SRO	IO Safety Responsible Officer
IO-TRO	IO Technical Responsible Officer
MQP	Management and Quality Programme
PA	Procurement Arrangement
PA-CN	Procurement Arrangement Change Notice
PIA	Protection Important Activity
PIC	Protection Important Component
PCR	Project Change Request
PT	Project Team
QAP	Quality Assurance Program
SIC	Safety Important Class
SL	Section Leader

4 References

[1]	ITER Quality Assurance Program (QAP) (22K4QX)
[2]	Configuration Management Glossary (X2SH46)
[3]	Procedure for the Preparation, Review, Approval, Award and Amendment of Procurement Arrangements (2W4F7A)
[4]	IO Deviation Request Template (2LRNQP)
[5]	Project Change Procedure (22F4E5)
[6]	Procedure for Configuration Control, Review and Audit (TZY7YV)
[7]	Sign-Off Authority (SOA) for Project Documents (2EXFXU)
[8]	Procedure for the Management of Safety Modifications (U34EB9)
[9]	Pressure Equipment Directive 2014/68/UE (RZ6PAK)
[10]	French Order dated 30 December 2015 concerning Nuclear Pressure Equipment (SMP384)
[11]	Implementation plan for design & manufacture of PE/NPE (VE2DSP)
[12]	Design Planning Procedure (U34ACR)
[13]	Design Change Control Procedure (U2QPDS)
[14]	ITER Integrated Safety, Environment and Security Management System (ISMS) Manual (4HCWJU)
[15]	In-Cash Procurement Procedure (658PD4)
[16]	MQP Process Management Procedure (7M445D)

5 General principles

5.1 Main principles

The main principles that shall be respected for management of a DR are as follows:

i. The DAs, suppliers of IO, and IO staff, can issue DRs for IO Approval.

ii. As per ref. [2], DRs are punctual departures from a particular requirement(s) from the current authorized configuration documentation and prior to the execution of the actions that have an impact on meeting the original specified requirement(s).

Note: A deviation permit is generally given for a limited quantity of items, period of time, and for a specific use.

iii. The DR process for both DA/CONT-DR and IO-DRs is composed of four main steps:

1) **Submission**, see sect. 6.3.1.1 and 6.3.2.1
2) **Review**, see sect. 6.3.1.2 and 6.3.2.2
3) **Decision, dispute and resolution**, see sect. 6.3.1.3 and 6.3.2.3
4) **Closure**, see sect. 6.3.1.4 and 6.3.2.4.

iv. DRs can impact different authorized configuration documentation (e.g. the PA baseline, the ITER technical baseline, etc.) depending on the DR submitter (see chapter 6).

v. DRs shall be managed using a dedicated IT system (DR Database[1] or IDM) from initial submission to closure, as per guidelines given in this procedure.

Note: DAs can use their internal IT applications/platforms to manage DRs before submission to IO.

5.2 Main requirements

i. Deviation Requests shall be submitted for IO review and approval/rejection before implementation of related activity(ies) (e.g. manufacture of the item).

ii. Before submission to IO, the DA/CONT DRs shall be internally reviewed by competent and authorised specialist(s) of the DA/supplier and approved for the submission to IO.

iii. IO DRs shall not be used to request to deviate from an agreed PA baseline or IO direct contracts (In-Cash contracts).

Note: IO requested changes impacting PAs, shall be managed according to the procedure Preparation, Review, Approval, Award and Amendment of Procurements Arrangements (PA), ref. [3]. In line with this procedure, in most cases the vehicle for changing PA baselines is the PA Change Notice (PA-CN).

Note: IO requested changes impacting IO direct contracts (e.g. In-Cash contracts), shall be managed according to the In-Cash Procurement Procedure, ref. [15].

iv. The DRs shall be issued using the DR Database or the DR Template (ref. [4]). If applicable, the DA/CONTs can provide their DRs using their internal template (ensuring that the file contains the IO cover page), as follows:

- Upload the internally approved DR into IDM so that the DR has a well-defined UID.
- Ensure that the DR respects the mandatory information as per sect. 5.2 v. of this procedure;

v. DR submitted forms shall contain (as a minimum) the information requested in the DR Template (ref. [4])":

- **Type of DR**: either DA, supplier of IO or IO submitter;
- **DR Reference Number**;

[1] A DR Database (https://user.iter.org/default.aspx?uid=FA2VRS) is currently in place to support IO construction sub-contractors DRs. It is strongly recommended that this DR Database be used for DA-DR and IO-DR as well.

- **DR Title**;
- **Type of Impact:** item or MQP process;
- **Quality Class** (QC[2])

  Note: For DRs impacting more than one activity or component with different QC classes, the submitter shall choose the highest QC in the DR Template (ref. [4]). A detailed description of the components impacted with individual QCs shall be provided in sect. 2 (Description of deviation) of the DR template (ref. [4]).
- **Safety Class**: SIC-1, SIC-2, SR, Non-SIC, PIA if applicable; For activities or components with different safety classes, the same approach as for QC applies.
- **IO PE or NPE**: yes/no, incl. PE/NPE, pressure category and radioactive level (N2-N3).
- **Impacted Requirement Document**: provide the reference, with a clear link to the IDM UID, of the document that contains the requirement(s) from which the submitter requests to deviate.

  Note: this can be a technical requirement document (such as a System Requirement Document, a Technical Specification, etc.) or a process requirement document (MQP document).

  Note: there may be several Impacted Requirement Documents, in such case they shall all be listed.
- **Description of Deviation**: provide a clear description (and indicate the document IDM UID) of the original requirement(s) (before), the proposed alternative requirement(s) (after), and a detailed justification for the proposed departure (e.g. impact on critical path, etc.). In addition, provide a detailed safety justification if PIC/PIA are impacted.
- **Impact Assessment**: expected additional technical impacts to the best knowledge of the submitter, including an assessment of other impacted PBS, PAs, performance, maintainability, operability, reliability, etc., if known. All impacts shall be assessed, including cost, schedule, performance and logistics.
- **List of expected impacted documents**: exhaustive list of all documents with a clear link to the document IDM UID to the best knowledge of the submitter, that are expected to be impacted should the DR be approved. The impacted documents are technical documentation that uses as input the requirement(s) that the submitter request to deviate from.

vi. DRs **shall not**:

- Lead to a modification of the Performance Baseline. The ITER Performance Baseline is the authorized configuration that comprises the ITER integrated cost, schedule and scope documentation.
- Constitute a permanent change to a document of the ITER Technical Baseline. If a DR leads to a permanent change of the ITER Technical Baseline, a Project Change Request (PCR, see ref. [5]) shall be triggered prior to acceptance of the change. The rationale for the request of a PCR is detailed in sect. 6.3.1.2.

Note: Changes impacting one of the ITER Project's baselines shall be managed using the Configuration Control procedure, ref. [6].

[2] Quality Class to be determined as per the Quality Classification Determination document.

6 Workflow

6.1 Flowchart

The flowcharts for the DA/CONT-DR and IO-DR processes are shown in Figure 1 and Figure 2 below.

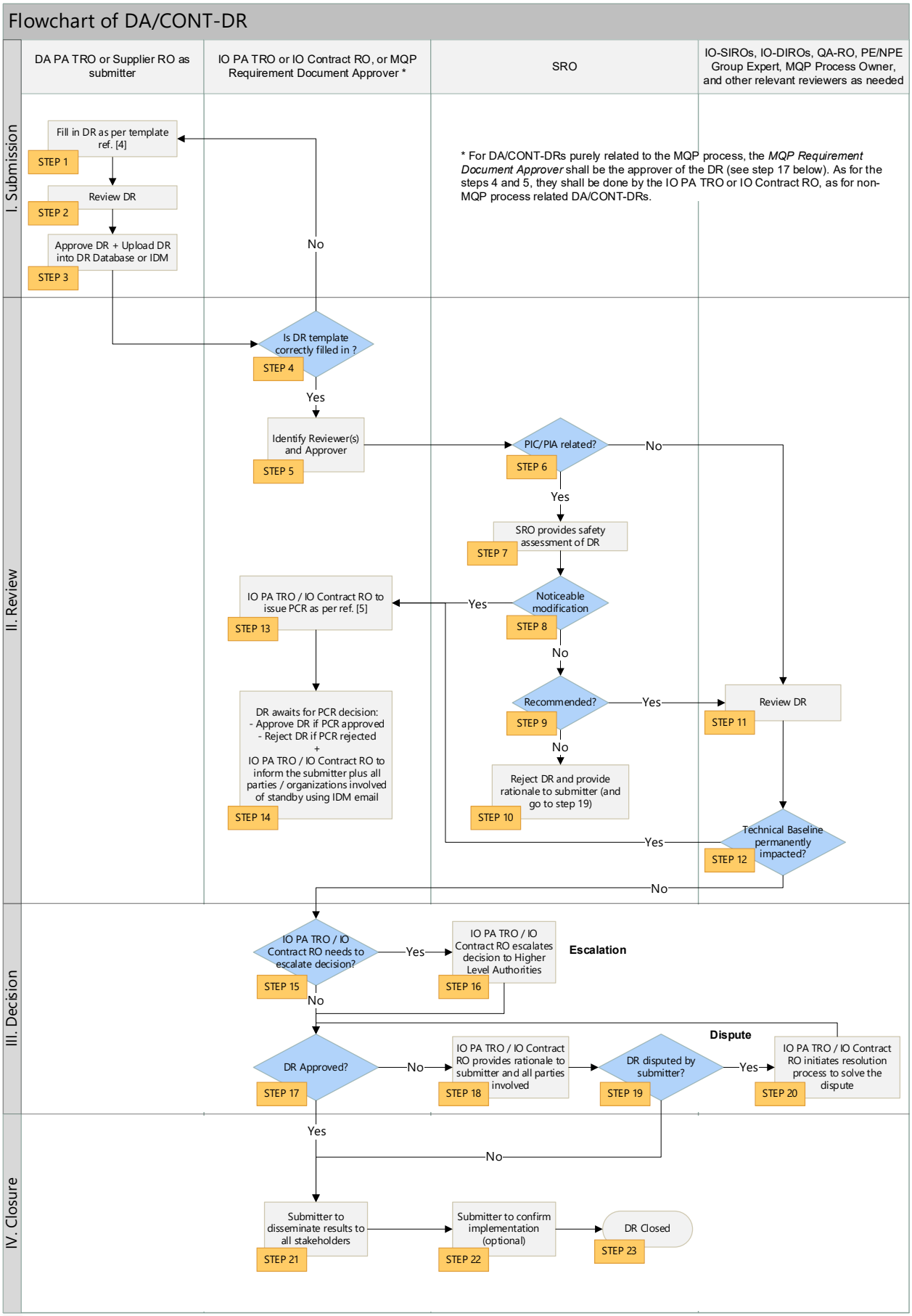


Figure 1 - Flowchart of DA/CONT-DR.

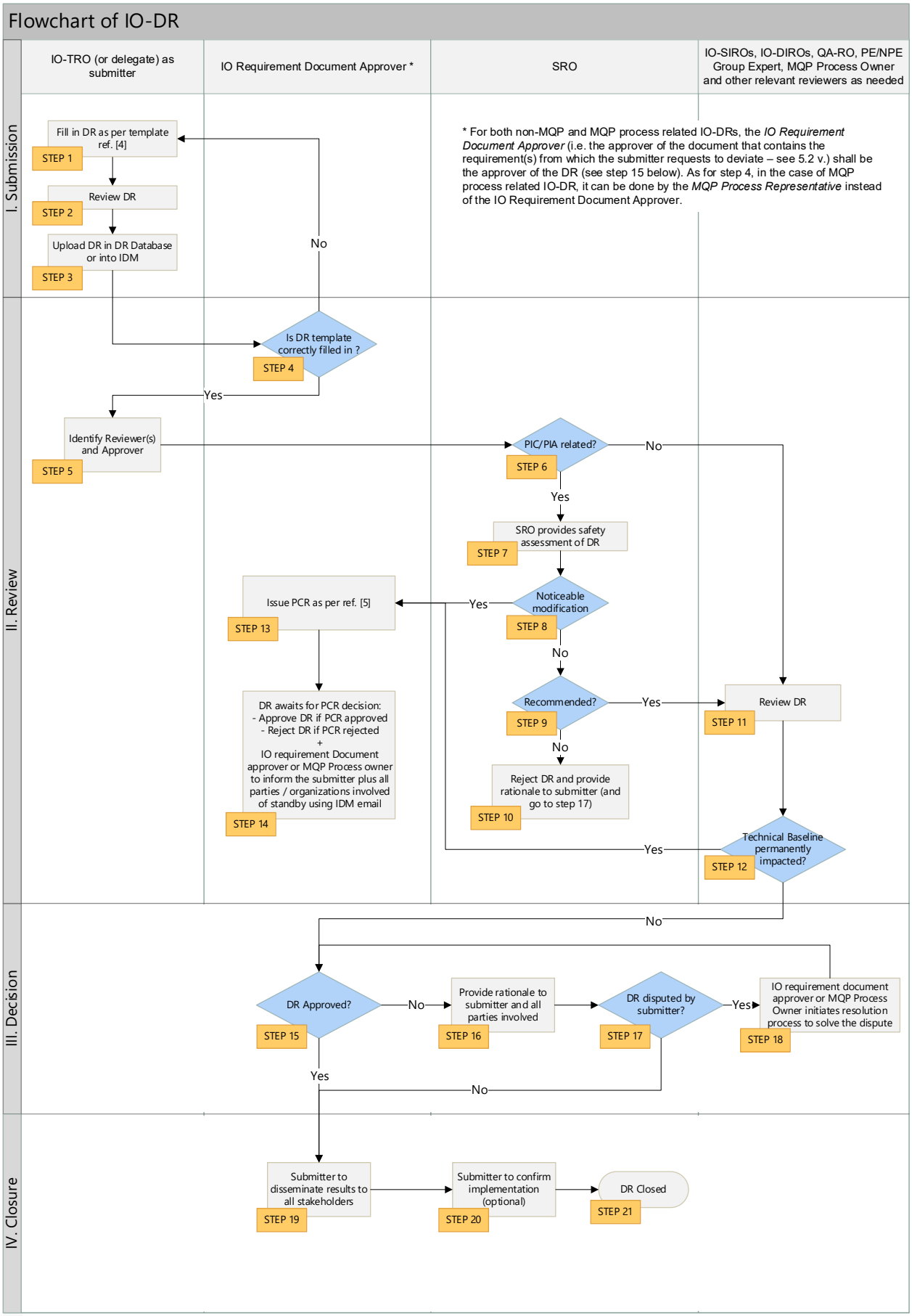


Figure 2 - Flowchart of IO-DR.

6.2 Responsibilities

The main responsibilities for the roles described in this procedure are described in sections 6.3.1 and 6.3.2.

The main roles covered in this procedure are:

- DA PA TRO, Supplier RO or IO TRO (as submitters)
- IO PA TRO or IO Contract RO
- DIRO, SIRO
- IO Expert, PE/NPE Group Expert, etc. as needed
- QARO
- SRO
- IO Requirement Document Approver
- MQP Process Owner, MQP Process Representative and other MQP stakeholders

6.3 Description of steps

6.3.1 DA/CONT-DR Process

Below we describe the tasks to be executed for each of the four main steps of the DA/CONT-DR (see Figure 1).

6.3.1.1 Submission

The DA PA TRO or the Supplier RO (submitters) shall:

- **Step 1:** Identify the necessity for a DR from a PA or contract baseline and initiate the request by using the DR Database or by following the DR template (ref. [4]).

  The DAs or suppliers can provide their DRs using their internal template, as described in sect. 5.2 Main Requirements (iv).
- **Step 2:** Review the DR for technical coherence, completeness and clarity, according to the relevant DA or Supplier internal procedures, prior to the submission to IO.
- **Step 3:** The DA PA TRO or Supplier RO line manager shall approve the DR before submission to IO and shall upload the DR template into the IT tool IDM (if the DR Database was not used).

6.3.1.2 Review

- **Steps 4 and 5: The IO PA TRO or IO Contract RO shall provide the first check by reviewing the DR submitted form for completeness and appropriateness, and verify that it is in agreement with the main requirements as per Sect. 5.2 of this procedure:**
  - If DR submitted form is correctly filled in, the IO PA TRO or Contract RO identifies the appropriate reviewers. The mandatory reviewers are:
    - SRO, if protection important components or activities are impacted (i.e. PIC/PIA ticked in the DR template ref. [4])
    - QARO
    - DIRO
    - SIRO
    - PE/NPE Group Expert (when ITER acts as manufacturer of PE/NPE equipment)

    - IO experts, if the field of concerned expertise is not covered by the mandatory reviewers and the approver
    - MQP process owner (or delegate), as well as the authors & reviewers of the MQP document from which the DR requests to deviate, if the DR is related to an MQP process.
  - Once reviewers are assigned, the IO PA TRO or IO Contract RO shall inform all reviewers that the review process has started using the IDM email function.
  - If the DR is not correctly filled-in, the IO PA TRO or IO Contract RO shall request further processing to the DA PA TRO or Supplier RO submitter.
  - The CMS-SL (or delegate) shall be added as observer.
- **Steps 6, 7, 8 and 9: If protection important components or activities are impacted, the SRO shall review as follows:**
  - Verify all impacts on regulatory, safety or environmental requirements, and provide the safety and environmental assessment in the DR template (ref. [4]). This assessment shall include the determination whether the proposed deviation constitutes a noticeable modification or, on the contrary, a non-noticeable modification, as defined in ref. [8];
  - Either:
    - Inform the IO PA TRO or Contract RO to trigger the PCR process, in case the deviation constitutes a noticeable modification, as follows:
      - Issue a PCR, as per ref. [5]. The PCR decision shall be registered in the DR template form (Step 13);
      - Maintain the DR is standby awaiting PCR decision and provide the rationale for the decision to issue the PCR to the submitter and all involved parties (Step 14);
    - Or recommend the DR;
    - Or reject (unless revised) the DR and provide rationale for the decision (see step 10).
  - If IO acts as a manufacturer of PE/NPE equipment, the PE/NPE Group Expert shall verify impacts on Essential Safety Requirements (ESR) (see ref. [9] and [10]) and quality requirements as defined in ref. [11], and assess if the DR shall be transmitted to the ANB.
- **Steps 11 and 12: The IO DIROs, SIROs and other technical reviewers as needed shall review the DR in order to:**
  - Ensure that the DR is technically justified and all requirements as per sect. 5.2 are respected;
  - Assess the technical aspects from system integration/configuration management point of view and provide the System/Design Integration assessment as needed, in the DR template.

    Note: The IO DIRO and SIRO shall ensure that the approved DRs are captured in the system configurations.
  - Verify if the DR impacts on ITER system level performance, reliability, operability, and interfaces, as needed;
  - Verify if the submitted DR impacts permanently any document from the ITER Technical Baseline.

- **If the IO DIRO or SIRO estimates that the requested deviation constitutes a permanent impact to the ITER Technical Baseline, he/she informs the IO PA TRO or Contract RO to trigger the PCR process, as follows:**
    - Issue a PCR, as per ref. [5]. The PCR decision shall be registered in the DR template form (Step 13);
    - Maintain the DR is standby awaiting PCR decision and provide the rationale for the decision to issue the PCR to the submitter and all involved parties (Step 14);

  Note: the DA is also entitled to trigger directly the PCR process.
- IO-QARO shall check the compliance of the submitted DR against the requirements in this procedure, the assignment of QC as per Quality Classification documentation, the assigned reviewers or approver according to this procedure, and the compliance against other concerned quality documents, e.g. Quality Plan, and other specific Sign-of-Authorities related to Project Teams (PT) and construction.
- Each reviewer shall have ten (10) business days to recommend / disapprove the DR, with a clear explanation. If after 10 days the reviewer has not signed the DR (either recommending or disapproving it) the IO PA TRO or Contract RO shall query as to its status and send an email reminding the reviewer(s) of the missing action.

6.3.1.3 Decision, Dispute and Resolution

- **If protection important components or activities are impacted, the SRO shall decide on the recommendation or rejection of the DR from the safety and environmental point of view:**
    - If recommended, the SRO shall notify the DR submitter of the decision and route it to review from the technical aspects system integration point of view (Step 11).
    - If rejected, the SRO shall provide rationale to submitter and all parties involved using the IT management tool IDM email function (Step 10).
- **Steps 15, 17, 18: For all DRs recommended by the SRO or not impacting protection important components or activities, the IO PA TRO or IO Contract RO (after the technical revision is terminated, Step 11), shall decide on the Approval or Rejection of the DR, and provide a rationale to the DR submitter and all involved parties.** DRs shall only be approved after establishing, through technical knowledge, expertise and experience, or by requesting the expertise of other experts, that approval of the request is acceptable with regards to the PA / CONT objectives and overall project needs;
- **For DA/CONT-DRs related to the MQP process, the approver shall be the IO approver of the MQP document from which the DR requests to deviate.**
- **Step 16:** If the decision related to the DR is above the authority of the IO PA TRO or IO Contract RO, the DR shall be escalated to a higher level authority. Higher level Authorities consist of:
    - Impacted Section Leader, or delegate;
    - Impacted Head of Division/Department or delegate, as appropriate;
- If the DR is rejected, the DA PA TRO or Supplier RO:
    - Shall try to develop an alternative plan that does not require deviation in order to fulfil requirements. If the DA PA TRO or Supplier RO devises and alternative solution that (still) involves a departure from the requirement(s), the IO PA TRO or IO Contract RO shall analyse the request and inform the submitter if this alternative solution can be considered for acceptance.

- If an alternative solution is not suggested, the DA PA TRO or Contractor RO can dispute the decision and liaises with the involved parties for solution seeking.

- **Step 20:** If the DR is rejected, or a reviewer disapproval rationale is disputed by the initiator and cannot be resolved at the IO PA TRO or IO Contract RO level, they shall initiate a resolution process to solve the dispute, as follows:
  - Appeal to the higher level management for a solution;
  - If not settled, the DR shall be listed in the Project Issue Management (PIM) list: https://jira.iter.org/secure/RapidBoard.jspa?rapidView=45&projectKey=PIM.
- The decision to approve a DR from a DA/Supplier A impacting the scope of a DA/supplier B, with no impacts to the ITER baseline, shall be taken by a higher level authority that has the full overview to make the decision of approving the DR from the DA/Supplier A and trigger a PA Change Notice (see ref. [3]) for the DA/Supplier B without changing the ITER baseline.

  Upon decision, the DA PA TRO or Supplier RO shall inform the submitter of the DR decision taken by using the IDM email function (as long as IDM is the available tool) and distribute the link to higher-level management (e.g. Section Leader, Head of Division), as necessary.
- Estimated time for decision on a DR is 2 weeks. One additional week to be considered if the decision needs to be escalated.

6.3.1.4 Closure

The DA PA TRO or Supplier RO (as submitters) shall:

- **Step 21:** Ensure that the DR decision was disseminated to all stakeholders and provide corrective action as needed.
- Ensure that all impacted documentation (including, document UID) is registered in the DR submitting form (as per sect. 5.2).
- **Step 22:** Confirm the DR implementation (optional), for cases when further critical actions are triggered by DR approval and/or related documentation needs to be revised to reflect the implementation of the deviation. For cases when DR implementation confirmation is required, the DR submitter shall attach all the necessary evidences to demonstrate the implementation.

6.3.2 IO-DR Process

As shown in Figure 2, the IO-DR process is similar to the DA/CONT-DR process except for a few steps as shown below.

6.3.2.1 Submission

Steps 1 to 3: The IO-DR submission process shall be performed similarly to the one described in sect. 6.3.1.1, with a few exceptions:

- The IO TRO (or a delegate) is the submitter of the IO-DRs.
- The IO-DR shall be reviewed internally by the IO-TRO (or a delegate) line manager, e.g. Section Leader or Head of Division/Department, using the IT tool.

6.3.2.2 Review

- **Steps 4 and 5: The IO requirement document approver (i.e. the document that contains the requirement(s) from which the submitter requests to deviate – see 5.2 v.) shall provide the first check by reviewing the DR submitted form for completeness and appropriateness, and verify that it is in agreement with the main requirements as per sect. 5.2 of this**

procedure. For IO-DR related to the MQP process, this check can instead be done by the MQP Process Representative.

- If DR submitted form is correctly filled in, the IO TRO identifies the appropriate reviewers. The mandatory reviewers are:
  - SRO, if protection important components or activities are impacted (i.e. PIC/PIA ticked in the DR template ref. [4])
  - QARO, DIRO, SIRO
  - PE/NPE Group Expert (when ITER acts as manufacturer of PE/NPE equipment)
  - IO experts, if the field of concerned expertise is not covered by the mandatory reviewers and the approver
  - MQP process owner (or delegate), as well as the authors & reviewers of the MQP document from which the DR requests to deviate, if the DR is related to an MQP process.
- Once reviewers are assigned, the IO TRO shall inform all reviewers that the review process has started using the IDM email function.
- If the DR is not correctly filled-in, the IO requirement document approver shall request further processing to the IO TRO submitter.
- The CMS-SL (or delegate) shall be added as observer.

- **Steps 6 to 14:** the other reviewers as necessary, shall execute the same steps as described in sect. 6.3.1.2.

6.3.2.3 Decision, Dispute and Resolution

Steps 15 to 18: For the IO-DR, decision, dispute and resolution follow the same steps as given in sect. 6.3.1.3, with the exception that:

- For the IO-DR, a decision shall be taken by the IO Requirement Document Approver (i.e. the document that contains the requirement(s) from which the submitter requests to deviate – see 5.2 v.), both for non-MQP and MQP process related DRs. No escalation is possible.
- If the IO-DR decision is disputed, the IO Document Approver shall initiate a resolution process by following the same steps as given in sect. 6.3.1.3.

6.3.2.4 Closure

Steps 19 to 21: For the IO-DR closure, the submitter shall follow the same steps as for the DA/CONT DR described in sect. 6.3.1.4.

7 Records

The expected records from the DR process are provided below.

Record	Template	Place to store	Doc type	Naming convention	Retention period
Deviation Request	Template in ref. [4], or DA/CONT template	DR Database (*) or IDM	DA QA Deviation Request Contractor QA Deviation Request ITER QA Deviation Request	IDM procedures or DR Database	ITER lifetime

(*) https://user.iter.org/default.aspx?uid=FA2VRS

8 Interactions with other processes

8.1 Interactions with the Design Control Process

This procedure belongs to the process of Configuration Management (QAP, sec. 3.1, see ref. [1]]) and interacts with the process of Design Control (QAP, sect. 3.3, see ref. [1]). The Design Control process provides guidance to the IO PA TRO, IO Contract RO or IO Requirement Document approver for the review of design integration aspects of DRs using the MQP procedures for Design Planning, ref. [12], and Design Change Control, ref. [13], among others.

8.2 Interactions with the Supply Process

This procedure interacts with the Supply process (QAP, sect. 3.4, ref. [1]). IO changes to PAs or IO direct contracts (e.g. In-Cash contracts) shall be managed using the Procedure for the Preparation, Review, Approval, Award and Amendment of Procurement Arrangements (PA), see ref. [3] and the In-Cash Procurement Procedure, see ref. [15].

8.3 Interactions with Nuclear Safety Processes

This process interacts with the Nuclear Safety processes. The Safety RO reviews the DR according to the Procedure for the Management of Safety Modifications (ref. [8]) and to ensure that it complies with the ITER Integrated Safety, Environment and Security Management System (ISMS) Manual (ref. [14]), including the MQP L2 and lower level procedures.

8.4 Interactions with MQP Process Management Process

This process interacts with the MQP Process Management process. As indicated in ref. [16], deviations from MQP should be permissions and not requirements or recommendations. Deviations from MQP shall be reviewed and approved by impacted original document's stakeholders and recorded in IDM.

It is recommended to use the current DR Procedure to track any Deviation to MQP requirement.

IDM UID
22F53X
VERSION CREATED ON / VERSION / STATUS
19 Mar 2021 / 9.1 / Approved
EXTERNAL REFERENCE / VERSION

MQP Level 2

Procedure for Management of Nonconformities

The purpose of this document is to specify the Nonconformity Management process, hereinafter NC from the Initiation to the Closure in the IO NC system. The Workflow as well as the Roles and Responsibilities of each stakeholder are specified in a generic way.

Approval Process			
	Name	*Action*	*Affiliation*
Author	**Neagu S.**	**19 Mar 2021:signed**	**IO/DG/SQD/QMD**
Co-Authors			
Reviewers	**Calpena S.** **Crowther D.** **Drummond M.** **Elbez-Uzan J.** **Ilves J. *** **Jung C. Y.** **Kirnev G.** **Lamotte P.** **Meignan V.** **Merola M.** **Miele P.** **Mokaria P.** **Pang B.** **Salamon B.** **Sato K.** **Yoon B.** **Zhang B.** **Zhao Z.**	**09 Apr 2021:recommended** **12 Apr 2021:recommended** **06 Apr 2021:recommended** **08 Apr 2021:reviewed** **12 Apr 2021:recommended** **06 Apr 2021:recommended** **29 Mar 2021:recommended** **02 Apr 2021:recommended** **13 Apr 2021:reviewed** **25 Mar 2021:recommended** **30 Mar 2021:recommended** **31 Mar 2021:recommended** **30 Mar 2021:recommended** **08 Apr 2021:recommended** **26 Mar 2021:recommended** **24 Mar 2021:recommended** **31 Mar 2021:recommended** **19 Mar 2021:recommended**	**IO/DG/SQD** **IO/DG/CORP/FPD/PCD/ESOC** **IO/DG/SQD/EPNS** **F4E (EU)** **IO/DG/SQD/QMD** **Russian Research Centre "Kurchatov ...** **IO/DG/CORP/FPD** **IO/DG/ENGN/EDD** **IO/DG/CORP/PCO/ECPC** **IN DA (Supplier & DA) (IN)** **IO/DG/ENGN/CIO/CMD/DCC** **QST (JP)** **Chinese Domestic Agency (CN)** **IO/DG/SQD/QMD**
Approver	**Tada E.**	**13 Apr 2021:approved**	**IO/DG/CORP**
Document Security: Internal Use *RO: Khomutnikov Aleksei*			
Read Access	**LG: SQD Managers, GG: MAC Members and Experts, LG: Quality Control Group, AD: ITER, AD: External Collaborators, AD: IO_Director-General, AD: External Management Advisory Board, AD: OBS - Quality Management Division (QMD) - EXT, AD: OBS - Quality Management Division (QMD), AD: Auditors, AD: ITER Mana...**		

Change Log			
Procedure for Management of Nonconformities (22F53X)			
Version	***Latest Status***	***Issue Date***	***Description of Change***
v1.0	In Work	25 Feb 2005	
v2.0	In Work	14 Sep 2005	
v3.0	In Work	14 Dec 2005	
v4.0	In Work	28 Feb 2006	
v4.1	Signed	10 Apr 2008	
v4.2	Signed	10 Apr 2008	
v4.3	Signed	11 Apr 2008	
v4.4	Approved	11 Apr 2008	
v5.0	In Work	18 Jun 2012	Definitions of Deviation and Specified Requirement clarified and immediate notification and agreement of classification of non-conformances introduced
v5.1	Approved	18 Jun 2012	Minor editorial change to contents
v6.0	Approved	02 Apr 2013	- modification of the title - add the following steps in the process for non-conformities: - root causse analysis - corrective action (if needed) - closure of NCR
v6.1	Approved	25 Jun 2013	Modifications according to approved MQP Doc Request G23MB4: - Changes to allow verbal agreement on remedial actions when the non-conformance does not impact on an external system - Minor NCR: the section 1, 2.1 and 2.2 need to be filled and sent to IO
v6.2	Approved	13 Mar 2015	Changes according to MQP doc Request - QWRRS2: - Addition of an explanatory footnote for PIC and PIA - Addition of PIA with PIC - Addition of list of internal NCRs to be sent to IO upon request of QARO
v7.0	Approved	18 Aug 2017	Update according to MQP doc request VBFECU (the summary of pre-reviews: MQPWG, SQAWG, SD, Construction Teams... can be found in the MQP doc request VBFECU). The changes consists in clarification, simplification by making the document generic (thus applicable to all phases; not only to Manufacturing but also to Construction), and rework of the document according to the MQP template 438T76: - Process NC introduced (not product NC as previously understood); - Simplification of number of documents (starting situation was 6 documents level2): 22F53X is now the Level 2 MQP for Nonconformity management, e.g. merging RGF2R7 (PT), dealing with both external IO NC and internal IO NC. - The workflow and roles rendered generic (e.g. notion of DIRO now extended to 'interaction RO', so that it can encompass Construction Teams). - Clarified list of criteria (Baseline, Performance,...) to guide in the categorization of NC (major / minor), still keeping the same criteria regarding Regulatory Requirements, Safety, Environmental impact. - The requirement of paragraph 2.9 of revised QAP version 8.5, and GIN007 (General Instruction Note from DG), are propagated: tracking of NC closure; re-enforcement of tracking mechanism of actions until implementation. - KPI of the process and escalation process (in case of dispute) are introduced.
v7.1	Approved	11 May 2018	As per MQP doc Request - WK69F2 Includes Module H needs
v8.0	Revision Required	10 May 2019	as per approved MQP doc Request - XYLYX5: - requirements regarding Counterfeit, Fraudulent, and Suspect Items (CFSI)

			as per Safety Division Action plan (definition CFSI included, clear requirement for SD involvement and responsibilities). - clarify the IO NC approval level (process owner / DH) as per NCR database application - reference of JIRA CAT system to be applied for action follow-up - clarification related to minimum time - frame from NCR detection until NCR recording (maximum two weeks is allowed). - clarifications regarding intermediate / conditional release of NCR that requires further long term actions (further actions and instruction to be recorded in release note).
v8.1	Signed	14 Jun 2019	Revision to implement reviewer comments from previous version. List of changes: - add reference - XKUKAX - add DAs responsibilities (as per NCR database application) - add clarifications regarding baseline levels (see chapter 5.1 and annex 2) - add further clarifications for NCR conditional release. - add annex 2 - Baseline level map as per [11] - add clarifications on appendix 1 - NC form
v8.2	Approved	17 Jun 2019	Revision - Technical IDM issue. Revision as per MQP doc Request - XYLYX5 & to implement reviewer comments from previous version. List of changes: - add reference - XKUKAX - add DAs responsibilities (as per NCR database application) - add clarifications regarding baseline levels (see chapter 5.1 and annex 2) - add further clarifications for NCR conditional release. - add annex 2 - Baseline level map as per [11] - add clarifications on appendix 1 - NC form
v9.0	In Work	19 Mar 2021	- Chapter 3.1 – arrange definition – alphabetic order - Chapter 3.1 – add the following definitions: o Causal Analysis Tree o Contractor o Inter-Organization Non-Conformity (I-NC): o IO NC system (add note for clarification NC database scope) o PE Group o Scrap (remedial action) o Root Cause Analysis (RCA) o Service o Service provider - Chapter 3.2 add the following abbreviations: o CAT; I-NC, PBS, PROR, SCG - Chapter 4.1 add the following references o [31] How to – Long Aging NCRs management 3CZWDX o [32] Risk and Opportunity Management Procedure 22F4LE o [33] Management review procedure 3L7SWX o [34] Lessons Learned meeting Procedure DV4UUH o Add note “The procedures are applicable to the DAs, only if they are listed in the Multi Party Amendment (MPA).” - Chapter 5.1, 5.2, 5.3 and 5.4 o Change the structure of procedure to reflect the NCR stages o For NCR categorization ITER_D_4HCC3W - HOW TO - NCR Categorization was added o Add RCA categories and Causal Analysis Tree (CAT) o Add mandatory requirements to defined expected due dates for decided remedial actions o Add mandatory requirements to defined expected due dates for NCR closure

			o Add specific section for Inter-Organizational Non-Conformity (I-NC) o Add requirements for application of fast NCR closure – applicable only for minor NCR o Add specific section for Conditional Release of NC. o Add clarification for RCA methodology - ITER_D_2X4E9A - Root Cause Analysis Leaflet o Add clarification for NCR closure o Add interaction with the risk and opportunity process. - Chapter 5.5 – changes to introduce specific requirements for Module H and H1. - Add chapter 5.7 – Internal NC of Performers - Chapter 7 – change the responsibilities for process owner and DH – for IO NCRs - Chapter 9.3 – add requirements for "Nonconformities survey process for PIC and PIA"
v9.1	Approved	19 Mar 2021	Technical issue

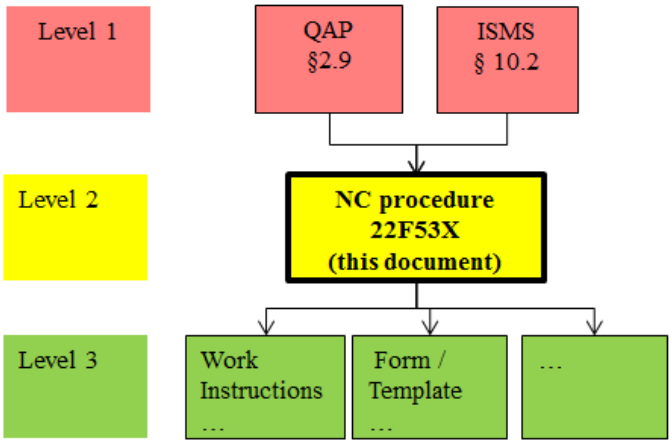
Table of Contents

1 Purpose

The purpose of this document is to specify the Nonconformity Management process, hereinafter NC from the Initiation to the Closure in the IO NC system. The Workflow as well as the Roles and Responsibilities of each stakeholder are specified in a generic way.

2 Scope

This MQP Level 2 Procedure belongs to the Process 'Quality Assurance' and propagates the requirements of the chapter 2.9 of the Quality Assurance Program (QAP) [5], and of the chapter 10.2 of the Integrated Safety Management System Manual (ISMS) [6]. Hierarchy of MQP documentation is illustrated below:



This procedure shall be followed for the management of Nonconformities detected during the all ITER project phases (from the design until operation/maintenance).
- for both types of NCs: Product NC and Process NC,
- by both internal and external performers (IO/ DAs/ suppliers / contractors).

2.1 Out of Scope

- Management of Deviation Request.
- Cost and schedule issues. To be treated as per contractual requirements.
- The management of Internal Nonconformities [1] of external Performers is not covered by this procedure.
    - However, external Performers shall make lists of their Internal Nonconformities available to IO for information, on request of IO.
- NC of Quality Audit (see link with others processes in **section 9**)

3 Definitions and acronyms

3.1 Definitions

Action assignee: An all-inclusive term to designate any person assigned to perform an action in the course of the NC treatment. This person can be from any organization.

Authorized Body/Authorized Notified Body: Organisation authorized by a member state to carry out conformity assessment of pressure equipment and /or nuclear pressure equipment.

Baseline documents (level 0, 1, 2 and 3) – to be used for NC categorization – definition as per [11].

[1] Nonconformities according to the QMS of the external Performers

The ITER baseline is the set of all configuration items with all of its applicable documents approved at one of the project's key milestones that serve as a reference for activities throughout the lifecycle of a product. The scope of a baseline shall be unique and not overlapping with any other.

Causal Analysis Tree: The Causal Analysis Tree is shown in Appendix 3 ("B"-Level) of the procedure. The Causal Analysis Tree is a result of a benchmarking study of industry causal analysis systems. The lowest level of the Causal Analysis Tree is typically referred to as the "B" Level. The Causal Analysis Tree allows for a tailored approach to developing corrective actions

Corrective vs preventive/risk-based actions [2]

- **Corrective action:** action to eliminate the cause of Nonconformity.
- **Preventive/risk-based action:** an all-inclusive term to refer to an action to eliminate the cause of a potential nonconformity

Contractor: legal entity/ organization who has entered into a contract with the IO.

Counterfeit, Fraudulent, and Suspect Items (CFSI)

A counterfeit item is a copy or substitute without legal right or authority to do so or one whose material, performance, or characteristics are knowingly misrepresented by the vendor, supplier, distributor, or manufacturer.

A fraudulent item that items which is intentionally misrepresented to be something they are not.

A suspect item is one in which there is an indication by visual inspection, testing, or other information that it may not conform to established industry-accepted specifications or national/international standards.

Deviation Request, DR (out of Scope)

Request for deviation from a specified requirement in a formal agreement (e.g. signed contract, signed Procurement Arrangements…).

DA RO

- DA staff member nominated as responsible for the coordination of NC process within DA and ensuring continuous interfaces with IO and performers (initiation and closure of the NC).
- For the NCR related to PA implementation, the IO NC system (NCR database) shall be used. For NCRs where the NC ownership will be under DA responsibility, the DA RO will apply DA specific NCR procedure.

Inter-Organization Non-Conformity (I-NC):

[2] Clarification on the term 'preventive' in this document: depending on Standards, various terminologies exist:

Definitions ISO 9000 v2015 (QMS - Fundamentals & vocabulary)	Concept of preventive action in ISO9001 v2015 (QMS - Requirements):	Terminology INB order [1]	Terminology IAEA GSR part 2 / 2016
3.12.1 preventive action action to eliminate the cause of a potential nonconformity or other potential undesirable situation … Note: **Preventive action** is taken to prevent occurrence whereas *corrective* action is taken to prevent recurrence.	**0.3.3 Risk-based thinking** The concept of risk-based thinking has been implicit in previous editions of ISO 9001, including for example carrying out preventive action to eliminate potential nonconformities … One of the key purposes of a quality management system is to act as a **preventive** tool. Consequently, ISO 9001 v2015 does not have a separate clause or sub clause on preventive action.	**Art. 2.6.3. − I.** – The operator ensures discrepancies are managed within a time-frame adapted to the issues concerned, in particular by … defining the appropriate remedial, **preventive** and corrective actions	**6.3.** The causes of non-conformances of processes … shall be evaluated and any consequences shall be managed and shall be mitigated … The status and effectiveness of all corrective actions and **preventive** actions taken shall be monitored and shall be reported to the management at an appropriate level in the organization.

Nonconformity with multiple interfaces between different entities DAs / IO and suppliers. A non-conformity that may be resolved more efficiently or in the best interests of the ITER Project by a party (DA or IO) other than by the Sending DA or its contractors. It applies in situations when a quality issue is identified late in the item's manufacturing process when there is a time criticality associated with the onward availability of this item, causing consequential impacts on later work.

Initiator of a NC:

- Entity or person who detect the Nonconformity and triggers its' registration. Mainly the performer but can be any stakeholder of the ITER project (e.g. IO-CT, IO-PT, DA, ASN, (A)NB staff members, etc.).

IO/ DA Specified Requirement:

- Specified requirements by IO/ DA including:
  - Technical and Quality requirements
  - Regulatory requirements.

IO NC Owner, hereafter IO-RO:

- IO staff member nominated as responsible for the coordination and closure of the NC, in the IO NC system (NCR database). Depending on NC scope the IO-RO is :
  - for Product NC, TRO (manufacturing phase) or CRO (construction phase).
  - for Process NC, the IO DH of affected entity.

IO-Interactions RO

- An all-inclusive term to designate a RO who is managing the project / contract affected by the original NC and related interactions with other systems (e.g. DIRO or RO in Construction Teams…).

IO NC system:

- An all-inclusive term used to refer to the agreed system for tracking and recording NCs until closure in IO. Either IO NCR Database (DB) or through IDM system (for specific cases – see the **note**).

Note: IDM maybe used only for specific cases when NC database does not provide necessary configurations, ensuring flexibility for recording of such specific NCR (e.g. cases when performers refuse or are not available to apply NCR DB, etc.). The use of IDM instead of NCR database shall be agreed with IO QARO in advance (by email). After NCR approval in IDM, QMD shall ensure the transfer (link) of such NCR from IDM to NCR database (NCR legacy) considering the graded approach established by QMD.

Long-term actions – Actions (remedial/ corrective actions) that requires more than one month for implementation and strict follow-up of responsible and due dates.

Manufacturer Means any organization or legal person who manufactures a product or has a product designed or manufactured, and markets that product under his name or trademark.

Nonconformity, herein NC

- Non-fulfilment of a requirement.
- Product or Process, which does not fulfil or fail in meeting IO */ DA,* specified requirements.

NC report

- Nonconformity Report, i.e. the record of each Nonconformity (NC); sometimes referred as NCR.

Performer

- An all-inclusive term used to cover both IO internal and external organizations, such as IO-CT, IO-PT, Domestic Agencies, Suppliers, Manufacturers and Contractors… who provide products (SSC…), works or services to ITER project.

PE Group

The PE Group is responsible for all matters related to the proper and efficient implementation of Pressure Equipment and Nuclear Pressure Equipment regulations within the whole ITER Project – part of EPNS.

Product NC: When the requirement related to the characteristic of an item, component or work is not fulfilled. As an example, failure in meeting a specified tolerance of a component.

Process NC: When the MQP procedural requirement are not fulfilled is relative to the specified way of working. As examples, failure in the propagation of requirements in the Supply Chain; failure in the execution of Design process, failure in the notification of a contractual hold point.

The Process NC related to IO processes, will be treated by IO as internal NC in accordance with detailed IO internal working instructions.

The Process NC related to performers processes, will be treated as Internal NC of performers in accordance their internal procedures – **see chapter 5.7 conditions**

Remedial action

- Action to eliminate a detected Nonconformity
    - **Use as-is:** the item deviates from requirements but is declared fit for the intended use.
    - **Rework**: compliance with the original requirements can be restored.
    - **Repair**: fitness for the intended use can be restored although the repaired item may not conform to the original requirements.
    - **Reject**: the item is not fit for the intended use.
    - **Scrap**: the item is not fit for the intended use (cannot be restored) and it cannot be used for different other scope.
    - **Other**

For process NC, the remedial actions will be specifically defined as per NC evaluation and RCA.

Root Cause Analysis (RCA)

Set of problem solving techniques targeted at identifying the actual root cause or the reason that caused the problem. The need for RCA stems from the fact that the elimination of the symptoms of the problems is not alone sufficient to address the problem, it has to be addressed at the cause level.

Service - output of an organization (service provider) with at least one activity necessarily performed between the organization and the IO. The dominant elements of a service are generally intangible.

Service often involves activities at the interface between IO (responsible for establishing the requirements) and service provider, as well as upon delivery of the service and can involve a continuing relationship.

Service provider – organization that provides a service. In a contractual situation, a service provider is sometimes called contractor.

3.2 Acronyms

Complementary or as quoted in [23] ITER abbreviations:

ASN	French Nuclear Safety Authority (from French: Autorité de Sûreté Nucléaire)
(A)NB	(Authorized) Notified Body
CAR	Corrective Action Request
CAT	Causal Analysis Tree – see annex 3
CCB	Configuration Control Board
CFSI	Counterfeit, Fraudulent, and Suspect Items
CRO	Contract Responsible Officer

DA	Domestic Agency
DH	Division Head
DR	Deviation Request
EPNS	Environmental Protection & Nuclear Safety Division
FR	Functional Reference
I-NC	Inter-Organization Non-Conformity
IO	ITER Organization (sometimes referred to as ITER)
IO-RO	IO Responsible Officer of the work package affected by the NC
IO-DIRO	IO Design Integration Responsible Officer
IO-QARO	IO Quality Assurance RO
IO-SRO	IO Safety Responsible officer
IO-CT	ITER Organization Central Team
IO-PT	Project Team established in accordance with 4.ii of [QYTZEP]
IDM	ITER Document Management(System)
ISMS	Integrated Safety Management System Manual
KPI	Key Performance Indicator
MQP	Management Quality Program
MIP/ITP	Manufacturing Inspection Plan / Inspection and Testing Plan
NC	Nonconformity
NCR	Nonconformity Report
NSI	Nuclear Safety Inspection
PA	Procurement Arrangement
PBS	Plant Breakdown Structure
PCR	Project Change Request
PIC	Protection Important Component, as defined in [24] 0
PIA	Protection Important Activities, as defined in [24]
PIM	Project Issue Management
PE/NPE	Pressure Equipment (PE) in the scope of [2] Nuclear Pressure Equipment (NPE) in the scope of [4]
PE Group	Pressurized Equipments Group – part of EPNS
PNI	Part Number of ITER
PROR	Project Risk and Opportunity Register
QAP	Quality Assurance Program
QMD	Quality Management Division
QMS	Quality Management System
RCA	Root Cause Analysis
RRF	Review of Regulatory Files
RO	Responsible Officer
SSC	System, Structure and Component
SCG	Safety Control Group
SOA	Sign-Off Authority
SR	Safety Related
SQD	Safety and Quality Department
TRO	Technical Responsible Officer

4 Applicable and Reference Documents

4.1 Applicable documents

Regulations	[1]	Order dated 7 February 2012 relating to the general technical regulations applicable to INB - EN	7M2YKF
	[2]	Pressure Equipment directive 2014/68/UE [French version]	RZ6PAK [RZ5PGG]
	[3]	Environmental code mainly art L557 and art R557 – Décret n° 2015-799 du 1er juillet 2015 relatif aux produits et équipements à risques - EN	U5TKD4
	[4]	ESPN Order dated 30 December 2015 modified – Arrêté du 30 décembre 2015 relatif aux équipements sous pression nucléaires - [EN]	SMP384
MQP Level 1	[5]	Level 1 MQP – ITER Quality Assurance Program (QAP)	22K4QX
	[6]	Level 1 MQP - ITER Integrated Safety, Environment and Security Management System Manual (ISMS)	4HCWJU
	[7]	ITER Policy on Safety, Security and Environment Protection Management	43UJN7
Interacting processes – MQP	[8]	Level 2 MQP - Document & Records process - Sign-Off Authority for Project Documents	2EXFXU
	[9]	Level 2 MQP – Nuclear Safety process - Procedure for the Safety Review of Regulatory Files	48VD6T
	[10]	Level 2 MQP – Nuclear Safety process - Organization of nuclear safety inspections in ITER Organization and its supplier chain	CW8EL3
	[11]	ITER Baseline diagram	2XWZEK
	[12]	Nonconformity and corrective actions Survey Process for PIC and PIA in Application of Articles 2.6.3, 2.7.1 and 2.7.3 of the INB Order	HDAWCU
	[13]	Level 3 MQP – Configuration Management process – Project Issue Management	SSU96T
	[14]	Level 2 MQP – Inspection and Testing process – Requirements for Producing an Inspection Plan	22MDZD
	[15]	ITER Procurement Quality Requirements	22MFG4
	[16]	Requirements for Producing a Contractors Release Note	22F52F
	[17]	Release Note Template	QVEKNQ
	[18]	Working Instruction for Mechanical Completion Dossier Preparation	UYUSEE
GIN	[19]	GIN 007 - Closure of Non-Conformance Reports	UKG3W8
Note: The procedures are applicable to the DAs, only if they are listed in the Multi Party Amendment (MPA).			

4.2 Reference documents

[20]	Quality Management System Audits	2DQTA8
[21]	ITER Corrective Action Procedure (CAR)	9QELY2
[22]	DA / Supplier / Sub-contractor QA Non-conformance Report Template	A6HRLB
[23]	ITER abbreviations	2MU6W5
[24]	Nuclear safety common definitions	RLZXMV
[25]	IO QA Non-conformance Report Template	2MVY2Z
[26]	Project Change Procedure	22F4E5
[27]	Guideline for identification (Symptoms) of Counterfeit,	

Fraudulent and Suspect Items (CFSI) XKUKAX

[28] Procedure for Implementation of the Inter-Organizational Non-Conformity Resolution Process YVPWYR
[29] ITER Project Management Plan (PMP) 2NCR3F
[30] Procedure for management of Deviation Request 2LZJHB
[31] How to – Long Aging NCRs management 3CZWDX
[32] Risk and Opportunity Management Procedure 22F4LE
[33] Management review procedure 3L7SWX
[34] Lessons Learned meeting Procedure DV4UUH

5 Basic principles

5.1 General principles for NC management

- The main steps for the methodology for NC management, are as follows:
  - The organisation, where the NC is detected, shall immediately stop works related to the nonconforming product /service and to inform IO.
  - Immediate actions to segregate *(*labelling and/or physical separation of NC shall be applied) the nonconforming item / work and to ensure safety.
  - Description of the nonconformity - NC report shall be immediately registered in NC system.
  - Agreement and implementation of remedial actions to eliminate the Nonconformity. The remedial action can be implemented only after IO formal agreement.
  - Root cause determination through RCA (Root Cause Analysis) using Causal Analysis Tree and decision on corrective & preventive/risk-based actions
  - Follow-up of actions from their initiation until their implementation
  - Verification of the effectiveness of actions.
  - NCR closure - NCR shall be handled and closed with the priority.

5.2 NCR initiation – 1a

During NC initiation stage – 1a, the following points need to be addressed (but not limited):

- Recording the NCR (Description of the problem)
- NCR categorization (major / minor)
- Preliminary proposal of remedial actions need to be established (if the initiator can provide this information at this stage).

Recording of NCR

Once NCR is detected, the initiator is recording the NC in the IO NCR database (status “Submit”) or equivalent electronic system (e.g. IDM for internal IO NCRs (status “Sign”) recognised by IO.

NC report shall be submitted within maxim 5 working days in the NC system to initiate the NC process (trigger the NCR review / approval cycle). In case of dispute between stakeholders, maximum two weeks from the NC detection time may be allowed with IO agreement only.

For management / use of IO NCR database, stakeholders shall apply detailed instructions:

- ITER_D_SM2JWP - NCR Database - Introduction & How to for IO-DA personnel
- ITER_D_SY6RQ5 - NCR Database - Introduction & How to for Suppliers and Contractors

Immediate actions shall be taken to segregate (*labelling and/ or physical separation of NC shall be applied*) the nonconforming item / work and to ensure safety.

After the NCR is submitted in the NC system, the review and approval cycle will be launched and will allow to the performer and all effected stakeholders to provide their feedback.

In case during the review / approval the NCR is rejected, then the NC owner (approver) is immediately informed and will have the responsibility to restart / re-submit the NCR only after all the conditions are agreed and applied. In case of disputes, the NC owner shall ensure further escalation as per - **section 10** of present procedure.

NCR categorization

The preliminary categorisation of NCR shall be done at the initiation stage with the involvement IO RO (confirm) and IO QARO in accordance with the following criteria:

- In ITER project, the way to implement this graded approach for NC management is to categorize NCs either as 'Major' NC or as 'Minor' NC depending on the impact of the NC to the safety, quality or performance.

- The following table provides guidelines to establish the category of the NCR. The final categorization shall be agreed between:

    - NC initiator (propose the NC categorization),
    - Performer (propose the NC categorization if initiator),
    - DAs TRO (provide support and agreement for NC categorization) in case of PAs implementation and
    - IO-RO with support of IO QARO (final confirmation of NC categorization).

Major NC	Safety / Regulation	- Nonconformity with a IO specified requirement affecting Regulatory Requirements, Safety, Environmental impact
	Baseline*	- Nonconformity with an impact on a Baseline document Level 0 / 1 / 2
	Interactions	- Nonconformity with interaction with other PBS, Construction and/or other Process
	Impact on Performance	- Implication on Functional performance
	Repetitive NC	- More than 2 similar NCRs can trigger one major NC to investigate root cause of recurrence.
Minor NC	Safety / Regulation	- Nonconformity with a specified IO requirement not affecting Regulatory Requirements, Safety, Environmental impact
	Baseline*	- Nonconformity with an impact on a Baseline document Level 3
	Interaction	- Nonconformity with no interaction with other PBS, Construction and/or other Process
	Impact on Performance	- Implication on layout (within the same space reservation of concerned system/ PBS)
	Nonconformity not falling under definition of Major NC.	

*Baseline document levels are defined as per IO procedures [11] and [29].

The detailed requirements /clarifications regarding NCR categorization are described in the ITER_D_4HCC3W - HOW TO - NCR Categorization.

During the NC initiation stage, performer shall propose preliminary remedial actions (if the initiator can provide this information at this stage) and need to be recorded in NC system for IO acceptance.

5.3 Assessment of Nonconformity – Stage 1b

During NC evaluation stage – 1b, the following points need to be addressed (but not limited):

- Final remedial actions need to be recorded in NC system and agreed with NC owner.
- Preliminary Root Cause Analysis (RCA) need to be applied and propose corrective actions / RCA category need to be established and recorded in NC System (when required)

During the NCR assessment stage, the remedial actions shall be clearly defined and agree by IO-RO.

For all the decided remedial actions the expected due dates and responsible for closure need to be established and recorded in NC system – Sage 1b.

RCA categorization with Causal Analysis Tree (CAT) evaluation shall be applied for all NCRs.

For Minor NCR, the application of RCA remains under performer internal responsibility and does not require IO acceptance. This approach regarding minor NCR evaluation does not release the performer from his responsibility to ensure correct evaluation of NCR, establishing the NCR Causes and corrective actions application.

The root-causes of nonconformities are categorized based on Causal Analysis Tree by the type of failure/ problems as following:

RCA category/ level	Description of RCA category by type of failure
A1	Design/ Engineering problem
A2	Equipment/ Material problem
A3	Human Performance problem
A4	Management (procedure/ process/ method) problem
A5	Communications problem
A6	Training Deficiency
A7	Other Problem

Each RCA categories/ levels (A) are also divided in sub-categories/ levels (B) as described in Annex 3 of present procedure. The sub-categories/ levels (B) – see annex 3, need to be recorded in the RCA report only.

The RCA category – level A, shall be recorded by performer in the NC system in the "Preliminary Analysis of Causes" section and confirmed by IO-RO (NC owner).

In IO and DA, the NC owner is primarily the RO of the item or work being affected by the NC.

- In case of NC involving several Performers, an owner in IO (or DA – for the cases when the NC does not have impact on IO requirements) shall be established with the responsibility to coordinate all actions between parties and supervise the overall action plan.

Two options are possible for NC treatment:

- A unique NC is opened covering all aspects and Performers;
- Several NCs are opened for each Performer.

If the NC owner face issues in finding agreement between parties, or if there is no agreement to find an NC owner, issue will be escalated according to **section 10** of present procedure.

For the cases when the DA is NC owner (NC with no impact on IO requirements), the DA shall apply their own specific NCR procedure accepted by IO.

For most of the cases the performer is also assigned for NCR closure. For specific cases when responsible for NC closure is other entity than performer, during the NC evaluation stage the NC owner (IO-RO / DA- RO), shall confirm (indicate) who is responsible entity for NCR closure.

Also, during the NC evaluation stage, after identification of NCR impact analyse, the NCR has to be linked (IDM, PLM etc.) to the applicable document (drawings, specification, procedure, etc.) that are affected by the NCR and requires future update. This task is under NC owner responsibility.

For specific situations, stage 1a (NC initiation) and stage 1b (NC evaluation) can be merged into one stage (1b) - if the NC initiator have all the necessary information: description of NC, Categorization, establish remedial actions, NC evaluation, Preliminary RCA, Corrective actions and categories.

Inter-Organizational Non-Conformity (I-NC)

The I-NC is a non-conformity applied in situations when a quality issue is identified late in the items manufacturing process when there is a time criticality associated with the onward availability of this item, causing consequential impacts on later work.

The NC identification is the trigger event of the I-NC but the close out of each process does not depend on the same elements.

The NCR should be kept open for technical corrective and remedial actions whereas the I-NC is kept open for financial actions as per applicable procedure [28]. The NCR can be closed even if the I-NC is not closed and vice versa.

When an I-NC is detected, the NCR title should indicate the mark “I-NC” to raise the attention of stakeholders and initiate application of I-NC mechanism. The mechanism and details for treatment of I-NC is described in the [28].

5.4 NCR closure – stage 2

When required (see note 1), a detailed RCA shall be performed with conclusions whether or not launching corrective actions, and should consider as appropriate any preventive/risk-based actions.

Note 1: The RCA is required to be applied for all NCs in accordance with the following criteria:

- For major NCR’s, the RCA need to be accepted by IO and shall be mandatory recorded in NC system.
- For minor NCR’s, the RCA does not require IO acceptance and shall be under performer responsibility only. For specific cases decided between performer and NC owner (IO-RO), the RCA may be submitted to IO for acceptance and recorded in NC system.

For all the corrective actions indicated in the RCA, the expected due dates and responsible for closure need to be established and recorded in the NC system (when Preliminary RCA is finalized -1b stage).

For complex RCA, the performer (responsible for NC closure) shall arrange specific RCA meetings and perform a detailed RCA. The RCA results and conclusions, together with the decided corrective actions shall be recorded in RCA report with the following information: RCA team members, RCA method, chronology of the events, causes of NC, corrective actions and risks required to eliminate and prevent the NC, etc.

For Root Cause Analysis (RCA) application the following guidance may be used ITER_D_2X4E9A - Root Cause Analysis Leaflet by the stakeholders.

The NCRs can be closed only after the following conditions are meet:

- **For minor NCRs:**
  - all remedial actions are closed (respecting the expected due dates – as recorded in the NCR stage 1) and evidences for remedial actions closure are recorded (attached to NCR for closure stage) in IO NC system.
  - For minor NCRs, the RCA application together with corrective actions implementation are under performer responsibility only and does not required IO acceptance.
  - in case the decided remedial actions (ex: "reject", "scrap") will not remain part of (will not affect) the final product or activity that will be delivered to IO and the related corrective actions (if necessary) will be implemented internally by performers without affecting IO products and activities, the NC can be closed immediately – fast NCR closure**. For such cases, the NC owner shall agree on fast NCR closure mode.

**note: Fast NCR closure is applicable for minor NCRs where the remedial actions ("reject" or "scrap") will not affect the final products / activities that will be delivered to IO. Fast NCR closure means, immediate NCR closure after initial stage of NCR is reviewed and approved – does not require a new review / approval cycle for NCR closure by all stakeholders.

- **For Major NCRs:**
  - all remedial actions are closed (respecting the expected due dates – as recorded in the NCR stage 1) and the evidences for remedial actions closure are recorded (attached to NCR for closure stage) in IO NCR database (or IDM).
  - all corrective actions (CA) decided as per RCA are closed (respecting the expected due dates – as recorded in RCA) and the evidences for CA closure are recorded in IO NC System (attached to NCR for closure stage).

The final closure of NC is confirmed if all related actions are implemented to guarantee the IO requirements of the item or work at the handover to IO.

For NCR closure, the performer (responsible for NCR closure) issues the update of NCR (NC report) in the IO NC system, to ensure NCR is reviewed & accepted /approved by all relevant stakeholders.

As a basic principle, the delivery of the items shall be released only if all the related NCR's are closed.

The IO NC system record the actions (remedial/corrective actions) agreed with Performers and also the internal actions in IO. If it is decided to follow some long-term actions (remedial/ corrective actions) in a separate system (JIRA CAT system or equivalent electronic system), traceability of the actions and tracking system shall be demonstrated to monitor the progress. The NCR shall not be closed if the related remedial actions / corrective actions are still open (see previous paragraphs for NC closure conditions.)

If during the NCR treatment, the risk and opportunities are identified then the IO-RO shall record the risk and opportunity in IO register (PROR) as per procedure [32].

Conditional Release of NC.

For exceptional cases, intermediate/ conditional release of the NCRs can be accepted only after agreement between IO (NC owner) and DA's / performers.

For such cases when conditional release of the NC is agreed to allow the shipment of components, tracking and checking of remaining points/ actions is required, until the final closure of the NC and handover.

To ensure proper follow-up of conditional release of NCRs, the performer shall maintain the NCR open until all the decided remaining conditions / actions are closed. The continuous follow-up of NCRs status will ensure on the same time the follow-up of such conditionally released NCRs.

For such cases when conditional release of NC is applied, clear further instructions/ actions shall be also indicated in the NCR and in the final delivery documentation (section 6 of [17] - Release Note template – QVEKNQ or section 12 – Punch list of Mechanical Completion Dossier prepared as per [18] - UYUSEE) to be taken into account on the next phases of the project.

The performer shall record the NC conditional release in NC system and NC owner will communicate this information to the corresponding IO team (IO construction team, PT, PBS team etc.) if any impact on the next phases of the project.

5.5 PE/NPE Assessment

This section is useable only when IO is acting as PE/NPE manufacturer. This section explains the process to sort out the nonconformity detected during design and manufacture of pressure equipment or nuclear pressure equipment.

Nonconformity shall be close out following relevant paragraph 5.3.

A nonconformity concerning a PE/NPE or Implementation plan for design & manufacture of PE/NPE (VE2DSP) is considered as properly closed by IO if the impact on the other past, current and future productions is performed.

5.5.1 Nonconformity related to Equipment manufactured by IO in the scope of Module H/H1

5.5.1.1 Process Nonconformity

IO describes and presents to ANB[3] the solutions it intends to adopt to remedy the process nonconformity related to the application of Implementation plan for design & manufacture of PE/NPE – VE2DSP and shall obtain ANB validation[4] before they are implemented.

5.5.1.2 Product NCR

Product Non-Conformances are classified as Major or Minor according to the criteria defined in chapter 5.2 above.

IO will describe the solutions it intends to adopt to remedy the non-conformances and will keep the related records available for ANB consultation.

5.5.2 Nonconformity related to Equipment manufactured by IO out of the scope of Module H/H1

5.5.2.1 Major Product Nonconformity

Only major product NCR affecting regulations [1], [2], [3] & [4] shall be sent to ANB.

IO describes and presents to ANB[3] the solutions it intends to adopt to remedy the major product NCR and shall obtain ANB validation[4] before they are implemented.

As soon as the NCR is uploaded in NCR database, PE/NPE expert shall send to ANB:

- the NC and all necessary information (report, drawing, picture…),
- remedial actions proposal : Whenever the supplier or subcontractor is able to repair in accordance with the PA documentation and/or selected code, this will be the preferred remedial action,
- Root-cause-Analysis.

If the repair is not following the PA/ contract documentation, contract and/or selected code, IO needs to evaluate if this repair has an impact on an essential safety requirement of [1], [2], [3] or [4] and if the hazards and risks analysis should be updated and submitted to ANB for approval.

To implement the remedial action(s), a revision of original MIP /ITP or new MIP/ITP will be prepared to include the new operations and the needed intervention points from all the parties. IO/ANB could add new control points (Hold points, witness points, reports and notification points).

5.5.2.2 Minor Product Nonconformity

The supplier or subcontractor is able to repair in accordance with the PA/ Contract documentation or existing repair procedure(s) approved by IO and accepted by ANB.

Minor NC and all evidences or reports are kept by IO in NCR database and are available to ANB on their demand (periodic meeting, ANB visit or audit).

When possible, IO shall accept the action plan without impact on the workshop schedule.

After implementation of the action plan, remedial action(s), corrective action(s) and evidence(s) are approved by IO (if required).

5.6 Case of NC related to CFSI

In case the Non-Conformity deals with a Counterfeit, Fraudulent and Suspect Item (CFSI), the Head of the EPNS Division informs the ASN using the template Déclaration d'évènement significatif à l'ASN (SKKSP3), after validation by the Director General. Such cases will be treated and reported as significant event following the regulatory requirements.

The template ITER_D_SRVZKZ - Compte-rendu d'évènement significatif is used for this analysis. After validation by the Director General, the analysis report is sent by the Head of the EPNS Division to the ASN within 2 months after the detection of the CFSI.

For identification (symptoms) of CFSI items the following guideline need to be followed and consulted by the stakeholders: [27] - XKUKAX - Guideline for identification (Symptoms) of Counterfeit, Fraudulent and Suspect Items (CFSI).

All the non-conformities dealing with a CFSI shall be evaluated by IO QARO and IO SRO to:

- ensure confirmation of CFSI case,
- initiate and perform RCA and
- ensure further escalation to EPNS Head.

5.7 Internal NC of performers.

During contracts / PAs implementation, the performers (DAs, Suppliers, contractors, sub-contractors) may identify internal NC that need to be managed internally within the performers organization without involving IO and other external entities.

Such internal nonconformities (NC) has the following characteristics:

- NC will not affect the final products and activities delivered to IO or different other entities (other DAs, supplier, contractor) in the scope of ITER project,

- NC will not have impact on contractual/ PAs requirements
- NC will not have impact on cost and schedule related to ITER project and
- NC will not have impact on regulatory requirements applicable for ITER project.

The performer internal NCRs, shall be managed by external performers in accordance with their internal NCR procedures.

The performers shall maintain fully traceability and evidences for internal NCR closure, to be available during the IO/ DAs audits and inspections.

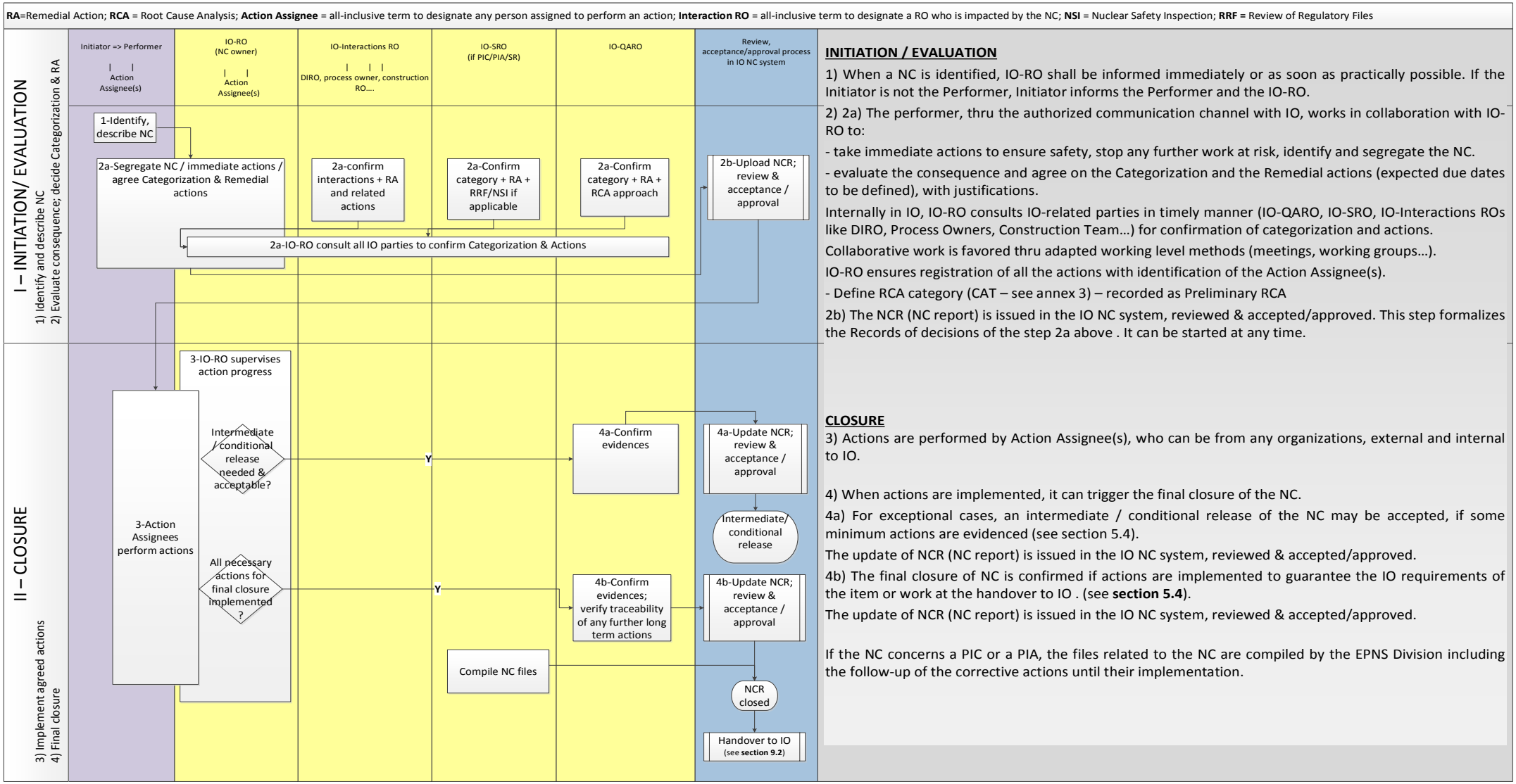
Internal NC of performers shall be recorded using performer's NCR templates and internal database (if applicable). A list (log/ register) of internal NCRs need to be maintained by the performer to allow strict control of NCR stages, trend reports and analyses. This internal NCR log shall be available at IO/ DAs request during the audits and inspections.

IO internal NCRs: For such NC (with no impact on other organizations), the involved stakeholders will be IO staff only and review / approval cycle will respect present procedure requirements. A dedicated working instruction – MQP level 3 (with no impact on DAs) will be prepared for detailing the instructions for treatment of IO internal NCRs.

6. Workflow

The work flow focuses on Roles and Responsibilities in a generic way. Two main stages of the process are defined, for both Product NC and Process NC:

I. **Initiation / evaluation:** This stage consists in taking immediate actions, describing the NC, evaluating the impact and agreeing on categorization and remedial actions.
II. **Closure:** This stage consists in implementing the actions agreed and in closing the NC with the required evidences.



INITIATION / EVALUATION

1) When a NC is identified, IO-RO shall be informed immediately or as soon as practically possible. If the Initiator is not the Performer, Initiator informs the Performer and the IO-RO.

2) 2a) The performer, thru the authorized communication channel with IO, works in collaboration with IO-RO to:

- take immediate actions to ensure safety, stop any further work at risk, identify and segregate the NC.
- evaluate the consequence and agree on the Categorization and the Remedial actions (expected due dates to be defined), with justifications.

Internally in IO, IO-RO consults IO-related parties in timely manner (IO-QARO, IO-SRO, IO-Interactions ROs like DIRO, Process Owners, Construction Team…) for confirmation of categorization and actions.

Collaborative work is favored thru adapted working level methods (meetings, working groups…).

IO-RO ensures registration of all the actions with identification of the Action Assignee(s).

- Define RCA category (CAT – see annex 3) – recorded as Preliminary RCA

2b) The NCR (NC report) is issued in the IO NC system, reviewed & accepted/approved. This step formalizes the Records of decisions of the step 2a above . It can be started at any time.

CLOSURE

3) Actions are performed by Action Assignee(s), who can be from any organizations, external and internal to IO.

4) When actions are implemented, it can trigger the final closure of the NC.

4a) For exceptional cases, an intermediate / conditional release of the NC may be accepted, if some minimum actions are evidenced (see section 5.4).

The update of NCR (NC report) is issued in the IO NC system, reviewed & accepted/approved.

4b) The final closure of NC is confirmed if actions are implemented to guarantee the IO requirements of the item or work at the handover to IO . (see **section 5.4**).

The update of NCR (NC report) is issued in the IO NC system, reviewed & accepted/approved.

If the NC concerns a PIC or a PIA, the files related to the NC are compiled by the EPNS Division including the follow-up of the corrective actions until their implementation.

7. Responsibilities

- The Performers shall ensure the implementation of the requirements of this document to control nonconformities.
- For NC under performers responsibility, the final acceptance by IO of Nonconformity Reports:
  a) Is limited to the particular contract and item referred in the report;
  b) Does not relieve the performer of any contractual obligations and responsibilities.
- Detailed stakeholders and their roles and responsibilities are listed in the following table.

#	Stakeholder	Responsibilities
1	Initiator	• Detect and identifies NC and notifies IO; • Alerts the involved parties, primarily the affected IO-RO as soon as practically possible (within one week) and with necessary details; The IO-RO may decide that the NC is actually an "Internal Non-conformity" and stop the initiation of the NC in IO NC system. • Notify the Performer, if different from the Initiator; • Responsible for registering or triggering the registration of the NC into the IO NC system; Sometimes, it can be directly the IO-RO who detects and identifies NC.
2	Performer	When Performer is the person detecting the NC, executes actions of Initiator as above; • Segregates NC, take immediate remedial actions. Stop (as per IO agreement) any further related work on the item until a decision on the NC is taken; • Make initial written proposal of the RCA categorization, using CAT and remedial actions. Initiates problem-solving technique to treat the NC, including as appropriate RCA and preliminary analysis of causes as soon as practically possible (typically within a couple of weeks). Performer can seek assistance from IO-QARO in the methodology of NC problem solving techniques. • Through the authorized communication channel with IO and DA' (in case of PA implementation), collaborates with IO-RO/ DA-RO to achieve the appropriate conclusion on NC categorization and actions (remedial actions and corrective actions). • Provides evidence of progress of the NC treatment to the IO-RO in a pro-active and timely manner. • Complementary to the required information by IO, manage comprehensively the NC in NC system. • The performer is the designated entity for NCR closure, responsible for implementation of remedial/corrective actions and trigger the NCR closure stage in NC System.
3	IO-RO NC-Owner	• IO Person assigned responsible : o For the coordination and control of the activities in the NC treatment; o Ensuring that the NC is documented and recorded in the IO NC system correctly. o Triggering and guarantying the closure of the NC. For that , the IO-RO shall: • Consult all related-parties, including IO-Interactions RO, IO-SRO (for NC concerning PIC and/or PIA), PE/NPE expert (as required) and IO-QARO to confirm categorization and actions decided. • Agree with the Performer and DA-RO (in case of PA implementation) on the apparent cause analysis tree and remedial actions; Participate and conclude on the impact assessment, including impact on IO Baseline documentation. • In case there is any change action(s) on IO Baseline documentation, manage the implementation according to [11], manage the initiation of a Project Change Request (PCR), if so requested by the DIRO. • Shall ensure that the NC is issued and registered in the IO NC system correctly. • Track the NC and related actions until the final closure of the NC in IO NC system.

#	Stakeholder	Responsibilities
		• In the review and approval cycle of the NC reports, is either the person **Approving**[3] or is **Reviewer** (if acceptance/approval is done by higher level of organisation). • IO-RO can seek assistance from IO-QARO in the methodology of NC problem solving and RCA techniques. In case of dispute to find and designate an IO-RO, see **section 10**
4	IO-SRO	• Checks if PIC, PIA, Safety Related (SR), are properly designated. • Agrees on the NC categorization (for NC concerning PIC and/or PIA). • Assess Safety impact and validates action proposal. • Reviews with respect to Regulations [1], [2], [3] & [4] • Is part of the review process of the NC reports, as appropriate for NC concerning PIC and/or PIA. • Confirms if there is a need for Safety Review of Regulatory Files [9]0 and / or Nuclear Safety Inspection [10]0 , and call for those processes as necessary.
5	PE Group	• Checks if PE/ NPE are properly designated. • Agrees on the NC categorization (if the NC is PE/NPE relevant). • Consult (A)NB for major product NCR and process NCR • Assess statutory & regulatory impact and validates action proposal • Review with respect to Regulations [1], [2], [3] & [4]. • Is part of the review process of the NC reports, as appropriate.
6	IO-Interactions RO (DIRO) <u>For Major NC only</u>	• Checks the NC potential impact on other areas than the original scope of the NC, review and confirm apparent cause analysis using CAT and remedial action proposal. • For NC at manufacturing stage, it includes the assessment of impact on Assembly, Installation and Operations. • Is part of the review process of the NC reports, as appropriate. • In case there is any change action(s) on IO Baseline documentation, ensure it is implemented according to [11]. • Analyse the NCR considering the design impact and if PCR is required to trigger further upper level project changes as per [26].
7	IO-QARO	• Checks the compliance of the NC process • Checks if proper RCA is undertaken, commensurate to the impact and risk of the NC, along with the necessary action(s). • Can provide a support to the stakeholders, as necessary, in the methodology of NC problem solving techniques. • Is part of the review process of the NC reports, as appropriate. • Checks the evidences required to grant the closure of NC. It involves traceability of the actions until implementation. • Confirms if any long-term corrective actions can be tracked in a separate system, to allow final closure of the NC on the individual item or work, and verifies the traceability of those actions. • In IO, provide assistance to sort what are internal IO actions and what are external IO actions. Indeed, an NC by an external performer may reveal the need for actions within IO. In that case IO-QARO ensures opening of the relevant NC/CAR in the appropriate IO system. • Facilitate the coordination between the stakeholders, and may become the IO NC

[3] The <u>approval level of NC can be delegated to a different IO stakeholder</u> (upper level or similar level) if agreed with Department Head of requester and approved by process owner. Such delegation regarding approval level of NC shall be documented with clear justifications using <u>deviation request</u> applied as per [30].

#	Stakeholder	Responsibilities
		owner, in case of complex NC, involving different processes.
8	QMD	• In application of GIN007 [19], QMD ensures that NCs are closed in due time. • Provide NC statistics and KPIs to monitor the effectiveness of the NC process.
9	IO-Tech Staff	• Person is designated by IO-RO as appropriate. • Review the NC regarding the technical aspects - added as additional reviewers of NC.
10	IO Process owner	• For IO internal NC, related IO processes and procedures deficiencies (need for improvements), the process owner is responsible for NCR review for confirmation of RCA and remedial and corrective actions implementation. • Ensure the process improvement (if needed) revising the affected procedures and working instruction as per decided actions triggered by NC evaluation.
11	IO DH or upper level	• For IO internal NCs, the approval shall be under DH of affected entity (or appointed representative) responsibility.
12	DA-RO	• DA Person assigned responsible : o For the coordination and control of the activities in the NC treatment within DA; o Ensuring that the NC is documented and recorded in the IO NC system correctly. o Triggering and guarantying the closure of the NC ensuring continuously interface/ communication with performer. Ensure continuous communication / interface with IO-RO to achieve the appropriate conclusion on NCR categorization, agree on related actions, remedial, and corrective actions (as required) and NCR closure.

8. Records/Outputs

- The form in Appendix 1 lists the minimum information required for managing a NC report.
  - The template [22] or template [25] is proposed to address this minimum information. Alternative formats (including in electronic form – NCR database) which include the essential metadata may be acceptable. They shall be subject to IO Quality Management Division acceptance in advance of their intended use.
- NCs are an integral part of a contract and PAs. Upon completion of the work, NC reports shall be included in the data package handed over to IO (**see chapter 9.2**).
- In IO, a NC register shall be maintained including all relevant metadata. The IO-RO is the Responsible person to ensure record of NC reports in the IO NC system, for the whole lifetime of the ITER project.

9. Link with other processes

9.1. Link with other 'Quality Assurance' processes (QA audit, CAR)

- The 3 following procedures have the same goal of addressing nonconformities and having proper corrective actions implemented. These procedures are governed by the same principles based on standard quality practices: problem description, Root Cause Analysis (RCA), corrective actions implementation and verification of effectiveness. They are complementary to address all types of inputs.
  - Nonconformities resulting from QA audits are managed through detailed steps described in [20]0
  - The CAR procedure [21]0 describes the process to manage Corrective Actions Requests as a result of other sources (for example DG decision, ASN request, a management review…).
    What is important is that actions are implemented by one of the above process, and that there is no duplication. This verification is done by Quality Management Division QMD.

9.2. Link with 'Procurement'

As elements governing ITER Procurement Quality Requirements0:

- NCs are an integral part of a contract. Upon completion of the work, NC reports together with relevant documentary evidence shall be included in the data package handed over to IO.
    - For Manufacturing, it is governed by the process for Producing a Contractors Release Note 0 and Manufacturing Dossier.
    - For Assembly&Installation, it is is governed by the process for Mechanical Completion Dossier 0.
- During execution of Inspection Plans governed by [14], if modifications appears to be necessary due to Nonconformity (such as repair…), the NC report should be referred in the Inspection Plan.
- The products / activities shall be released for delivery only if all the related NCR's are closed.
  The release of the PAs credits / contracts termination shall be applied if all the related NCRs are closed.
  For exceptional cases, please see conditional release - chapter 5.4.

9.3. Link with 'Nuclear safety'

- In the treatment of NC, SRO may trigger the need for the Review of Regulatory File (RRF) [9]0 or / and for a Nuclear Safety Inspection (NSI) [10]0. See **chapter 7** (role of IO-SRO).

- Nonconformities survey process for PIC and PIA shall be performed by SCG in accordance with Articles 2.6.3, 2.7.1 and 2.7.3 of the INB Order.

- An biannual assessment report shall be prepared by SCG and approved by SQD Head, for global review of non-conformities on the cumulated effect of uncorrected discrepancies on the installation, and identify and analyse the recurrence propensity for similar types of NC as requested by the article 2.7.1 of the INB Order [1]. The SCG is responsible for the annual assessment of trends and the cumulated effect of NCRs and analyse the recurrence propensity for similar types of nonconformities.

- Input data for such report could also come from the lessons-learned feedback as per [34].

9.4. Link with 'Configuration Management' process

- In the NC categorization, one of the criteria is the level of control (level 1/2/3/4/5) of the IO Baseline Documentation impacted. Those levels are governed by IO procedure [11].
- If the treatment of NC implies the modification of IO Baseline Documentation, the proper Change Action(s), under the relevant Level of CCB shall be managed according to [11] (**chapter 7)** and PCR [26].
- In **chapter 10** (Dispute and Resolution), the PIM process [13] can be called (Project Issue Management).

9.5. Link with 'Documents and Records'

- In **section 0**, the present procedure 22F53X describes the roles of IO Stakeholders as reviewers of the NC reports, as an input to SOA (Sign-Off Authority) [8]0. It can be summarized in following table:

<table>
<tr><th></th><th>IO-RO</th><th>IO-Interactions RO</th><th>IO-QARO</th><th>IO-SRO</th><th>PE Group</th></tr>
<tr><td rowspan="2">Minor NC</td><td rowspan="3">Approve[4] or Review</td><td>-</td><td rowspan="3">Review</td><td rowspan="3">Review
(if PIC/PIA/SR)</td><td rowspan="3">Review
(if PE/NPE)</td></tr>
<tr><td rowspan="2">At minimum IO-DIRO Review Stage I [5]</td></tr>
<tr><td>Major</td></tr>
</table>

NC					

SOA 0 being document-based does not give indication of the status of a document within a workflow. The present procedure 22F53X develops the stages of NC treatment, each of them grading the required minimum list of reviewers. Therefore, in case of contradiction, this MQP procedure 22F53X, and its derived MQP Level 3 documents, take(s) precedence.

9.6. Link with "PE/NPE conformity assessment"

In the treatment of NC, PE Group may trigger the need to update a procedure or any document used as support of the Quality System accepted by ANB.

If during the resolution of an existing nonconformity, a visual examination required for the final assessment of the PE/NPE is impacted, IO will allow ANB to perform a new visual examination.

The pressure test could be performed even if all the nonconformities are not closed if IO provides evidences to ANB that these opened non-conformities will not have an impact on the pressure test.

9.7. Link with Finance & budget process

Management of I-NC is part of finance & budget process and shall be applied in accordance with [28].

10. Dispute and resolution

Criteria for triggering escalation includes, but is not limited to:

- dispute on the way to close a NC;
- long aging NC - opened for a long time (typically more than 12 months) without any justification;
- dispute on ownership of NC; as an example, when there is multiple interfaces involved (e.g. different systems, multiple Performers and organisations …).

In IO, the mechanism how to escalate is as follows:

- Submission first to Division Head (DH) level;
- If resolution within IO is not gained at the Division Head (DH) level, it will be submitted to the QMD Head and technical Department Head level;
- If still no resolution is made, then the NC will be submitted to ''PIM" (project issue management; issue at PIM [13]).

11. KPI

IO has established 2 KPI indicators to assess the efficiency of the process:
1. The time between the detection of the NC and submission of NC (5 working days).
2. The time between the detection date of the NCR and the closure of NCR. – LL NCR

The internal specific KPIs for monitoring of NCR management performance may be established by IO process owner and shall be monitored/reported as per Management Review procedure [33].

In application of QAP [5] section 2.9,

'' The Non-conformities shall be resolved with high priority and this resolution shall not exceed 9 months in average and 12 months individually, except initial agreement from the IO DG or the QMD Head.''

---

[4] IO-RO is either the person Accepting/Approving (as per contract definition), or is Reviewer (if acceptance/approval by higher level of organisation).
For IO NC the approval shall be obtained from process owner or DH (see chapter 7). The approval level on DAs site shall be applied as per DA NCR procedures

[5] Stage I is the Initiation stage as per **section 0**, with one objective being agreement on remedial actions.

If long time (Long Aging - LL) is necessary to close the NC, justification shall be provided by NCR owner (with performer support) and recorded. The detailed requirements regarding long aging NCRs management are described in the [31].

Appendix 1: List of related information / data to be provided in NC system template

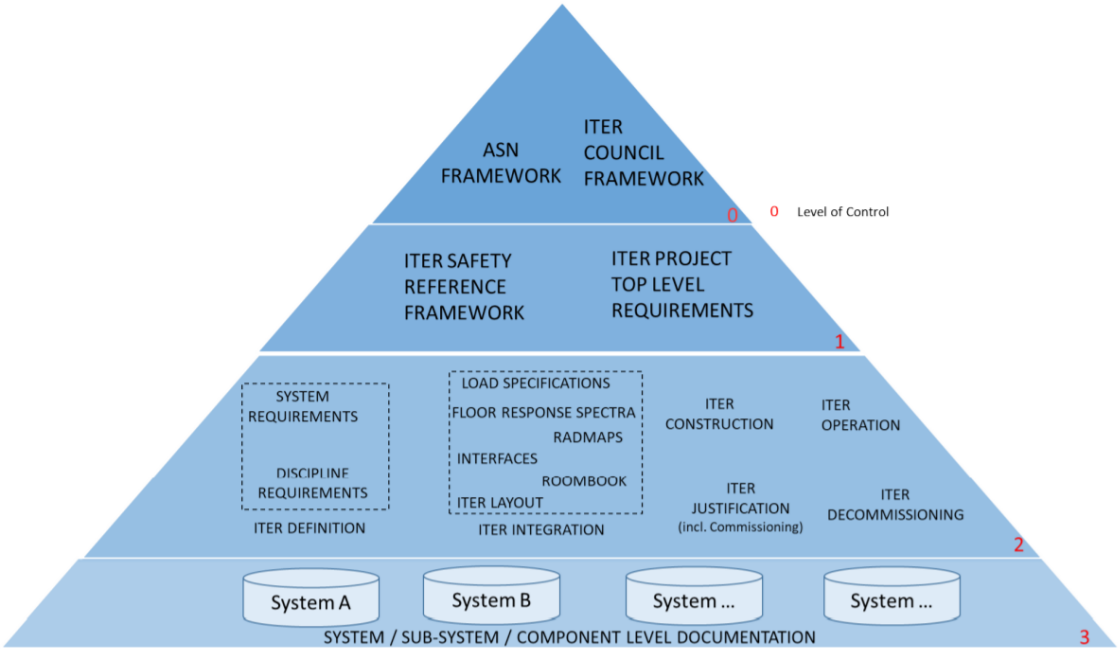
	Field	M = Mandatory O = Optional
NC Initiation Stage **I**	Title of Nonconformity	M
	External Performer(s) NC Reference(s)	M (if applicable)
	ITER Contract reference (PA/Task Agreement / Direct contract as applicable)	M (if applicable)
	DA	M (if applicable)
	Supplier / Contractor	M (if applicable)
	Affected DA (other than related contact)	M
	Plant Breakdown Structure (PBS)	M
	Item / Work identification and localization (objective is to keep traceability)	M
	FR / PNI/ SN (for product NC only) – see note **	*M*
	CWP	O
	NC Category (Major or Minor)	M
	Quality Class	O
	Is PIC? PIA? SR?	M
	Date of NC detection	M
	Requirements	M
	Description of the Nonconformity vs. Requirement	M
	Proposed preliminary Remedial Action(s) and description	M
	Initiator and organization (with signature *)	M
NC evaluation Stage **I**	Confirmation of final Remedial Action(s) (*expected completion date for closure)*	M
	Justification of Remedial Action (s)	M
	Preliminary Root Causes Analysis RCA (following CAT – annex 3)	M
	Impacted Documents, including Baseline Documents	M
	Target date for NC closure	M
	Supporting Documents	O
	Is a PCR/CCB Required? (if Y, reference #)	M (MAJOR)
	Is an RRF/NSI Required? (if Y, reference #)	M (if PIC/PIA/SR)
	Performer(s) RO (with signature*)	M
	IO ROs (with signature*)	M
	IO Reviewers (with signature*)	M
	IO Acceptance/Approval (with signature *)	M

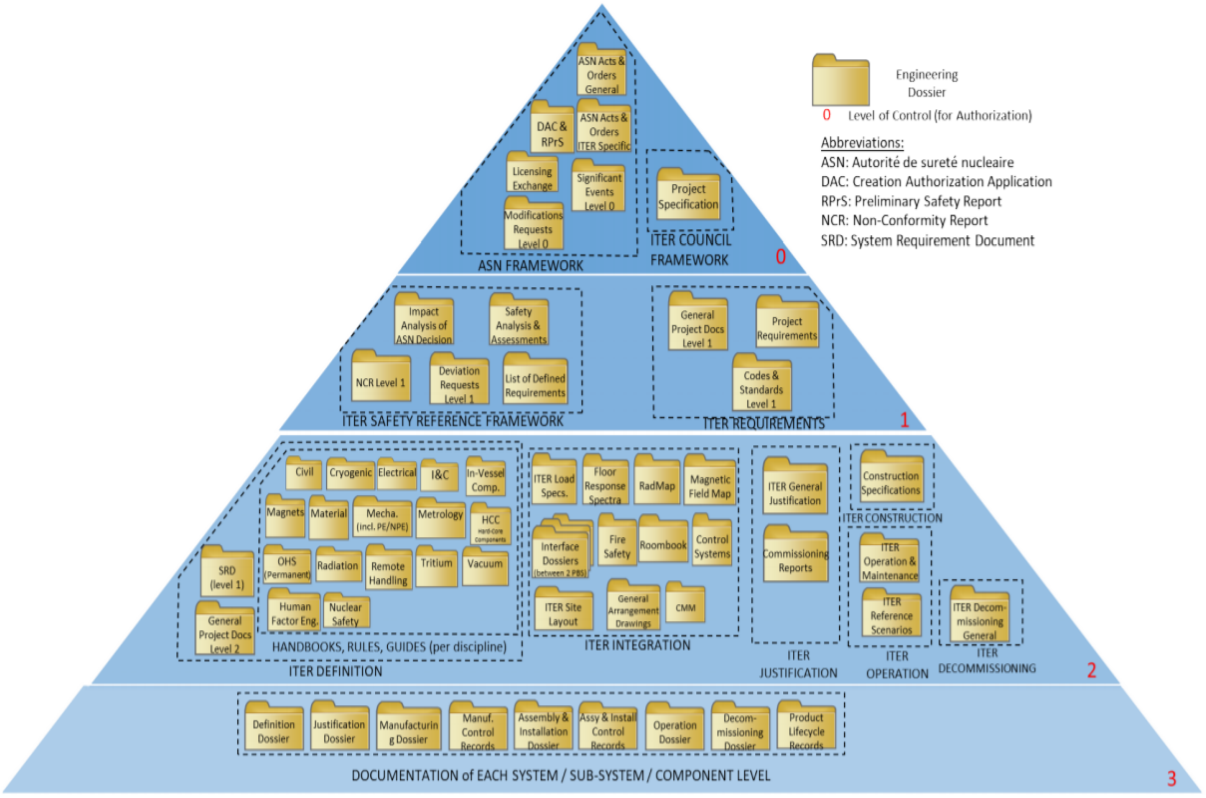
NC Closure Stage **II**	Follow-up on remedial action(s): when implemented + evidences	M
	Root Cause Analysis	M (Major)
	Are Corrective (and Preventive/risk-based) Actions Required? Y/N If Y, description of actions and due date.	M (Major)
	Follow-up on Corrective actions required for final NC closure: when implemented + evidences	M (Major)
	Performer(s) RO (with signature *)	M
	IO ROs (with signature *)	M
	IO Reviewers (with signature *)	M
	IO Acceptance/Approval (with signature *)	M

(*) 'with signature' means that there shall be a formal trace (electronic signature –*NCR database*) of the signature of the person.

(**) When the NC affect a single item, the item SN (serial Number), FR (functional reference) and PNI identifier shall be used. When the NC affect an entire batch, the PNI shall be used to identify all concerned items

Appendix 2 – TECHNICAL BASELINES overview levels as per [11] – see ITER baseline diagram



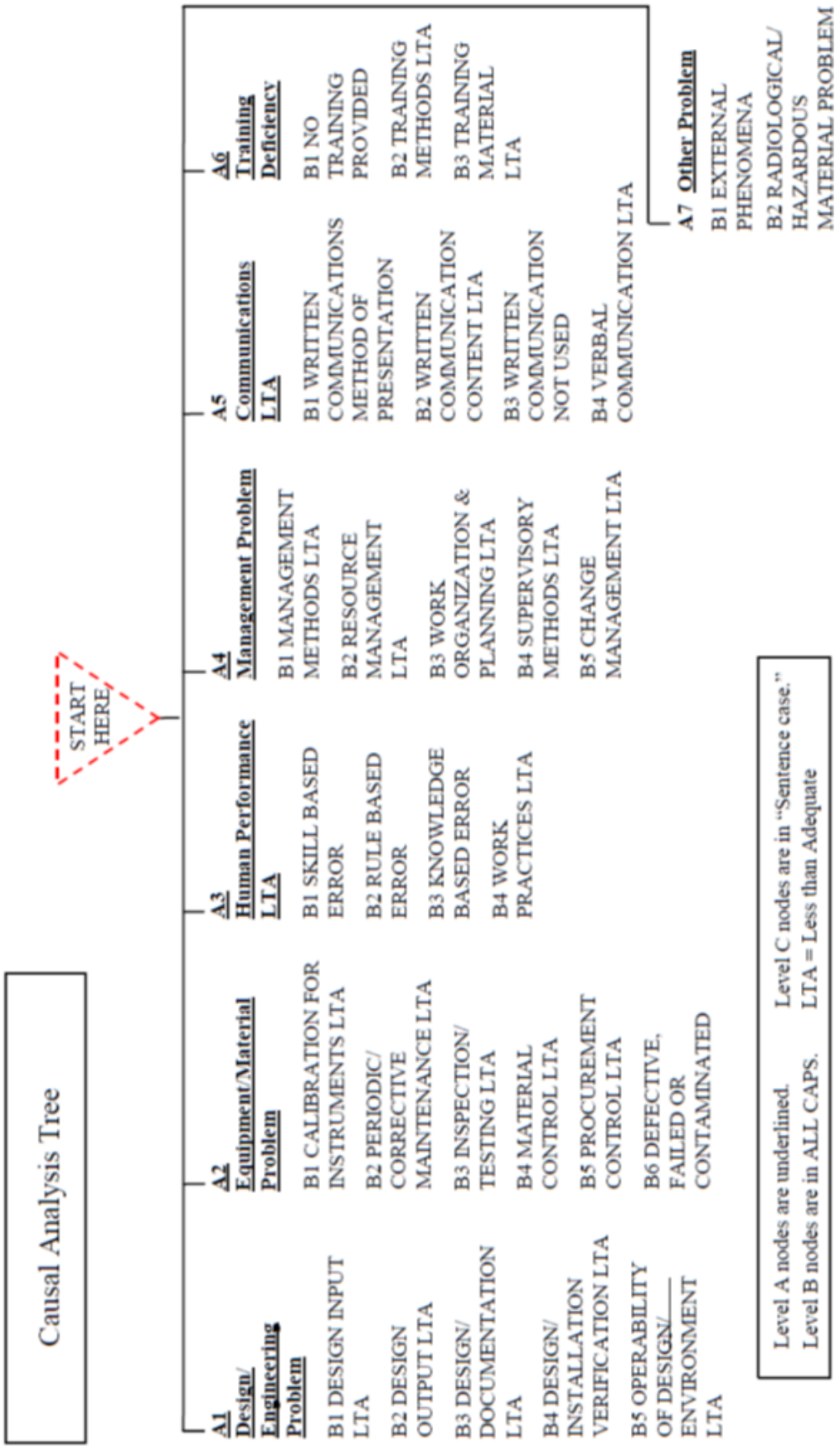


Details of ITER baselines with Engineering dossiers type and baseline levels as per [11].

MANAGEMENT BASELINES.

The management baseline requirements are indicated in chapter 9.5 of ITER_D_2NCR3F - ITER Project Management Plan (PMP).

Appendix 3 – Causal Analysis Tree for Root Cause Analysis (RCA)



Deviation Request (DR)

1. General

Type of DR	**IO / DA / CON**	Issue Date	
DA/ CON / ref. num.			
DR Title			
Item/ Component identification			
Work Activity:			
	PBS description		PBS number
Main PBS			
Quality class (QC)	QC 1: ☐ QC 2: ☐ QC 3: ☐ QC 4: ☐		
Safety self - assessment by RO	PIC/SIC-1	PIC/SIC-2	Non-SIC	PIA
	☐	☐	☐	☐
IO Manufacturer of the Pressure Equipment or Nuclear pressure Equipment	Yes ☐ No ☐	PE ☐ NPE ☐	Pressure Category: ☐ 0 ☐ I ☐ II ☐ III ☐ IV	Radioactive level: ☐ Level N2 ☐ Level N3

2. Description of Deviation

Introduction	
Description of the original requirements (Before)	
Description of the proposed alternative (After)	
Justification (for PIC and PIA, include safety justification)	

Deviation Request (DR)

3. Impact assessment (to be filled by initiator)

Other technical impact	☐	
Cost impact	☐	
Schedule impact	☐	
Impact on interface, other impacted PBS, PA, etc.	☐	
Impacted documents	☐ *List impacted document title and Uid + Rev. Num.*	
Other impacts	☐	
Follow-up of DR implementation (see note 4*)	Required ☐	Not required ☐

4. Safety and Environmental (Assessment by EPNS-DH – see note 2*)

Assessment result and comments	☐ Escalation required to a EPNS meeting required / ☐ Accepted (No escalation) ☐ Rejection unless revised

5. System / Design Integration (Assessment by IO-DIRO – see note 3*)

Assessment result and comments	☐ Escalation to a PCR required ☐ Accepted (No escalation to PCR required)

6. Decisions

	Name	Signature*	Date	Decision
Initiator				
CON RO				
DA RO				
IO-Approver				☐ Approve * ☐ Reject *

7. Confirmation of Implementation (if required – see section 3 – impact assessment)

	Name	Signature*	Date
CON-RO			
DA RO			
IO-Approver			

8. List of Attachment

Note *:

1- Signature of DR and confirmation of IO decision (reject/ accepted) are mandatory required. IDM system may be used for DR review and approval signatures (DR shall indicate the reviewers / approver names and date).
2- EPNS-DH (delegated SRO) assessment will be recorded in IDM system – with a clear resolution if DR is rejected/escalated.
3- DIRO assessment will be recorded in IDM system. If escalation to PCR is required then the section 5 of DR shall be mandatory filled.
4- The DR implementation confirmation "is required" typically for the cases when further critical actions are triggered by DR approval and/ or related documentation need to be revised to reflect the deviation implementation.

Warning: These guidelines in blue text to be removed prior to IDM upload

Note: This template should be filled out in its entirety. Incomplete information or inconsistencies with reference documents could lead to this report not being approved by IO and not releasing the components for transportation.

Upon upload to IDM; use doc-type [HS]-Delivery Report with the respective Controller as a mandatory reviewer and the IO-ILM Representative as the Approver. (See 2ZA626 for names).
Also the IDM UID of this document needs to be sent to logistics.data@iter.org per the DRR requirements.

Delivery Report for:

Please state Shipment Description here

Procurement Arrangement:

and/or

Contract/PO Number:

Please state PA, Contract, and/or PO # here

Table of Contents

1 Purpose

*This section outlines the **reason the Delivery Report is provided***

[Your text such as: The purpose of this Delivery Report is to provide IO-ILM (Integrated Materials & Logistics Management Group), the ALT (Advanced Logistics Team (logistics.data@iter.org)) and the Logistics contractors the information needed to adequately manage the planning, reception, and Materials Management of these ITER component(s).

Furthermore, this Delivery Report is a contract deliverable and is consistent with IO Management Requirements defined in ITER_D_X3NEGB - Working Instruction for the Delivery Readiness Review (DRR).

2 Scope

This Delivery Report applies to the delivery of (state shipment description/summary here) to the IO to the location and consignee stated in Section 5.

***IMPORTANT NOTES**:*

- ***The IO-TRO or delegate shall raise a Jira ticket to the IO cataloguing team to create PNIs per ITER_D_UYGU3S - WI for Creation of Part Number of ITER, PNI and Cataloguing.***
- ***There shall be a unique identifier/code/PNI for each item-type. These PNIs and other identifiers (Tag, heat, and/or serial numbers) shall be specified on the Packing List and Release Note, as well as those items' classifications.***
- *If needed, a Package & Packing List Template is available here:* ***XBZLNG***
- ***This packing list should be in the native file format (i.e. MS Excel), attached to the "Attachments" section of the IDM metadata of this Delivery Report, or if the PL has its own UID in IDM, please reference it in Section 4 of this Delivery Report.***
- ***The components shall be physically labelled in accordance with ITER_D_VYJ7U2 - Procedure for Labelling on Physical Items***

3 Important Dates

3.1 Packaging Date:

Please state the date(s) the shipment is expected to be packaged or was packaged at the supplier or manufacturer's facility.

3.2 Estimated Shipping Date:

Please state the date(s) the shipment is estimated to be shipped from the supplier, DA, or manufacturer to the IO.

3.3 Estimated Delivery Date:

Please state the date(s) the shipment is expected to deliver to the IO Site or designated storage IO storage facility. IO fully understands that this date is subject to change, but please provide the estimated IO delivery date to the best of your knowledge.

4 Applicable & Relevant Documents

***At a minimum, this section shall reference the Release Note**, corresponding **Equipment Storage & Preservation Requirements Form** (even if "In-Work"), and **Packing List** (if uploaded separately)*

Other possible references include: Lifting and Handling instructions, Packing Reports, Operations or Maintenance Manuals, BOMs, Drawings, Deviation Notices, Non-conformance reports, Material Safety Data Sheets, TI Number (if Daher is Transporter) etc.)

[1]	Release Note
[2]	Packing List
[3]	Equipment Storage & Preservation Requirements Form
[4]	

5 Consignee Details

This section states the full address of the place of delivery and the point-of-contact responsible to receive the package

[Your text such as:
ITER Organization, Building 89/ Warehouse Zone 2
Route de Vinon-sur-Verdon
CS 90 046
13067 St Paul Lez Durance Cedex -
Attention: Yanchun Qiao
+33 4 42 17 62 57

6 Shipper/Exporter Details

Please state the Sender's full address and name (point of contact) with contact information.

IMPORTANT NOTE:

If this delivery comes from a country outside of the EU (European Union), the rules and steps as defined in ITER_D_LF4QST - Procedure for the Import and Export of Goods shall be followed to ensure import customs clearance into France.

7 Additional Relevant Information

If not already referenced elsewhere or provided in Section 4, please provide as applicable:

- *Statement of Enclosed Documentation (to **physically accompany the component(s))** if any.*
- *Reference to TI/SPL/or TO Number (if DAHER International will be the Logistics Service Provider (LSP))*
- *Identification & Marking details (Part Number of ITER– PNI / Serial Number - SN)*
- *Specific Lifting & Handling Instructions*
- *Drawings showing Center of Gravity (COG), lifting points, etc.*
- *Dangerous or Hazardous goods Information (i.e. Material Safety Data Sheets (MSDS))*
- *Special transportation, storage and/or preservation plans during transit.*

8 Storage and Preservation Recommendations:

*This section states the sending entity's **recommendations** for storage and preservation (if periodic preservation activities are required). This should align with the Vendor operations or maintenance manuals.*

IMPORTANT NOTE:
The official Storage & Preservation Requirements shall be a separate document using ITER_D_WU9636 - Template - Equipment Storage & Preservation Requirements Form *and uploaded in IDM folder* Preservation Requirements

SUPPLIER STORAGE & PRESERVATION RECOMMENDATIONS
Recommended Storage Level: *(Should align with suppliers' documents (i.e. vendor manual))* ☐ A {Temperature & Humidity Control *(between 5°C and 28°C and 10% - 70% Relative Humidity at all times)*} ☐ B {Temperature Control (*between 5°C and 60°C at all times*)} ☐ C {Indoors or Equivalent, no temperature control} ☐ D {Outside storage}
Additional Storage or Preservation Information: Please provide any additional or specific storage or preservation recommendations for the items in this delivery.

9 Receipt Inspection Level (RIL) Preference

This is for the inspection to be done upon delivery to the IO. For full details of the process and RILs please reference ITER_D_RXCTBZ - Procedure for Reception of Components at the ITER Site

(Can be decided here by DA-TRO, IO-TRO, or IO-QARO only)

Receipt Inspection Level (RIL) Preference: ☐ Unknown (decide at IO) or:	☐ RIL-1 (Open package, 100% component inspection with IO-TRO, IO-QARO, and QCC) ☐ RIL-2 (Open package, component-level inspection by OLC with IO-TRO and/or IO-QARO and/or QCC) ☐ RIL-3 (Same as RIL-2, but no IO presence mandatory) ☐ RIL-4 (Package-level inspection only, Do Not Open packages) ☐ RIL-Data (i.e. for direct deliveries. No Inspection or Storage by OLC, SMat data only)

9.1 Receiving Inspections and Tests Required on IO site:

***Note**: **This applies only to RIL-1 or RIL-2 inspections**. Specific receiving inspections and tests on IO site are defined by IO-TRO (such as SAT- (Site Acceptance Testing) procedures).*

If no specific requirements for inspection or testing exist, this can be "N/A"

No.	Description of receiving inspections and tests required	Applicable procedures/ documentation for this inspection and/or testing
[1]		
[2]		

10 Declaration of Integrity

Supplier or DA Section:

Please provide a declaration of integrity of the packages and the components. This can be attached as an appendix, separate page, or to remain in this section, but it shall be signed and included in this Delivery Report.

This may be an electronic (IDM) signature to maintain Delivery Report legibility.

[Your text such as: The undersigned hereby certifies that the components and package(s) described in this Delivery Report and corresponding Packing List(s) meet the contractual requirements with the exception of any deviation notices and non-conformance reports specified and referenced within this Delivery Report.

Name and Title:

Signature:

Date:

JADA-55332TS0021-3
ITER_D_RBZBEQ

Bill of Material and Component Classifications of PoPola

ITER Project Japan Domestic Agency

	Name	Affiliation	Date
Author	IMAZAWA Ryota (TRO) 今澤 良太	Plasma Diagnostics Group	25-Apr-2022
Reviewers	TAKAMIZAWA Jun 高見澤 潤	Plasma Diagnostics Group	25-Apr-2022
Approver	HATAE Takaki (RPGL) 波多江 仰紀	Plasma Diagnostics Group	26-Apr-2022

Change log

Brunch no. (date) (IDM no.)	Change description
- (17 Aug 2015) (RBZBEQ v1.0)	First version
1 (1 Oct 2015) (RBZBEQ v1.1)	— Enovia trees in sections below were updated; Section 5.7, 5.8, 5.9, 5.10, 5.16, 5.17, 5.20, 6, 7.2, 7.5, 7.6 and 7.8 — Diagnostic room layout in Section 5.20, 6 and 7.8 were updated. — In Section 2, “Retroreflector” and “In-PP components” were merged into “in-VV components because they are the same classification. TC of ex-vessel components was amended (TC-1A -> TC-4B).
2 (21 Dec 2015) (RBZBEQ v1.2)	— Information of 2D diagram was added to Section 2 “PBS Structure” — Section 3 “ENOVIA Tree” was updated — Section 4 “Classification Table” was updated — New section, “PED and ESPN Classification”, was added. — Information about size/weight and ID in 2D diagrams were added to Section 6-8.
3 (21 Apr 2015) (RBZBEQ v2.0)	Texts and document structure are completely changed.

Table of Contents

Abbreviations:

— CB: Cassette Body (divertor)
— CBD: Cabling Diagram
— EMM: EPP Mirror Module
— EP: Equatorial port
— EPP: Equatorial Port Plug
— FD: Final Design
— FR: Functional Reference (number)
— FW: First Wall
— GBS: Geographical Breakdown Structure
— IS: Inter space
— ISMB: Inter space mirror box
— PC: Port cell
— PCMB: Port cell mirror box
— PD: Preliminary Design
— PFD: Process Flow Diagram
— PID: Piping and Instrumentation Diagram
— PNI: Part Number of ITER
— QC: Quality Class
— RH: Remote Handling
— RR: Retroreflector
— SC: Seismic Class
— SIC: Safety Important Class
— SLD: Single Line Diagram
— TC: Tritium Class
— UMM: UPP Mirror Module
— UP: Upper port
— UPP: Upper Port Plug
— VC: Vacuum Class

1 Introduction

The primary aim of the PoPola is to measure the change of polarization of injected far-infrared (FIR) laser light in order to identify the profile of plasma current, or equivalently safety factor. There are thirteen PoPola measurement channels to accomplish this measurement task. Each channel is comprised of a set of optical components that launch a laser beam from Equatorial Port Plug 10 (EPP10) or Upper Port Plug 10 (UPP10) across the plasma to a retroreflector. Figure 1 shows the overview of PoPola optical transmission line. Diagnostic room is at L2 of Building 74. The laser beam passes through the optical transmission line in a port cell and a gallery.

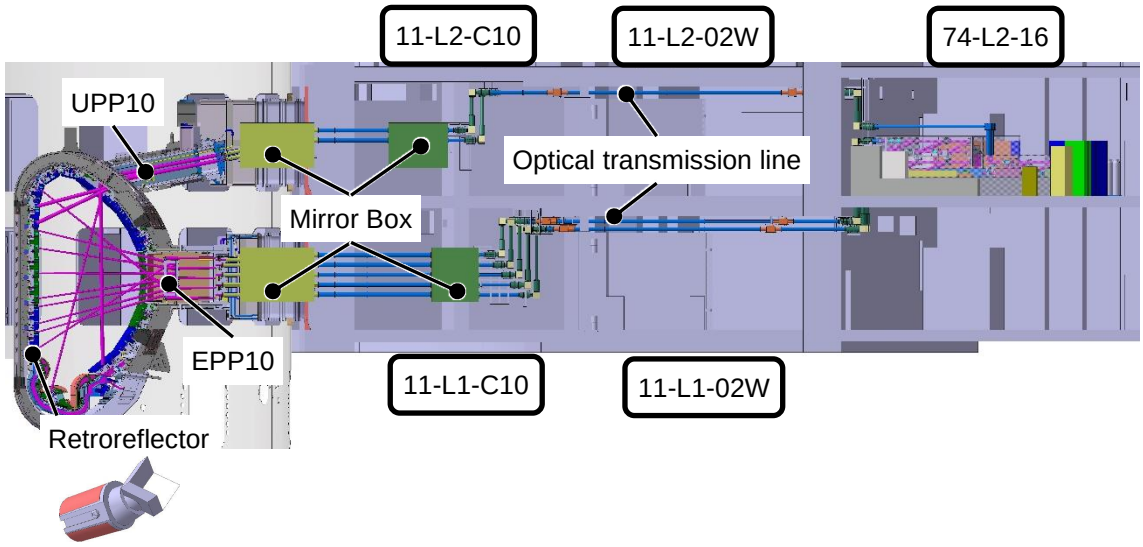


Figure 1 Overview of PoPola Optical Transmission Line

Figure 2 show the PoPola viewing chord layout (in other words, the layout of the laser paths) in the vacuum vessel. The ID of the viewing chord consists of alphabet and number. Alphabet “E” and “U” stands for EPP10 and UPP10, respectively, that the laser beam comes from. The number is just defined as sequential.

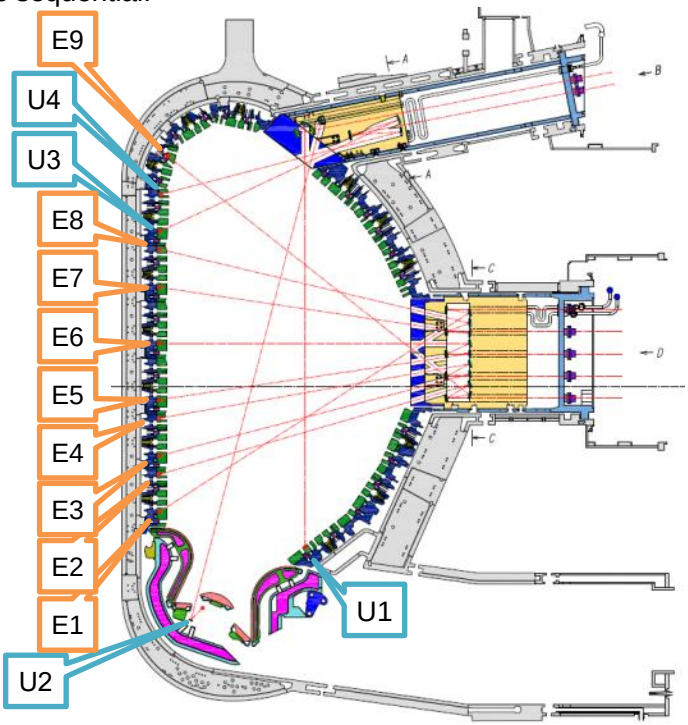


Figure 2 Overview of PoPola viewing chords

Figure 3 show an overview the PoPola in-vessel components. There are two kinds of retroreflectors; one in the blanket and the other on the divertor. In the diagnostic port plug, the

authors call a set of mirrors and supports as “mirror module”. The mirror modules in EPP10 and UPP10 are called EMM (EPP Mirror Module) and UMM (UPP Mirror Module), respectively. Moreover, both EMM and UMM consist two parts. As shown in Figure 3, EMM consists of the upper part called UEMM (Upper EMM) and the lower part called LEMM (Lower EMM). Similarly, UPP consists of the front part called FUMM (Front UMM) and the rear part called RUMM (Rear UMM).

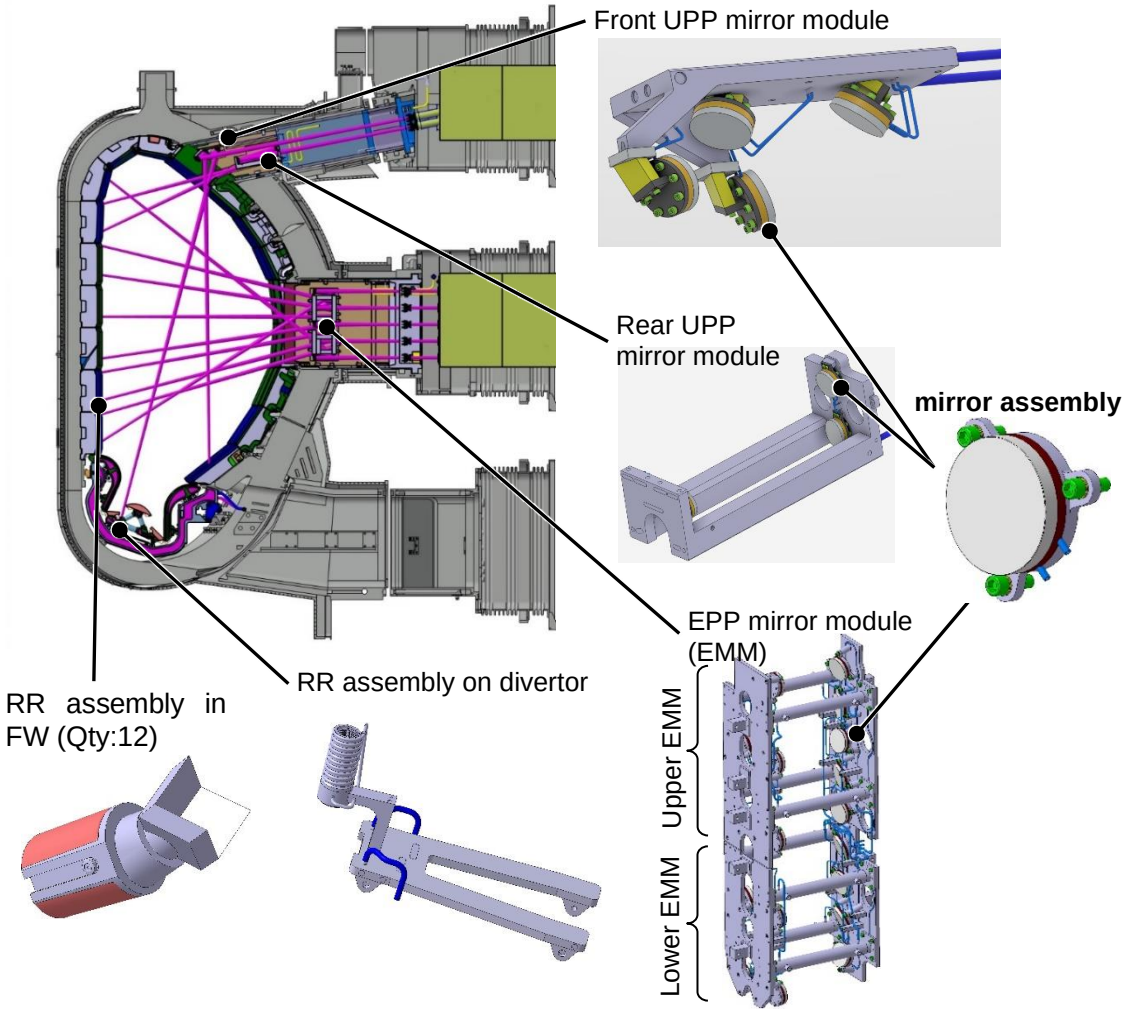


Figure 3 PoPola in-vessel components

Figure 4 shows an overview of the PoPola ex-vessel components in the port cell. At the closure pate of the diagnostic port plug, retroreflectors dedicated for laser beam alignment are attached to vacuum windows. In the port interspace, the optical components are placed in a large box called ISMB (interspace mirror box). Similarly, in the port cell, the optical components are placed in PCMB (port cell mirror box). Except for ISMB and PCMB, the ex-vessel transmission lines consist of pipes. In the gallery, the pipes are fixed to the ceiling. The support structures of the pipes at the ceiling are also in the scope of PoPola system.

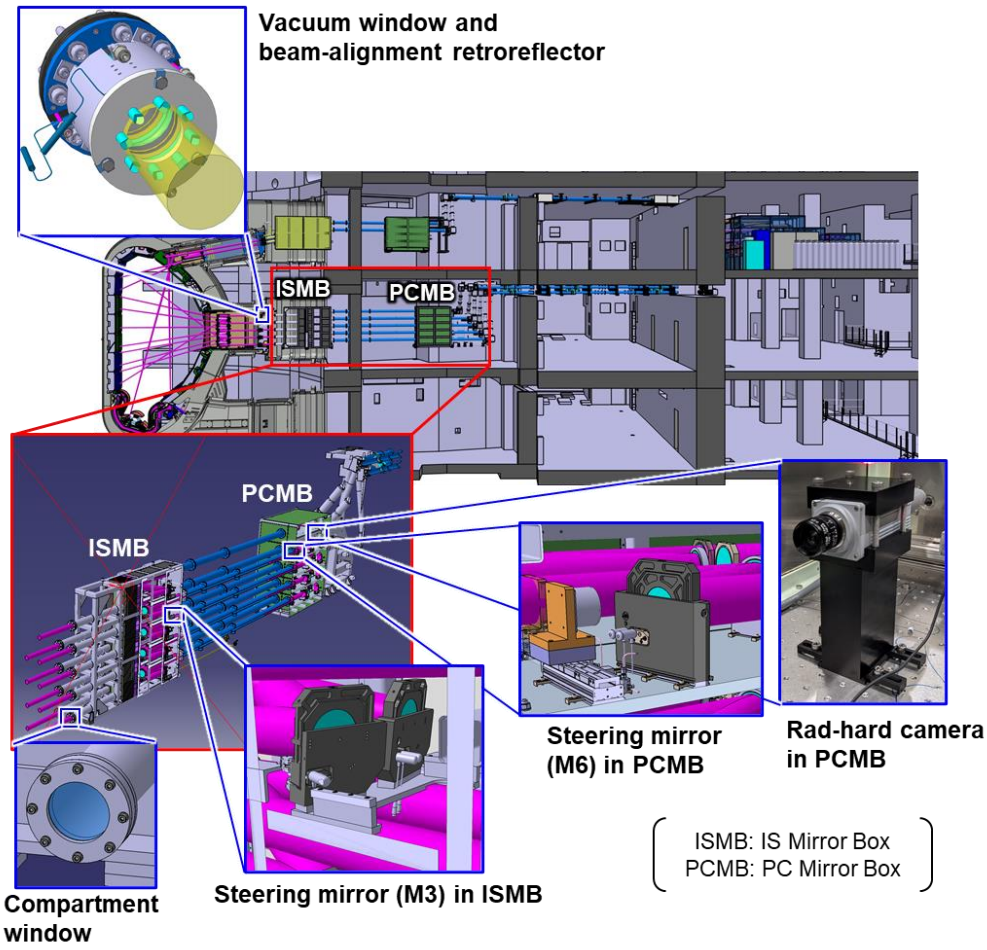


Figure 4 PoPola ex-vessel components interfacing directly with the port integrator of Equatorial Port 10.

2 Scope

This document identifies the PoPola components by using the ITER numbering system (i.e. FR and PNI) and clarifies the classification of each components such as quality class, safety class and vacuum class. Besides, the useful information such as a viewing chord ID, GB and the component drawing are also provided.

Design maturity of the PoPola components are not uniform because some components need to be manufactured earlier than others depending on their delivery dates. For instance, the final design of the retroreflector was completed, and the manufacturing study of the retroreflector just started in 2022. In contrast, the design of the components in the upper port 10 has been scarcely updated after the closure of the preliminary design review in 2016. Thus, this version is not the final version, and this document will be updated in accordance with the progress of the design maturity.

3 PBS Structure

55.C6 PoPola consists of eleven subsystems at PBS level 3. Brief explanation can be found in the table below. PBS of each PoPola component can be found “FR” column of tables in Section 5.

PBS	Title	Description
55.C6.00	PoPola Common	Common components in diagnostic building (e.g. clean booth, air-conditioner, safety switches)
55.C6.EA	PoPola Eq system A	Equatorial port system A
55.C6.EB	PoPola Eq system B	Equatorial port system B (Ex-vessel components of E2, E4, E8) (upgradability)
55.C6.UP	PoPola Up system	Upper port system
55.C6.FA	PoPola FIR laser EA	FIR laser system for 55.C6.EA (600 mW)
55.C6.FB	PoPola FIR laser EB	FIR laser system for 55.C6.EB (upgradability)
55.C6.FU	PoPola FIR laser UP	FIR laser system for 55.C6.UP (400 mW)
55.C6.DA	PoPola Detector EA	PoPola detector for 55.C6.EA
55.C6.DB	PoPola Detector EB	PoPola detector for 55.C6.EB (upgradability)
55.C6.DU	PoPola Detector UP	PoPola detector for 55.C6.UP
55.C6.IC	PoPola I&C	I&C, Cubicles

2D diagrams of each PBS are as follows.

PBS	Title	PFD	PID	SLC	Cabling
55.C6.00	PoPola Common	9XK2LM	PHY5ZR	RUXPR5	9ZJQW3
55.C6.EA	PoPola Eq system A	NA	S93GA7	NA	S99BXY
55.C6.EB	PoPola Eq system B	NA	S99KLH	NA	S97AUF
55.C6.UP	PoPola Up system	NA	S97YJX	NA	S9CEK6
55.C6.FA	PoPola FIR laser for EA	NA	S96ZUN	NA	S7VU9S
55.C6.FB	PoPola FIR laser for EB	NA	S99NY2	NA	S97VWL
55.C6.FU	PoPola FIR laser for UP	NA	S7UC3V	NA	S98DB2
55.C6.DA	PoPola Detector for EA	NA	S7FYRD	NA	S42CAC
55.C6.DB	PoPola Detector for EB	NA	S967FT	NA	S7SHEE
55.C6.DU	PoPola Detector for UP	NA	S97GCN	NA	S96U32
55.C6.IC	PoPola I&C	NA	NA	NA	S948PP

4 Evaluation of Quality Classification

Quality classification was evaluated by following “Quality Classification Determination” (24VQES v5.2). The evaluation results are the tables below. It should be noted that the components in the scope of IO-CT such as a vacuum window and a safety cubicle are excluded from this evaluation.

Components in the vacuum vessel

	Inputs for QC evaluation					Results of QC evaluation								
	SIC	SC	VQC	TC	ESPN	F1 QC	F2 QC	F3 QC	F4 QC	F5 QC	F6 QC	F7 QC	FQC	QC
Retroreflectors in blankets	non	SC2	VQC1	TC-1A	NA	1	3	1	3	3	2	1	1.93	**1**
Retroreflectors on divertor	non	SC2	VQC1	TC-1A	N3 Cat. 0	1	3	1	1	3	2	1	1.71	**1**
in-port-plug mirror module	non	NSC	VQC1	TC-1A	N3 Cat. 0	1	3	3	1	3	2	1	2.14	**2**

It should be noted that the ESPN categorization is explained in the following documents.

- “55.C6 - Components Classification BOM for CCR”, ITER_D_3DX9R9 v1.1
- “55.C6 PoPola – Summary report justifying ESPN classification of in-Equatorial-Port-Plug-10 component”, ITER_D_696J63 v1.1

Components on the closure plate of the diagnostic port plug

	Inputs for QC evaluation					Results of QC evaluation								
	SIC	SC	VQC	TC	ESPN	F1 QC	F2 QC	F3 QC	F4 QC	F5 QC	F6 QC	F7 QC	FQC	QC
Beam-alignment retro-reflectors	SR	SC2	NA	TC-4B	NA	3	3	3	3	2	3	3	2.89	**3**

Ex-vessel components in Building 11

	Inputs for QC evaluation					Results of QC evaluation								
	SIC	SC	VQC	TC	ESPN	F1 QC	F2 QC	F3 QC	F4 QC	F5 QC	F6 QC	F7 QC	FQC	QC
Laser injection optics in IS/PC	non	NSC	NA	TC-4B	NA	3	3	3	3	3	2	2	2.86	**3**
Optical transmission line (pipes for laser enclosure)	non	SC2	NA	TC-4B	NA	3	3	3	3	3	3	3	3.00	**3**
Secondary confinement equipment (including supports and fire protection box)	SIC-2	SC1 (SF)	NA	TC-4B	NA	1	3	2	1	1	2	2	1.79	**1**

Components in Building 74

	Inputs for QC evaluation					Results of QC evaluation								
	SIC	SC	VQC	TC	ESPN	F1 QC	F2 QC	F3 QC	F4 QC	F5 QC	F6 QC	F7 QC	FQC	QC
Components in Building. 74	non	NSC	NA	NA	NA	3	3	3	3	3	1	1	2.71	**3**

5 Component lists

The authors provide component lists by the area. As explained in Section 2, the design maturity depends on the PoPola components. When “Maturity” is “FD” (final design) in the tables below, you see that all information is provided. On the other hand, when “Maturity” is “PD” (Preliminary Design), components may lack some information indicated by “TBD”. The information will be provided by FDR associated with the component.

5.1 Retroreflectors

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Component drawing	Maturity
CST-S03-IN_VV	Retroreflector in blanket	—	—	—	non	SC2	QC1	VQC-1B	TC-1A	non	non	https://user.iter.org/?uid=3G8YFB_v2	FD
(ditto)	*for E1*	toroidal section #10, FW #1 Lower	55C6EA-RR-1000	I00RFYNB9	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	toroidal section #10, FW #01 Upper	55C6EB-RR-2000	I00RFYNCQ	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	toroidal section #10, FW #02 Lower	55C6EA-RR-3000	I00RFYND8	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	toroidal section #10, FW #02 Upper	55C6EB-RR-4000	I00RFYNEP	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	toroidal section #10, FW #03 Lower	55C6EA-RR-5000	I00RFYNF7	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	toroidal section #10, FW #04 Lower	55C6EA-RR-6000	I00RFYNGN	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	toroidal section #10, FW #05 Lower	55C6EA-RR-7000	I00RFYNH6	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	toroidal section #10, FW #05 Upper	55C6EB-RR-8000	I00RFYNJV	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	toroidal section #10, FW #07	55C6EA-RR-9000	I00RFYNKD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U1*	toroidal section #10, FW #18	55C6UP-RR-1000	I00RFYT9D	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	toroidal section #10, FW #06 Lower	55C6UP-RR-3000	I00RFYTBE	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	toroidal section #10, FW #06 Upper	55C6UP-RR-4000	I00RFYTCX	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
CST-S03-IN_VV	Retroreflector on divertor (U2)	toroidal section #10, CA #28	55C6UP-RR-2000	I00RFYTAW	non	SC2	QC1	VQC-1A	TC-1A	non	N3 Cat. 0	https://user.iter.org/?uid=3G8YFB_v2	FD

5.2 Components attached to EPP10

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Component drawing	Maturity
CST-S05-EQ_10	EPP Mirror Module (EMM)	EP10, DSM#2	—	—	non	NSC	QC2	VQC-1A	TC-1A	RHC3	N3 Cat. 0	https://user.iter.org/?uid=5R3R6W_v1	FD
(ditto)	*Upper EMM*	*(ditto)*	55C6EA-WMM-0100	I00SYPF6U	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*Lower EMM*	*(ditto)*	55C6EA-WMM-0101	I00RFYNLU	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L1-C10	Vacuum Window	EP10, closure plate	—	I00VY78TZ	SIC1/2	SC1(S)	QC1	VQC1-A/3-A	TC-1A	non	non	Classification: S3U8FQ v2.3	FD
(ditto)	*for E1*	*(ditto)*	55C6EA-WA-1100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	55C6EA-WB-2100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	55C6EA-WA-3100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	55C6EA-WB-4100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	55C6EA-WA-5100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	55C6EA-WA-6100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	55C6EA-WA-7100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	55C6EA-WB-8100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	55C6EA-WA-9100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L1-C10	Beam-alignment retroreflector	EP10, closure plate	—	I00RFYNMC	SR	SC2	QC3	non	TC-4B	non	non	https://user.iter.org/?uid=68ZK5H_v2	FD
(ditto)	*for E1*	*(ditto)*	55C6EA-RR-1100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	55C6EB-RR-2100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	55C6EA-RR-3100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	55C6EB-RR-4100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	55C6EA-RR-5100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	55C6EA-RR-6100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	55C6EA-RR-7100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	55C6EB-RR-8100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	55C6EA-RR-9100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*

5.3 Components attached to UPP10

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Component drawing	Maturity
CST-S05-UPR_10	UPP Mirror Module (UMM)	UP10	—	—	non	NSC	QC2	VQC-1A	TC-1A	RHC3	N3 Cat. 0	TBD	PD
(ditto)	*Front UMM*		55C6UP-WMM-0100	I00RFYTDF	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*Rear UMM*		55C6UP-WMM-0101	I00RFYTEY	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L2-C10	Vacuum Window	UP10, closure plate	—	I00VY78TZ	SIC1/2	SC1(S)	QC1	VQC1-A/3	TC-1A	non	non	Classification: S3U8FQ v2.3	PD
(ditto)	*for U1*	*(ditto)*	55C6UP-WA-1100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	55C6UP-WA-2100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	55C6UP-WA-3100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	55C6UP-WA-4100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L2-C10	Beam-alignment retroreflector	UP10, closure plate	—	I00RFYNMC	SR	SC2	QC3	non	TC-4B	non	non	https://user.iter.org/?uid=68ZK5H_v2	FD
(ditto)	*for U1*	*(ditto)*	55C6UP-RR-1100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	55C6UP-RR-2100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	55C6UP-RR-3100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	55C6UP-RR-4100	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*

5.4 Components in EP10 interspace

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Component drawing	Maturity
11-L1-C10	EP10 Interspace Mirror Box (ISMB)	EP10, ISS	55C6EA-WMA-0200	I00RTPQC4	non	NSC	QC3	non	TC-4B	non	non	https://user.iter.org/?uid=5KNZXS_v3	FD
11-L1-C10	Transmission line penetrating BS in EP10	EP10, BS	—	—	non	SC2	QC3	non	TC-4B	non	non	https://user.iter.org/?uid=6AJ9RT_v2	FD
(ditto)	*for E1*	*(ditto)*	55C6EA-PI-1200	I00S8H9JS	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	55C6EB-PI-2200	I00S8H9KA	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	55C6EA-PI-3200	I00S8H9LT	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	55C6EB-PI-4200	I00S8H9MB	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	55C6EA-PI-5200	I00S8H9NU	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	55C6EA-PI-6200	I00S8H9PC	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	55C6EA-PI-7200	I00S8H9QV	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	55C6EB-PI-8200	I00S8H9RD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	55C6EA-PI-9200	I00S8H9SW	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
					(ditto)	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L1-C10	**<Component of ISMB>**	EP10 ISMB	—	—	non	NSC	QC3	non	TC-4B	non	non	https://user.iter.org/?uid=5KNZXS_v3	FD
(ditto)	Compartment window	*(ditto)*	—	I005KK3ZQ	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E1*	*(ditto)*	55C6EA-WA-1200	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	55C6EB-WA-2200	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	55C6EA-WA-3200	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	55C6EB-WA-4200	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	55C6EA-WA-5200	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	55C6EA-WA-6200	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	55C6EA-WA-7200	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	55C6EB-WA-8200	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	55C6EA-WA-9200	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	Exhaust gas line	*(ditto)*	55C6EA-PI-0200	I004VSHZR	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	Exhaust valve #1	*(ditto)*	55C6EA-VR-0300	I004VSJ77	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	Exhaust valve #1	*(ditto)*	55C6EA-VG-0301	I004VSJBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*

5.5 Components in UP10 interspace

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Component drawing	Maturity
11-L2-C10	UP10 Interspace Mirror Box (ISMB)	UP10, ISS	55C6UP-WMA-0200	I00RTPQNF	non	NSC	QC3	non	TC-4B	non	non	TBD	PD
11-L2-C10	Transmission line penetrating BS in UP10	UP10, BS	—	—	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	*for U1*	*(ditto)*	55C6UP-PI-1200	I00S8H8GZ	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	55C6UP-PI-2200	I00S8H8HH	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	55C6UP-PI-3200	I00S8H8JJ	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	55C6UP-PI-4200	I00S8H8K2	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L2-C10	**<Component of ISMB>**	UP10 ISMB	—	—	non	NSC	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	Compartment window	*(ditto)*	—	—	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U1*	*(ditto)*	55C6UP-WA-1200	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	55C6UP-WA-2200	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	55C6UP-WA-3200	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	55C6UP-WA-4200	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	Exhaust gas line	*(ditto)*	55C6UP-PI-0200	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	Exhaust valve #1	*(ditto)*	55C6UP-VR-0300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	Exhaust valve #1	*(ditto)*	55C6UP-VG-0301	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*

5.6Components in EP10 port cell

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Component drawing	Maturity
11-L1-C10	Duct	EP10 PC, PCSS	—	—	non	SC2	QC3	non	TC-4B	non	non	https://user.iter.org/?uid=6CNJHQ_v2	FD
(ditto)	*for E1*	*(ditto)*	55C6EA-PI-1306	I00S8H8YR	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	55C6EB-PI-2306	I00S8H974	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	55C6EA-PI-3306	I00S8H96L	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	55C6EB-PI-4306	I00S8H953	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	55C6EA-PI-5306	I00S8H94K	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	55C6EA-PI-6306	I00S8H932	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	55C6EA-PI-7306	I00S8H92J	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	55C6EB-PI-8306	I00S8H8Z9	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	55C6EA-PI-9306	I00S8H98M	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L1-C10	Duct Support in EP10	EP10 PC, PCSS	55C6EA-ZJ-0301	I005KK3W7	non	SC2	QC3	non	TC-4B	non	non	https://user.iter.org/?uid=6NDEX4_v3	FD
11-L1-C10	EP10 Port Cell Mirror Box (PCMB)	EP10 PC, PCSS	55C6EA-WMA-0300	I00RTPQDL	non	NSC	QC3	non	TC-4B	non	non	https://user.iter.org/?uid=5UAAH9_v2	FD
11-L1-C10	EP10 transmission line support	EP10 PC, PCSS	55C6EA-ZJ-0300	I00RTPQFK	non	SC2	QC3	non	TC-4B	non	non	https://user.iter.org/?uid=6CZZLY_v1	FD
11-L1-C10	Transmission line	EP10 PC. On "EP10 transmission line support"	—	—	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	*for E1*	*(ditto)*	55C6EA-PI-1302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	55C6EB-PI-2302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	55C6EA-PI-3302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	55C6EB-PI-4302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	55C6EA-PI-5302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	55C6EA-PI-6302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	55C6EA-PI-7302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	55C6EB-PI-8302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	55C6EA-PI-9302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L1-C10	Flexible Light Guide	EP10 PC, outside PCSS	—	—	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	*for E1*	*(ditto)*	55C6EA-WMA-1300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	55C6EA-WMB-2300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	55C6EA-WMA-3300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	55C6EA-WMB-4300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	55C6EA-WMA-5300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	55C6EA-WMA-6300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	55C6EA-WMA-7300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	55C6EA-WMB-8300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	55C6EA-WMA-9300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L1-C10	Transmission line	EP10 PC. At ceiling	—	—	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	*for E1*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L1-C10	Ceiling support	EP10 PC. At ceiling	TBD	I00S34G7M	non	SC2	QC3	non	TC-4B	non	non	TBD	PD

5.7 Components in UP10 port cell

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Component drawing	Maturity
11-L2-C10	Duct	UP10, PCSS	—	—	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	*for U1*	*(ditto)*	55C6UP-PI-1306	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	55C6UP-PI-2306	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	55C6UP-PI-3306	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	55C6UP-PI-4306	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L2-C10	Duct Support in UP10	UP10, PCSS		TBD	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
11-L2-C10	UP10 Port Cell Mirror Box (PCMB)	UP10, PCSS	55C6UP-WMA-0300	I00RTPQPX	non	NSC	QC3	non	TC-4B	non	non	TBD	PD
11-L2-C10	UP10 transmission line support	UP10, PCSS		I00RTPQRW	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
11-L2-C10	Transmission line	UP10 PC. On "UP10 transmission line support"	—	—	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	*for U1*	*(ditto)*	55C6UP-PI-1302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	55C6UP-PI-2302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	55C6UP-PI-3302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	55C6UP-PI-4302	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L2-C10	Flexible light guide	UP10, outside PCSS	—	—	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	*for U1*	*(ditto)*	55C6UP-WMA-1300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	55C6UP-WMA-2300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	55C6UP-WMA-3300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	55C6UP-WMA-4300	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L2-C10	Transmission line	UP10 PC. At ceiling	—	—	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	*for U1*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L2-C10	Ceiling support	UP10 PC. At ceiling	TBD	TBD	non	SC2	QC3	non	TC-4B	non	non	TBD	PD

5.8 Components in L1 gallery

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Component drawing	Maturity
11-L1-02W	Fire protection box at PC side	L1 Gallery. Close to PC lintel	TBD	I00589G9S	SIC2	SC1(SF)	QC1	non	TC-4B	non	non	TBD	PD
11-L1-02W	2nd window at PC side	L1 Gallery. Close to PC lintel	—	—	SIC2	SC1(SF)	QC1	non	TC-4B	non	non	TBD	PD
(ditto)	*for E1*	*(ditto)*	55C6EA-WA-1400	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	55C6EB-WA-2400	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	55C6EA-WA-3400	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	55C6EB-WA-4400	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	55C6EA-WA-5400	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	55C6EA-WA-6400	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	55C6EA-WA-7400	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	55C6EB-WA-8400	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	55C6EA-WA-9400	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L1-02W	Fire protection box at Bld.74 side	L1 Gallery. Close to Bld. 74	TBD	I0059FBL2	SIC2	SC1(SF)	QC1	non	TC-4B	non	non	TBD	PD
11-L1-02W	2nd window at Bld.74 side	L1 Gallery. Close to Bld. 74	—	—	SIC2	SC1(SF)	QC1	non	TC-4B	non	non	TBD	PD
(ditto)	*for E1*	*(ditto)*	55C6EA-WA-1401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	55C6EB-WA-2401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	55C6EA-WA-3401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	55C6EB-WA-4401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	55C6EA-WA-5401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	55C6EA-WA-6401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	55C6EA-WA-7401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	55C6EB-WA-8401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	55C6EA-WA-9401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L1-02W	Transmission line	L1 Gallery. At ceiling	—	—	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	*for E1*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E2*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E3*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E4*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E5*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E6*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E7*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E8*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for E9*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L1-02W	***<Ceiling Support>***	L1 Gallery. At ceiling										https://user.iter.org/?uid=2KLNLC_v3	FD
(ditto)	C6_L1_CEILING_SUPPORT_01_ASSY	*(ditto)*	55C6EA-ZJ-0001	YMUUKW	SIC2	SC1(S)	QC1	non	TC-4B	non	non	*(ditto)*	*(ditto)*
(ditto)	C6_L1_CEILING_SUPPORT_02_ASSY	*(ditto)*	55C6EA-ZJ-0002	YMUULF	SIC2	SC1(S)	QC1	non	TC-4B	non	non	*(ditto)*	*(ditto)*
(ditto)	C6_L1_CEILING_SUPPORT_03_ASSY	*(ditto)*	55C6EA-ZJ-0003	YMUUMX	SR	SC2	QC2	non	TC-4B	non	non	*(ditto)*	*(ditto)*
(ditto)	C6_L1_CEILING_SUPPORT_04_ASSY	*(ditto)*	55C6EA-ZJ-0004	YMUUNG	SR	SC2	QC2	non	TC-4B	non	non	*(ditto)*	*(ditto)*
(ditto)	C6_L1_CEILING_SUPPORT_05_ASSY	*(ditto)*	55C6EA-ZJ-0005	YMUUPY	SIC2	SC1(S)	QC1	non	TC-4B	non	non	*(ditto)*	*(ditto)*
(ditto)	C6_L1_CEILING_SUPPORT_06_ASSY	*(ditto)*	55C6EA-ZJ-0006	YMUUVT	SIC2	SC1(S)	QC1	non	TC-4B	non	non	*(ditto)*	*(ditto)*

5.9 Components in L2 gallery

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Component drawing	Maturity
11-L2-02W	Fire protection box at PC side	L2 Gallery. Close to PC lintel	TBD	I005LM5BB	SIC2	SC1(SF)	QC1	non	TC-4B	non	non	TBD	PD
11-L2-02W	2nd window at PC side	L2 Gallery. Close to PC lintel	—	—	SIC2	SC1(SF)	QC1	non	TC-4B	non	non	TBD	PD
(ditto)	*for U1*	*(ditto)*	55C6UP-WA-1400		*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	55C6UP-WA-2400		*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	55C6UP-WA-3400		*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	55C6UP-WA-4400		*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L2-02W	Fire protection box at Bld.74 side	L2 Gallery. Close to Bld. 74	TBD	I005FWJW7	SIC2	SC1(SF)	QC1	non	TC-4B	non	non	TBD	PD
11-L2-02W	2nd window at Bld.74 side	L2 Gallery. Close to Bld. 74	—	—	SIC2	SC1(SF)	QC1	non	TC-4B	non	non	TBD	PD
(ditto)	*for U1*	*(ditto)*	55C6UP-WA-1401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	55C6UP-WA-2401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	55C6UP-WA-3401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	55C6UP-WA-4401	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L2-02W	Transmission line	L2 Gallery. At ceiling	—	—	non	SC2	QC3	non	TC-4B	non	non	TBD	PD
(ditto)	*for U1*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U2*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U3*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
(ditto)	*for U4*	*(ditto)*	TBD	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
11-L2-02W	***<Ceiling Support>***	L2 Gallery. At ceiling										https://user.iter.org/?uid=5FUDB3_v3	PD
(ditto)	C6_L2_CEILING_SUPPORT_01_ASSY	*(ditto)*	55C6UP-ZJ-0001	I005FULQL	SIC2	SC1(S)	QC1	non	TC-4B	non	non	*(ditto)*	*(ditto)*
(ditto)	C6_L2_CEILING_SUPPORT_02_ASSY	*(ditto)*	55C6UP-ZJ-0002	I002QT9LZ	SR	SC2	QC2	non	TC-4B	non	non	*(ditto)*	*(ditto)*
(ditto)	C6_L2_CEILING_SUPPORT_03_ASSY	*(ditto)*	55C6UP-ZJ-0003	I002QT9MH	SR	SC2	QC2	non	TC-4B	non	non	*(ditto)*	*(ditto)*
(ditto)	C6_L2_CEILING_SUPPORT_04_ASSY	*(ditto)*	55C6UP-ZJ-0004	I005FULYG	SR	SC2	QC2	non	TC-4B	non	non	*(ditto)*	*(ditto)*
(ditto)	C6_L2_CEILING_SUPPORT_05_ASSY	*(ditto)*	55C6UP-ZJ-0005	I005FUM8L	SIC2	SC1(S)	QC1	non	TC-4B	non	non	*(ditto)*	*(ditto)*
(ditto)	C6_L2_CEILING_SUPPORT_06_ASSY	*(ditto)*	55C6UP-ZJ-0006	I005FUMGG	SIC2	SC1(S)	QC1	non	TC-4B	non	non	*(ditto)*	*(ditto)*

5.10Components in Building 74

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Supplier, Model no.	Maturity
	<LASER AND OPTICS>												
—	FIR Laser system (55.C6.FA)	—	—	—	non	NSC	QC3	non	non	non	non	TOYAMA	PD
74-L2-17	*Main unit*	PoPola diagnostic room	55C6FA-LAA-0001	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	*Controller*	PoPola diagnostic room	55C6FA-POC-0001	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	*Power Supply*	PoPola diagnostic room	55C6FA-PSU-0001	I00VNAGPU	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
—	FIR Laser system (55.C6.FA)	—	—	—	non	NSC	QC3	non	non	non	non	TOYAMA	PD
74-L2-17	*Main unit*	PoPola diagnostic room	55C6FB-LAA-0001	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	*Controller*	PoPola diagnostic room	55C6FB-POC-0001	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	*Power Supply*	PoPola diagnostic room	55C6FB-PSU-0001	I00VNAGPU	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
—	FIR Laser system (55.C6.FA)	—	—	—	non	NSC	QC3	non	non	non	non	TOYAMA	PD
74-L2-17	*Main unit*	PoPola diagnostic room	55C6FU-LAA-0001	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	*Controller*	PoPola diagnostic room	55C6FU-POC-0001	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	*Power Supply*	PoPola diagnostic room	55C6FU-PSU-0001	I00VNAGPU	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	Chiller (55.C6.FA)	PoPola diagnostic room	55C6FA-HX-0002	I00SYNW4K	non	NSC	QC3	non	non	non	non	Thermoflex TF10000	PD
74-L2-18	Chiller (55.C6.FU)	PoPola diagnostic room	55C6FU-HX-0002	I00SYNWEQ	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	Chiller (55.C6.FB)	PoPola diagnostic room	55C6FB-HX-0002	I00SYNWAN	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	H.V supply of FA	PoPola diagnostic room	55C6FA-PSU-0002	I00SYNW2J	non	NSC	QC3	non	non	non	non	IDX, IPN-20K200-M (customized)	PD
74-L2-18	H.V supply of FB	PoPola diagnostic room	55C6FB-PSU-0002	I00RUVFYB	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	H.V supply of FU	PoPola diagnostic room	55C6FU-PSU-0002	I00SYNWCP	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	Vacuum Pump #1 of FA	PoPola diagnostic room	55C6FA-PV-0004	I00SYNYHR	non	NSC	QC3	non	non	non	non	Edwards, nXR90i	PD
74-L2-18	Vacuum Pump #2 of FA	PoPola diagnostic room	55C6FA-PV-0005	I00S65PER	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	Vacuum Pump #1 of FB	PoPola diagnostic room	55C6FB-PV-0004	I00SYNYHR	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	Vacuum Pump #2 of FB	PoPola diagnostic room	55C6FB-PV-0005	I00S65PER	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	Vacuum Pump #1 of FU	PoPola diagnostic room	55C6FU-PV-0004	I00SYNYHR	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	Vacuum Pump #2 of FU	PoPola diagnostic room	55C6FU-PV-0005	I00S65PER	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-18	Alcohol supply unit	PoPola diagnostic room	55C600DIA-0001	TBD	non	NSC	QC3	non	non	non	non	HORIBA STEC, LSC-7900-0004 (customized)	PD

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Supplier, Model no.	Maturity
	<DETECTION SYSTEM>												
74-L2-16	Detection system (55.C6.DA)	PoPola diagnostic room	55C6DA-DIA-0001	TBD	non	NSC	QC3	non	non	non	non	TBD	PD
74-L2-16	Detection system (55.C6.DB)	PoPola diagnostic room	55C6DB-DIA-0001	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	TBD	*(ditto)*
74-L2-16	Detection system (55.C6.DU)	PoPola diagnostic room	55C6DU-DIU-0001	TBD	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	TBD	*(ditto)*
74-L2-16	Cryo-cooler #1 (55.C6.DA)	PoPola diagnostic room	55C6DA-PC-0001	I00VN9UNL	non	NSC	QC3	non	non	non	non	CRYOMECH, PT405RM-CPA2850	PD
74-L2-16	Cryo-cooler #2 (55.C6.DA)	PoPola diagnostic room	55C6DA-PC-0002	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	CRYOMECH, PT405RM-CPA2850	*(ditto)*
74-L2-16	Cryo-cooler (55.C6.DB)	PoPola diagnostic room	55C6DB-PC-0002	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	CRYOMECH, PT405RM-CPA2850	*(ditto)*
74-L2-16	Cryo-cooler (55.C6.DU)	PoPola diagnostic room	55C6DU-PC-0002	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	CRYOMECH, PT405RM-CPA2850	*(ditto)*

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Supplier, Model no.	Maturity
	<CUBICLES>												
74-L2-16	PSH cubicle	PoPola diagnostic room	55C6IC-CU-7201	I00VN9USN	non	NSC	QC3	non	non	non	non	—	PD
74-L2-16	EA control cubicle	PoPola diagnostic room	55C6IC-CU-8002	I00RUVCJR	non	NSC	QC3	non	non	non	non	—	PD
74-L2-16	UP control cubicle	PoPola diagnostic room	55C6IC-CU-8003	I00RUVFHK	non	NSC	QC3	non	non	non	non	—	PD
74-L2-16	EB control cubicle	PoPola diagnostic room	55C6IC-CU-8004	I00VNAGXY	non	NSC	QC3	non	non	non	non	—	PD
74-L2-16	EA alignment cubicle	PoPola diagnostic room	55C6IC-CU-8011	I004VSQ87	non	NSC	QC3	non	non	non	non	—	PD
74-L2-16	DA cubicle	PoPola diagnostic room	55C6IC-CU-8012	I004VSQAE	non	NSC	QC3	non	non	non	non	—	PD
74-L2-16	UP&EB alignment cubicle	PoPola diagnostic room	55C6IC-CU-8014	I00RUVCLQ	non	NSC	QC3	non	non	non	non	—	PD
74-L2-16	DU&DB cubicle	PoPola diagnostic room	55C6IC-CU-8015	I00RUVCET	non	NSC	QC3	non	non	non	non	—	PD

GBS	Component name	Location	FR No.	PNI	SIC	SC	QC	VC	TC	RHC	ESP/ESPN	Supplier, Model no.	Maturity
	<UTILITIES>												
74-L2-16	Water feedthrough #1	PoPola diagnostic room	55C600-DF-0002	TBD	non	NSC	QC3	non	non	non	non	—	PD
74-L2-16	Water feedthrough #2	PoPola diagnostic room	55C600-DF-0009	TBD	non	NSC	QC3	non	non	non	non	—	PD
74-L2-16	Air Conditioner (55.C6.FA)	PoPola diagnostic room	55C6FA-CL-0002	I00RUVF7N	non	NSC	QC3	non	non	non	non	SMC, IDHA-23B-E	PD
74-L2-16	Air Conditioner (55.C6.FU)	PoPola diagnostic room	55C6FU-CL-0003	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*	*(ditto)*
74-L2-16	Compressed Air Manifold	PoPola diagnostic room	55C600-DF-0001	I005KDERU	non	NSC	QC3	non	non	non	non	—	PD

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ITER_D_696KB9

Technical Specification of PoPola Mirror Modules in Equatorial Port Plug 10

ITER Project Japan Domestic Agency

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Change log

Brunch no. (date) (IDM version)	Change description	Author
- (5 Nov 2021) (696KB9 v1.0)	The first version.	R. Imazawa
1 (21 Dec 2021) (696KB9 v1.1)	Table 5 “Chemical composition of SS316L(N)-IG (wt.%)” was added.	R. Imazawa

Table of contents

1. Purpose

This document provides all specifications that a manufacturer will need to comply with when they fabricate the mirror module in equatorial port plug of PoPola.

2. Definition

The definitions of abbreviations in this document are given in Table 1.

Table 1 the abbreviations in this document

EPP	Equatrial Port Plug
EMM	EPP Mirror Module
UEMM	Upper EMM
LEMM	Lower EMM
IVH	ITER Vacuum Handbook
JIS	Japanese Industrial Standards
MPH	ITER Material Property Handbook
OD	Outer Diameter
PoPola	PBS.55.C6 Poloidal Polarimeter
RT	Radiographic Test
SDC-IC	Structural design criteria - In-vessel Components
UT	Ultrasonic Test

3. References

[1] Technical Description of PoPola Mirror Modules in Equatorial Port Plug 10, ITER_D_696XRM (or JADA-55342DE0101)
[2] Structural design criteria - In-vessel Components (SDC-IC), ITER_D_222RHC
[3] ITER Vacuum Handbook (IVH), ITER_D_2EZ9UM
[4] ITER Material Properties Handbook (MPH), ITER_D_2226FR
[5] Drawing of Mirror Modules in EPP10: ITER_D_5R3R6W
[6] ITER Vacuum Handbook Attachment 1 Welding, ITER_D_2FMM4B
[7] ITER Vacuum Handbook Appendix 3 Materials, ITER_D_27Y4QC
[8] CAD Manual 12-2 Piping Design, ITER_D_33WL3N
[9] Optical Analysis and Design of PBS.55.C6 PoPola, ITER_D_RC2LB5 (or JADA-55332TS0022)
[10] Chit resolution report for PoPola CDR Chit #17 “Effect of potential bending of the flat plasma-facing mirrors” , ITER_D_UVR9CH
[11] Factory qualification test plan, ITER_D_69765M (or JADA-55342PL0101)
[12] ITER Vacuum Handbook Appendix 15 Vacuum Baking, ITER_D_2DU65F (ver.1.3)
[13] ITER Vacuum Handbook Appendix 2 Environmental Cleanliness, ITER_D_2EL9Y6 (ver.1.4)
[14] ITER Vacuum Handbook Appendix 13 Guide to cleaning and cleanliness, ITER_D_2ELUQH (ver.1.2)
[15] ITER Vacuum Handbook Appendix 4 Accepted Fluids, ITER_D_2ELN8N (ver.1.5)
[16] 55 C6 Manufacturing Assessment of PoPola Mirror Modules in Equatorial Port Plug 10, ITER_D_696RYF (or JADA-55342TS0102)

4. System Description

The primary aim of the PoPola is to measure the change of polarization of injected far-infrared (FIR) laser light in order to identify the profile of plasma current, or equivalently safety factor. There are thirteen PoPola measurement channels to accomplish this measurement task. Each channel is comprised of a set of optical components that launch a laser beam from Equatorial Port Plug 10 (EPP10) or Upper Port Plug 10 (UPP10) across the plasma to a retroreflector. Figure 1 and Figure 2 show an overview of the PoPola viewing chords and the PoPola in-vessel components, respectively. Especially, components in the scope of this documents are the mirror module in EPP10. It is called EMM (EPP Mirror Module) and consists of two parts. The upper part is called UEMM (Upper EMM) and the lower one is called LEMM (Lower EMM). Figure 3 and Figure 4 shows the overview of UEMM and LEMM.

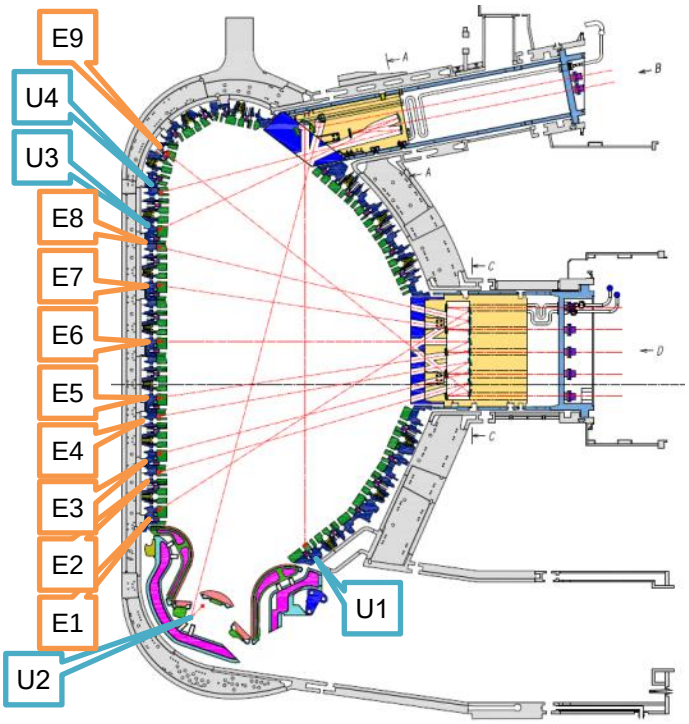


Figure 1 Overview of PoPola viewing chords

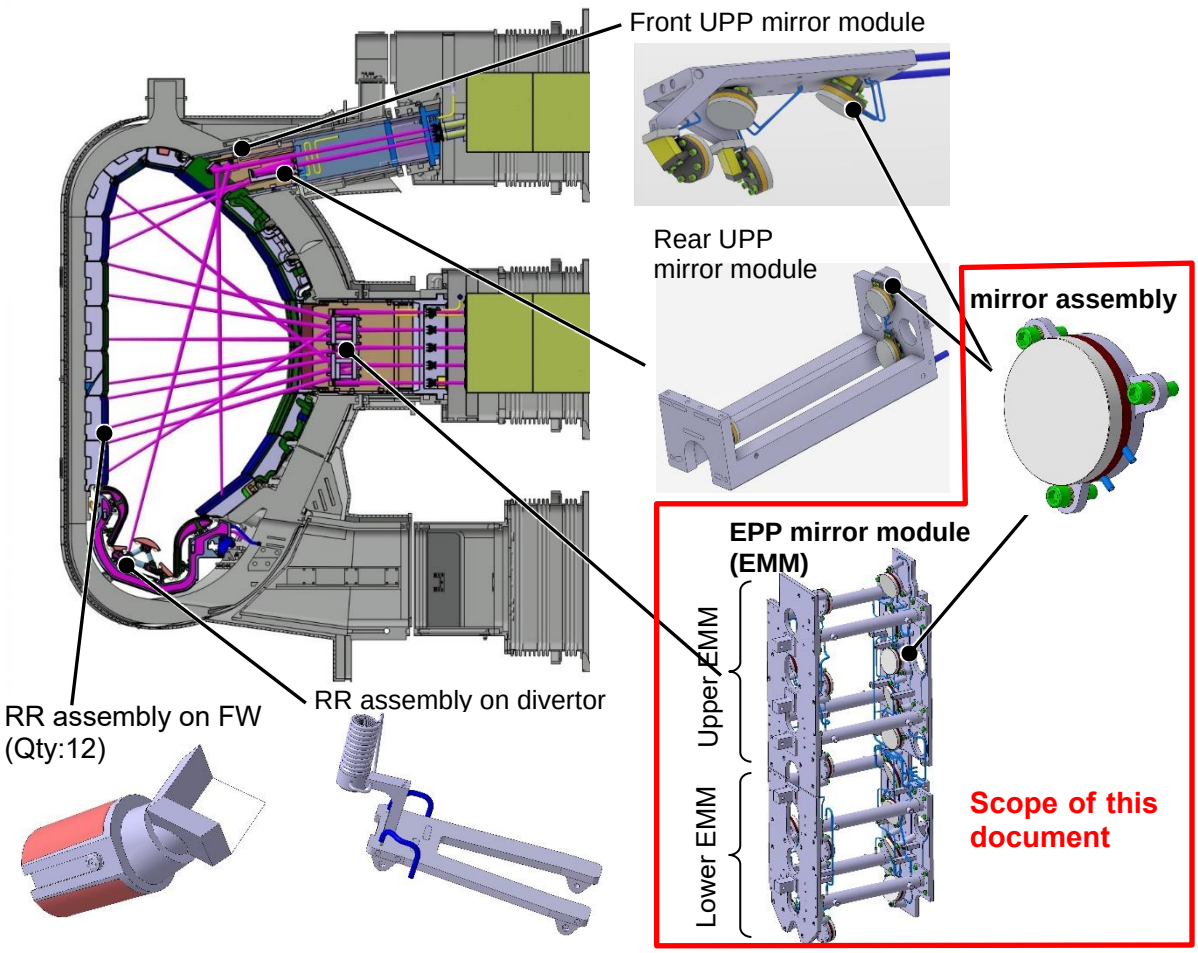


Figure 2 PoPola in-vessel components

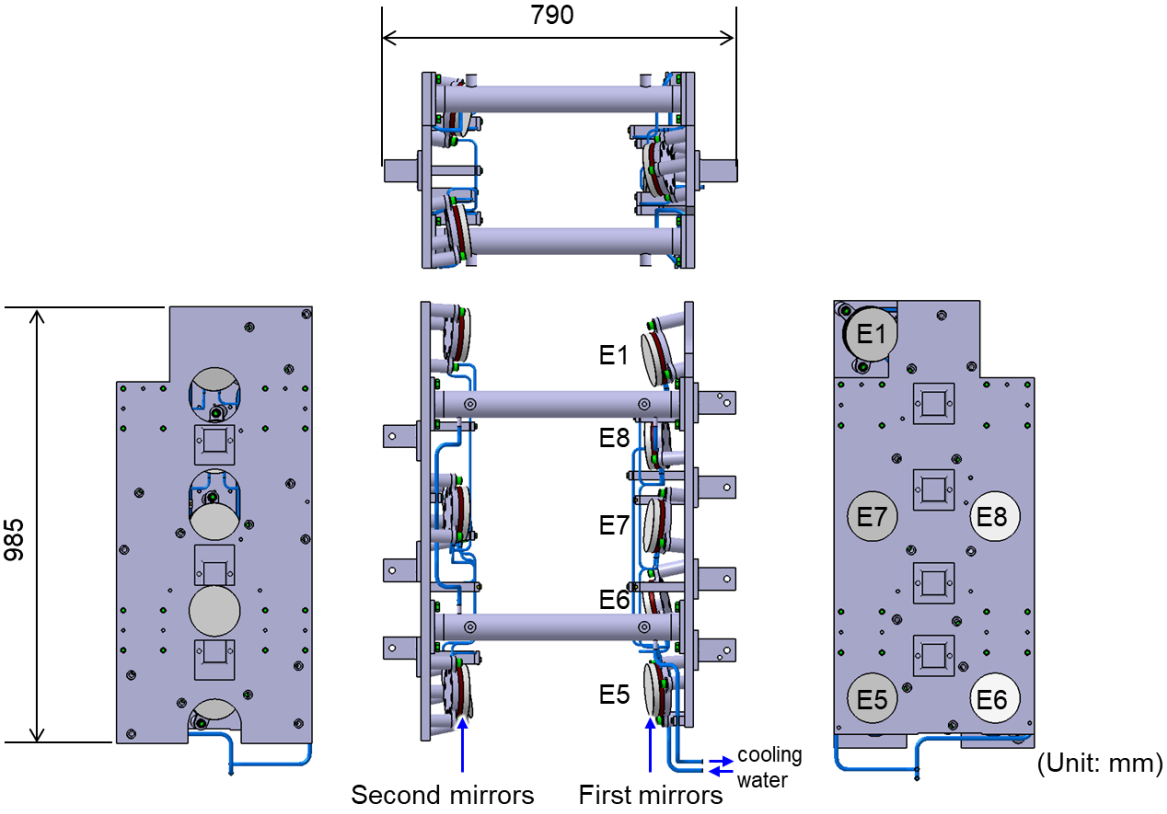


Figure 3 UEMM (Upper part of EP Mirror Module)

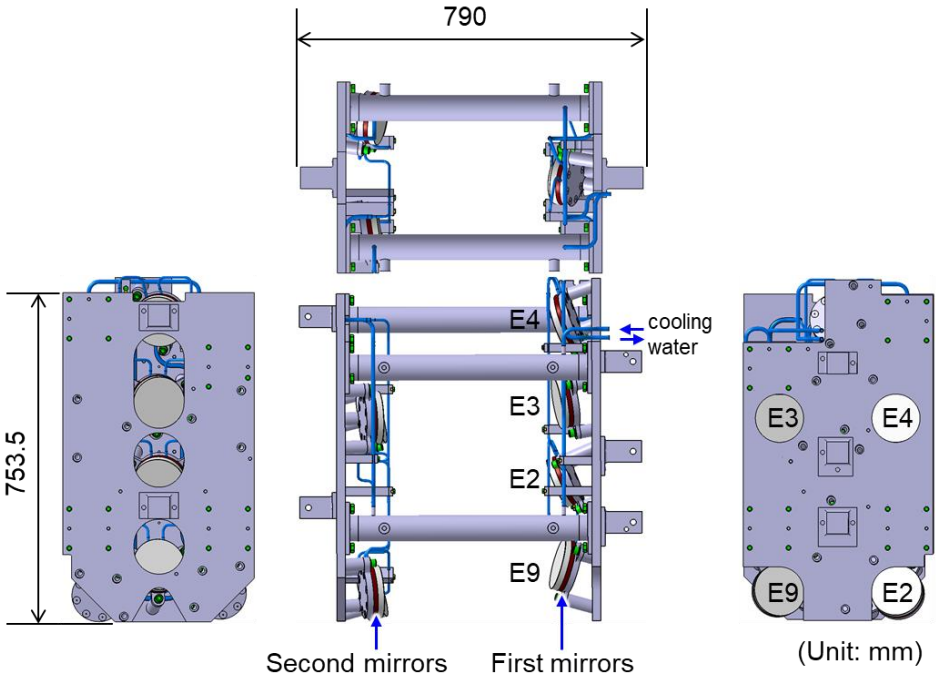


Figure 4 LEMM (Lower part of EP Mirror Module)

Both of UEMM and LEMM consist of the same components such as mirror assemblies, connecting rods, baseplates, and pipes. Figure 5 and Figure 6 show overview of components and assemblies. Technical description [1] provides the detailed explanation about each component.

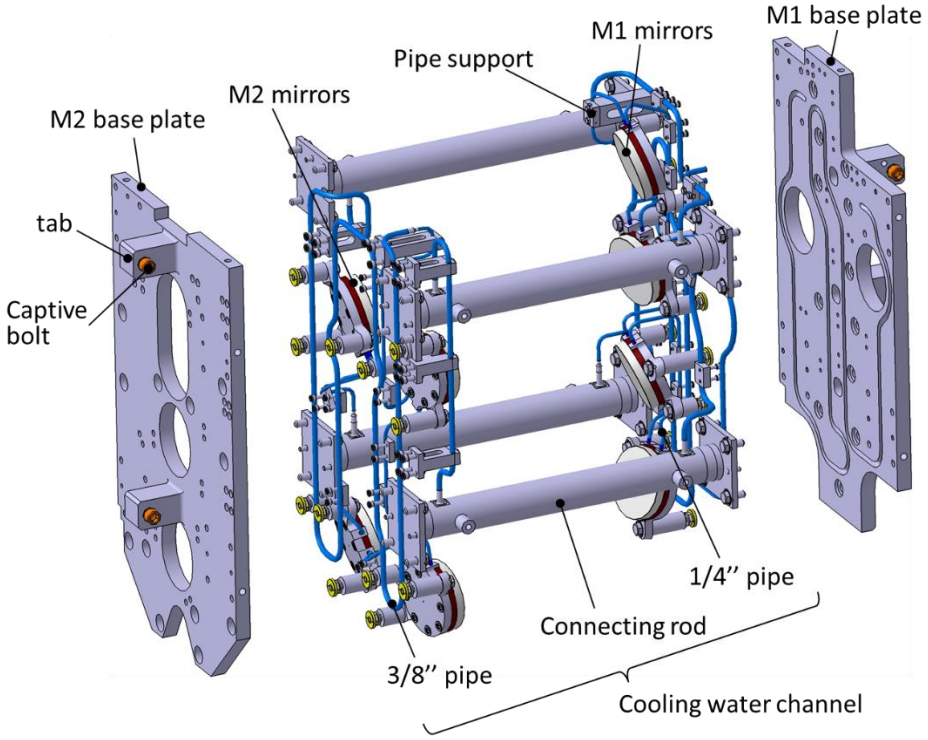


Figure 5. Components of EMM

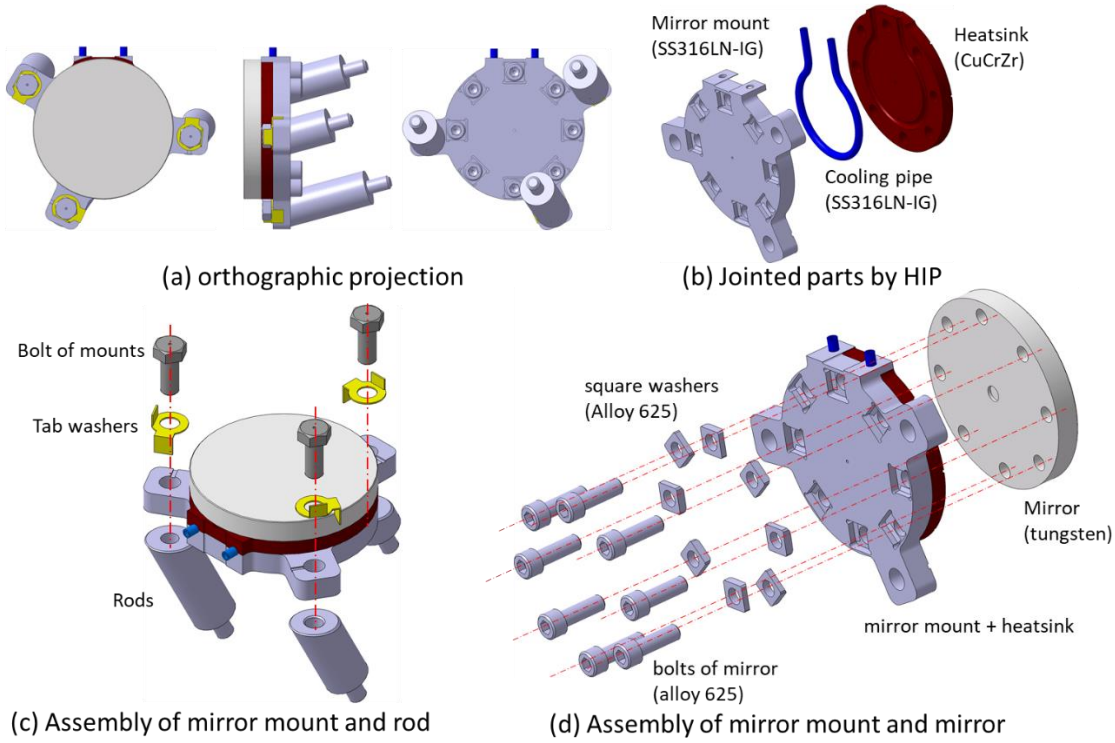


Figure 6. Components associated with mirror mount.

5. Technical Specification

5.1. Functional Specifications

Optical function

− To transmit the FIR laser of wavelength of 118.8 μm.

Mechanical function

− To cool the mirrors and the supports so that thermal deformations are less than (or equal to) the allowable tolerances based on the optical design requirements specified in Section 5.3 (6).

− To maintain the structural integrity under the expected loads so that no cooling water leaks into the vacuum vessel.

5.2. Environmental Specifications

Plasma discharge

The thermal conditions for EMM during plasma discharge are given in Table 2.

Table 2 Thermal load condition for EMM

Item	Value
Radiation heat load to mirror	694 W/m^2
Nuclear heat load to mirror	1.0 MW/m^2
Mass flow	0.18 kg/s (total) (0.09 kg/s for UEMM) (0.09 kg/s for LEMM)
Temperature of coolant water	70 °C
Inlet pressure of coolant water	4.8 MPa

Baking

During baking, the cooling water temperature is 240°C, and the pressure of cooling water is 4.8 MPa.

5.3. Design Specifications

(1) Equipment Class

The classifications of EMM components are shown in Table 3. PoPola's in-vessel components, including the EMM, are non-SIC equipment.

Table 3 Classifications of EMM

Safety Class	Safety Fanction	Seismic Class	Quality Class	Vacuum Class	RH Class	ESP/ESPN
Non-SIC	N	SC2	QC1	VQC-1A	non-RH	N3 Cat 0

(2) Applicable codes and standards
- (a) ESP/ESPN
- (b) The International Organization for Standardization (ISO).
- (c) RCC-MRx 2015 for manufacturing
- (d) SDC-IC for design [2]
- (e) ITER Vacuum Handbook [3]
- (f) ITER Material Properties Handbook [4]

(3) Dimensions

See the drawing [5].

(4) Parts and materials

The drawing [5] specifies materials and weights. Table 4 shows the summary of the material list.

Table 4 Material list of EMM

No.	Material	Component name
1	SS316LN-IG	– Mirror mounts – Rods – Baseplates – Connecting rod – 1/4’ cooling pipes – 3/8’ cooling pipes – Reducers – Pipe supports – Bolts – Washers – Nuts
2	Pure Tungsten	Mirrors
3	CuCrZr	Heatsink
4	Alloy 625	Bolts

The materials in Table 4 shall comply with the ITER Material Properties Handbook (MPH) [4]. It is necessary for manufacturer to prepare traceable documents such as mill test certificate and inspection documents complying with EN10204 type 3.1.

Special requirements related to material specifications are as follows:

Requirement on SS316L(N)-IG

- The chemical composition of SS316L(N)-IG shall be Table 5 that is copied from MPH [4].
- Following the specification on heat treatment conditions described in MPH [2], steel products that have been exposed to temperatures of 1050 °C to 1150 °C then rapidly cooled using solution heat treatment shall be used.
- A manufacturer shall prepare technical requirements specified in a purchase order in compliance with RCC-MRx RM 011-1. When employing RM 011-1.1 “General case”, the manufacturer can select either one of RM 032, RM 332-1, RM 332-2, RM 332-4 or RM 332-5. Mechanical tests of material depend on the selection. Whichever the manufacturer selects, the chmical composition of SS316L(N)-IG in MPH [4] shall be satisfied.
- Section 5.3 of IVH [3] shall be complied.
  - When the final thickness is less than 5 mm, the material needs to be made from cross-forged material which is Electro-Slag Remelted (ESR) or Vacuum Arc Remelted (VAR). The rate of inclusions in such steels shall be checked in accordance with ASTM E-45 Method D (or equivalent) to be within the following inclusion limits: Inclusion Type A-C ≤ 1.0 and Inclusion Type D ≤ 1.5.
  - When the final thickness between 5 mm and 25 mm, products shall be manufactured from approved steel (listed in IVH Appendix 3 [7]), in the form of stock which has been cross-forged (upset forged).
  - When the final thickness is more than 25 mm, no requirements are specified in Section 5.3 of IVH [3]

Table 5. Chemical composition of SS316L(N)-IG (wt.%)

	316L(N)-IG ITER grade
	max or range
C	0.030
Mn	1.60-2.00
Si	0.50
P	0.025
S	0.010
Cr	17.00 - 18.00
Ni	12.00 - 12.50
Mo	2.30 - 2.70
N	0.060 - 0.080
Cu	0.30
B	0.0020
Co	0.05
Nb	0.01
Ta	0.01
Ti	0.10

Requirements on Pipe

EMM uses two kinds of pipes; OD1/4″ and OD3/8″. The first pipe is the outer diameter is 1/4″ (=6.35) mm, and the thickness is 1 mm. The second pipe is the outer diameter is 3/8″ (=9.35) mm, and the thickness is 1 mm. The dimensions comply with “CAD Manual 12-2 Piping Design” [8]. The thickness of the both pipes comply with requirements on the thickness defined in RCC-MRx RB 3632. The both pipes need to be inspected complying with NF EN 10216-5 that is referred by RCC-MRx.

According to Section 12.1 of IVH [3], the pipe shall be seamless one. Figure 7 shows the requirements of pipe material copied from Section 12.1 of IVH [3].

A manufacturer shall prepare technical requirements specified in a purchase order in compliance with RCC-MRx RM 011-1. When employing RM 011-1.1 “General case”, the manufacturer can select either one of RM 034, RM 334-1, or RM 334-2. Mechanical tests of material depend on the selection. Whichever the manufacturer selects, the chmical composition of SS316L(N)-IG in MPH [4] shall be satisfied

> For VQC 1A and VQC 2A, & VQC 4A (process to insulation vacuum) pipework of wall thickness less than 2.0 mm designed to contain helium, Electro-Slag Remelted (ESR) or Vacuum Arc Remelted (VAR) material shall be used for the pre-extruded material and the inclusion limits of Section 5.3 adhered to.

Figure 7. Requirements of pipe material copied from Section 12.1 of IVH [3]

Requirements on tungsten

The chemical composition of pure sintered tungsten shall be 99.96% W. The chemical composition ratios in MPH [4] shall be satisfied.

Requirements on CuCrZr

The CuCrZr shall comply with UNC C18150 standard CuCrZr as described in the IVH Appendix 3 [7] or, CuCrZr specified as ITER Grade having a chemical composition of 0.6% to 0.9% Cr, and 0.07% to 0.15% Zr as described in MPH [4].

(5) Surface profile

Regarding laser reflective surfaces, surface roughness (Ra) needs to be 10 nm or less

and flatness needs to be 5,940 nm or less (less than 1/20 of the laser wavelength of 118.8 μm). Taking into account the acheivement of the prototype manufacturing, the specification of the flatness of the product is 1 μm or less.

Regarding all other surface finishes, the maximum average surface roughness (Ra) shall be 6.3 μm or less according to the requirements for VQC 1 components in Section 8.1 “Surface Roughness" of IVH [3]. An extract of the relevant maximum average surface roughness requirements for VQC 1 components copied from IVH [3] is shown in Figure 4.

8 Surface Finish

8.1 Surface Roughness

Metallic components for different VQC shall be supplied with the maximum average surface roughness listed in Table 8-1. Surface roughness is defined in accordance with ISO 4287: 2000.

Classification	Maximum average Surface Roughness Ra (μm)	Measurement Technique
VQC 1	6.3	Electric stylus
VQC 2	12.5†	Electric stylus
VQC 3	12.5	Electric stylus
VQC 4	12.5	Electric stylus

† Where to satisfy this surface roughness requirement additional machining would be required a rougher surface is accepted provided the surface is easily cleanable and can be shown not to catch fibres when wiped with a lint free cloth.

Figure 4. Requirements of surface roughness copied from IVH [3]

(6) Mirror angles of EMM

- Tolerance of relative mirror angle between the first mirror and the second mirror is ±0.16° [9].
- The out-of-plane deformation of the mirror shall be 10 μm or less [10].

(7) Welded Joints

The welded joints of the EMM are shown in Figure 8, and the specifications of each joint are given in Table 6. The manufacturer shall comply with requirements that both IVH and RCC-MRx specify.

Requirements from IVH

The manufacturer shall carry out qualification and welding in accordance with IVH Attachment 1 [6], which is based on the international standards ISO 9606, ISO 15614 and ISO 15609. Figure 9 shows the applicable standards regarding welding.

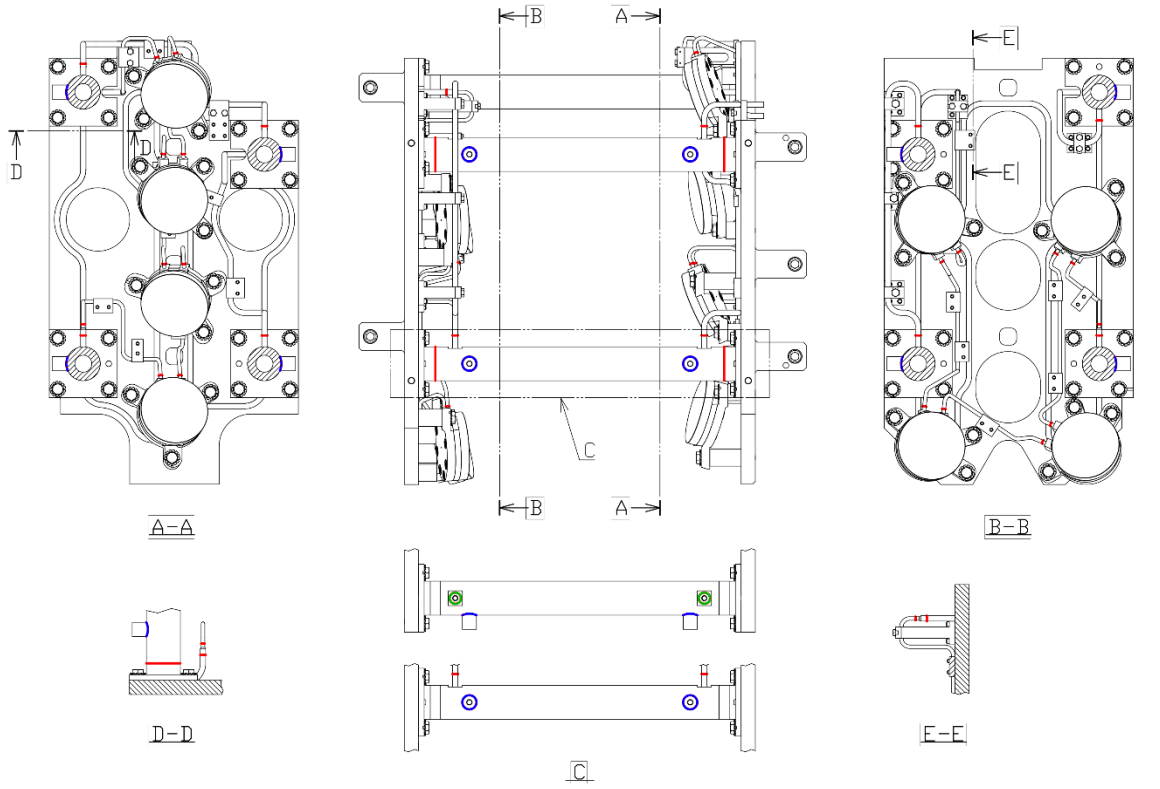
Because the vacuum equipment class of EMM is VQC1A, 100% volumetric inspection (RT or UT) shall be performed for the pressure-retaining joints that form the cooling water boundary (red lines in Figure 8) in accordance with Section 7.1.4 “Inspection and Testing of Production Welded Joints" of IVH [3] (see Figure 10). The standards for the welding procedures and post-weld inspections are given in Figure 9.

If conducting penetrant testing for surface inspections, the PT shall be carried out in accordance with the procedures approved by the ITER Organization, including removal of the testing liquid.

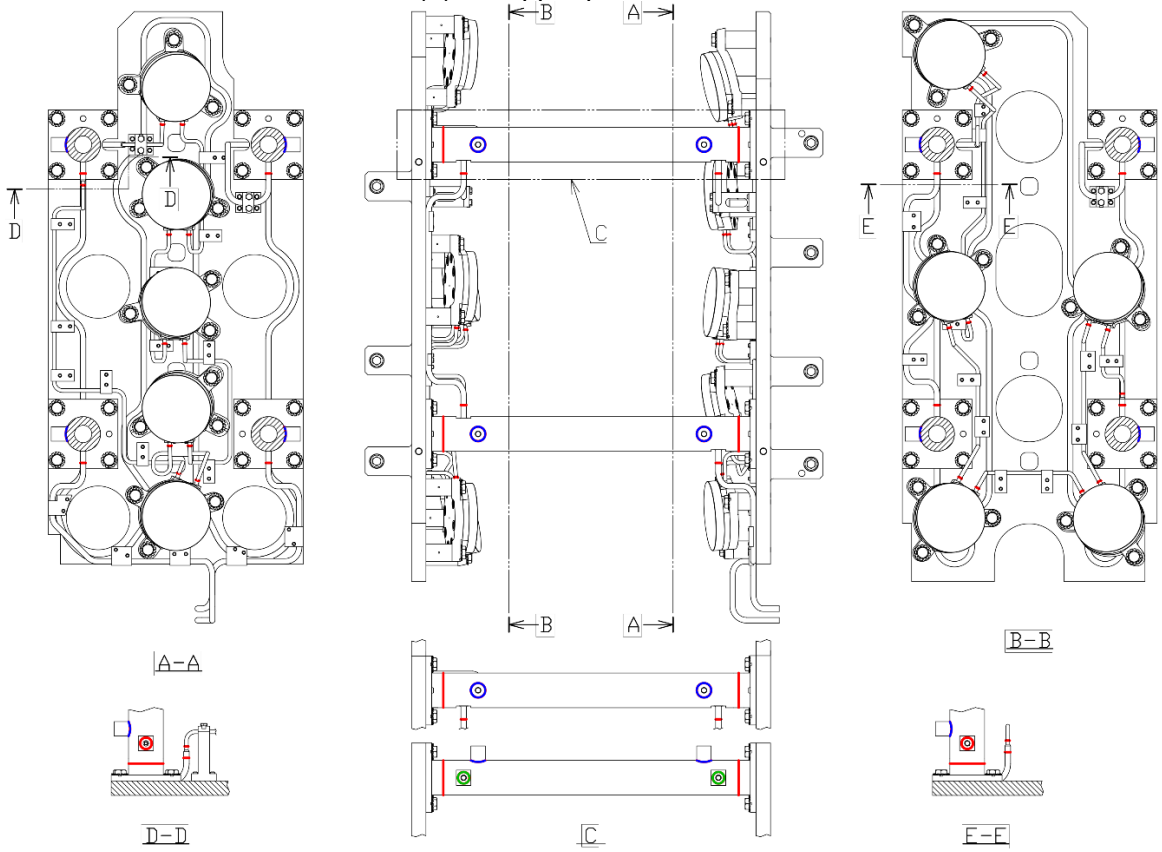
Helium leak tests shall also be performed in accordance with "7.1.6. Helium Leak Testing of Production Welds" (see Figure 10). Leak test procedure manuals shall be prepared in advance and approved by ITER Organization. In case of leak test failure, mutual agreement concerning corrective measures is necessary prior to re-executing

the leak tests.

The manufacturer shall comply with the reuiqrements regarding tests such as acceptance levels and the total number of tests are specified by IVH Attachment 1 [6]. For example, Figure 11 shows the acceptance levels specified in IVH Attachment 1.



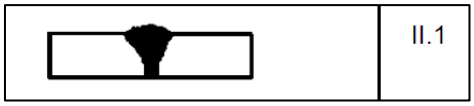
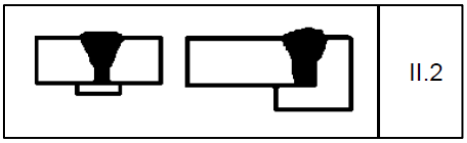
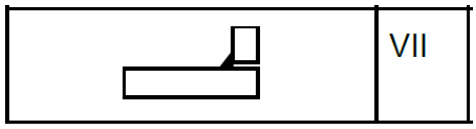
(a) the upper part of EMM



(b) the lower part of EMM

Figure 8. Welded joints of EMM

Table 6. Specification of types of welded joint

Color code	Pressure-containing member [1]	Type of welded joint [2]
Red	Yes	
Green	Yes	
Blue	No (Welded joints at a threaded boss that is used just for assembly)	

[1] According to ASME PTC 23 defition, pressure contaiing member means a component which is exposed to and contains pressure, and pressure retaining member means a component which holds one of more pressure containing members together but is not exposed to the pressure.

[2] Types of welded joint is defined in Table IC 4012-1 of SDC-IC.

ISO 15607	Specification for the qualification of welding procedures for metallic materials – general rules
ISO 15614	Specification and qualification of welding procedures for metallic materials-welding procedure test
ISO 15609	Specification and qualification of welding procedures for metallic materials – Welding procedure specification
ISO 17637	Non-destructive examination of fusion welds. Visual examination.
ISO 4063	Welding and allied processes – Nomenclature of processes and reference numbers.
ISO 3452	Non-destructive testing. Penetrant testing.
ISO 17638, ISO 9934	Non-destructive examination of welds. Magnetic particle examination of welds
ISO 17636	Non-destructive examination of welds. Radiographic examination of welds.
ISO 17640	Non-destructive examination of welds. Ultrasonic Examination.
ISO 9606-1	Qualification test of welders – Fusion welding – Part 1: steels.
ISO 9606	Qualification test of welders – Fusion welding – Part 2: aluminium and aluminium alloys.
ISO 14344	Welding and allied processes – Flux and gas shielded electrical welding processes – Procurement guidelines for consumables.
ISO 5817	Fusion welded joints in steel, nickel, titanium and their alloys (beam welding excluded) – Quality levels for imperfections.
ISO 14732	Welding personnel. Approval testing of welding operators
ISO 9712	Non-destructive testing - Qualification and certification of NDT personnel
ISO 22825	Non-destructive testing of welds - Ultrasonic testing - Testing of welds in austenitic steels and nickel-based alloys
ISO 10380	Corrugated metal hoses and hose assemblies

Table 4-1 Standards relating to welding

Figure 9. Standards relating to welding copied from IVH Attachment 1 [6].

7.1.4 Inspection and Testing of Production Welded Joints

All such inspection and testing shall be carried out using approved procedures in accordance with Attachment 1.

For all VQC 1A, VQC 2A water boundaries and vacuum boundary welds which become inaccessible, 100% volumetric examination of production welds shall be performed, unless a method of pre-production proof sampling is approved.

7.1.6 Helium Leak Testing of Production Welds

All vacuum sealing welds in each VQC shall be subject to helium leak testing in accordance with the procedures of Section 25.

Where multi-pass welding is required in the production of components of VQC 1A and VQC 2A, it is recommended that leak testing of the root weld pass shall be performed with only this pass completed. However, for multi-pass welding that takes place on the ITER site, this requirement is mandatory.

Figure 10. Reference about welded joints in IVH [3]

Defect Type		Permitted maximum
Planar Defects	Cracks or lamellar tears Lack of root fusion Lack of side fusion Lack of inter-run fusion Lack of root penetration	Not permitted
Solid inclusions	Slag inclusions - individual	20% of t or 2 mm, which ever is smaller
	Slag inclusions - Group	Aggregate length not to exceed t in a length of 12 t, except when the distance between successive indications exceeds 6L where L is the longest indication in the group
	Inclusions – ***Tungsten*** or Copper	Not permitted
Cavities	Isolated pores - round	Diameter <20% t or 2 mm, whichever is smaller
	Gas pore uniformly distributed porosity	1% for single layer (2% for multi-layer) by area where the area of the radiograph to be considered is the length of the weld affected by the porosity times the maximum thickness of the weld
	Elongated pores - wormholes	***Not permitted***
	Linear Porosity	***Not permitted***
Profile defects	***Under cut***	***Some intermittent undercut permitted. Depth not to exceed 0.5 mm for t > 3 mm or 10% for t < 3 mm. Under cut to blend smoothly with the parent material.***
	Incompletely filled groove, sagging. Root concavity, shrinkage groove	0.05 t or 0.5 mm, which ever is smaller. Weld thickness shall not be less than the parent plate thickness
	Excess penetration - pipe	Not greater than 5% of the pipe internal diameter up to 2 mm max.
	Excess penetration – plate	t = 0.5 to 3 mm: , h ≤1 mm+10% b t > 3mm: h ≤1 mm+20% b max 3mm.
		h=height of excess penetration on backside of plate and b the width
	Excess weld material	Not greater than 10% weld width
	Misalignment	***Not greater than 10% of the parent material thickness***
	Fillet leg length (asymmetry)	Unequal leg length should not exceed 20% of the fillet throat thickness
	Burn through	Not permitted
Other	Root oxidation	Not permitted where a backing purge gas is specified in the WPS

Table 6-6 Acceptance levels

Figure 11 Acceptance levels of welding copied from IVH Attachment 1 [6].

Requirements from RCC-MRx

The manufacturer shall comply with the requirements that RCC-MRx specifies for Class N3 components. For instance, RCC-MRx Table RS 7462 (Figure 12) is applicable to the welding of the connecting rod, and RCC MRx RF 4351 (Figure 13) is applicable to the welding of 1/4-inch cooling pipes.

Table RS 7462: class $N3_{Rx}$ – maximum permitted reinforcements for arc-welded butt welds (electrons and laser beam exclude) – steels, nickel, titanium

	Maximum permitted reinforcements on the front side	**Maximum permitted reinforcements on the back side**
Welds with backing run	(502) 1/10 of the bead width + 2 mm **with a maximum of 5 mm**	(502) 1/10 of the bead width + 2 mm
Welds without backing run	(502) 1/10 of the bead width + 2 mm **with a maximum of 5 mm**	e/10 + 1 with a max of 3 mm (**1**)

(502 – 504): Excess weld metal – Excessive penetration. Cassification given in *NF EN ISO 6520-1* standard

(1) For butt welds on class $N3_{Rx}$ pipes, the permitted reinforcement on the back side (504) is increased to:

2 mm for e ≤ 5 mm 2.5 mm for 5 < e ≤ 10 mm 3 mm for e > 10 mm

- e : nominal thickness of the pipe

Figure 12. Example of requirements specified in RCC-MRx (maximum permitted reinforcement)

RF 4350 ALIGNMENT TOLERANCES FOR PIPES AND PIPING

RF 4351 Steels, nickel and its alloys

a. When the inside surfaces of butt welded counterbored pipe components are inaccessible, the inside diameters of the components shall be offset in accordance with the method given in **RF 4330**. In these cases, the maximum misalignment at any point around the joint shall not exceed 1.5 mm.

b. In order to butt weld welded steel pipe and fittings whose thickness-to-diameter ratio is such that the pipe cannot be counterbored and may be subject to deformation, the Manufacturer shall calibrate the end sections of the joint, when necessary, to meet the tolerance requirements given in a. above.

c. For longitudinal joints of welded pipe, the internal offset shall not exceed:

- 1 mm for e ≤ 20 mm
- e/20 (in mm) for 20 mm < e ≤ 40 mm
- 2 mm for e > 40 mm.

For small schedule pipes welded longitudinally using the TIG process, it is recommended that these values be reduced.

d. For large pipes manufactured from rolled and longitudinally welded heavy steel plate, the tolerance requirements given in **RF 4320** and **RF 4330** shall apply.

Figure 13. Example of requirements specified in RCC-MRx (alignment tolerances for pipes)

(8) Brazed joints

The 1/4'' pipes are brazed to the M1 and the M2 base plate. Filler material is Au-18%Ni (W32X33) that is approved in the material database (N3SVRJ). In accordance with Section 7.2.3 "Inspection and Testing of Brazed Joints" of IVH [3], to ensure that there are no voids or blowholes, the surface of the brazing filler metal shall be visually inspected to ensure that there are no visible signs of inclusions and that the braze has filled the joints without overspreading.

In order to qualify the brazing procedure, a factory qualification test [11] will be carried out. Test samples shall be made, and then tests such as visual inspections and outgassing tests shall be made. The brazing procedure qualified by the factory qualification test shall be applied to the production equipment. Should brazing corrective measures be required, mutual agreement among the contractor, JADA and IO-CT is necessary prior to re-brazing.

Figure 14 shows the relevant references that are specified in IVH [3].

7.2.3 Inspection and Testing of Brazed Joints

Brazed joints shall be subject to qualification to ensure the vacuum integrity of the joint.

All brazed joints shall be inspected visually to ensure that the vacuum exposed braze regions are clean, flush and free from voids, blowholes, etc., that there is no visible evidence of inclusions and that the braze material has filled the joint without excessive over-run.

Where practicable, radiography of an agreed percentage sample of brazed joints shall be carried out. Where this is not practicable, then samples shall be produced for sectioning and microscopic examination.

The use of liquid dye penetrant or magnetic particle techniques shall not be permitted for the inspection of brazed joints or in the inspection of joint preparations.

All brazed joints which form part of a vacuum boundary shall be subject to 100% helium leak testing.

No braze shall be re-run for rectification of any sort without prior agreement.

Figure 14. Reference about brazed joints in IVH [3]

(9) Summaryu of Testing and Inspection

Table 7 shows the tests and inspections to be performed on production of EMM.

Table 7 Inspection and testing for CBRR

Test item		Reference standard	Remarks
Visual inspection		—	—
Dimensional inspection		—	Use calibrated instruments to measure component dimensions.
Surface inspection (roughness and flatness) of mirrors		—	See 5.3 (5)
Inspection of mirror angle		—	See 5.3 (6) and 5.4 Process C
Welding inspection	Visual inspection	ISO 17637	—
	Penetrant testing (PT)	ISO 3452	—
	Radiographic testing (RT)	ISO 17636	—
	Ultrasonic testing (UT)	ISO 17640	—
	Pressure tests	RCC-MRx RB 5200	—
	Helium leak tests	RCC-MRx RMC 7400 (ITER Vacuum Handbook 25. And Appendix12)	—
Destructive test of HIP joint		—	See 5.4 Process B
Thermal cycling tests		—	Unwitnessed inspection to check for initial defects (assuming three cycles at temperatures of 50°C/h or more))
Flow test		—	Unwitnessed inspection to confirm that there are no problems such as pressure loss due to blockage of the flow path.

(10) Outgassing requirements

Outgassing tests are required for all in-vessel components, according to IVH [3]. The allowable amount of gas release is defined in Section 5.4 “Outgassing" of IVH [3] according to its vacuum equipment class. The EMM is class VQC1A, which specifies maximum steady-state gas emissions of 1×10^{-7} Pa m^3 s^{-1} m^{-2} for hydrogen isotopes and 1×10^{-9} Pa m^3 s^{-1} m^{-2} for impurities.

Outgassing measurements are not performed on production equipment, instead, the satisfactionof the outgassing requirements are verified by the factory qualification. The manufacturing process of the procuts shall be identical with what is verified by the factory qualification.

(11) Baking requirements

The components and parts comprising the EMM shall be baked in accordance with the baking reference temperatures and baking times (Table 8) in IVH Appendix 15 [12].

Table 8 Standard temperatures and durations for vacuum baking

Vacuum Classification	Temperature (°C)	Time (hr)	Comment
VQC 1	240	24	
VQC 1*	350	24	Stainless steel and beryllium
	450 - 2000	24	Carbon composites (see Appendix 16)
	250	24	Precipitation-hardened copper alloys
	350	24	Tungsten

* For vacuum items in line vicinity of plasma

(12) Cleanliness requirements

After surface finishing, components are to be degreased using a solvent or alkaline detergent, then washed using desalinated water, then dried, in compliance with IVH Appendix 2 [13]. For washing/cleaning procedures, refer to IVH Appendix 13 [14]. Only use cleaning and degreasing procedures approved by the ITER Organization on production equipment.

For the area after final washing, the number of suspended particles shall be monitored to ensure that particles larger than 0.5 μm do not exceed $5\times10^6/m^3$, in accordance with the requirements for VQC1 equipment in IVH Appendix 2 [13]. All other products after final washing are to be handled under the environment shown in Table 9.

Table 9 Environmental cleanliness pertaining to VQC copied from IVH Appendix 2 [13].

VQC	Cleanliness requirements	Personnel	Area Cleanliness	Monitoring
1	Segregated clean area. Limited Access to authorised personnel. Authorised equipment operated to approved procedures. Management of equipment (e.g. no vacuum pumps exhausting into clean area)	Trained personnel. Protective hair nets. Powder free latex or nitrile outer gloves. Clean white overalls. Overshoes. Clean job specific footwear	Daily Cleaning of area including floors and surfaces. Sticky mats at area entry	Daily air quality checks. Results stored in component document package. Weekly cleanliness test of area with results stored in component document package
2	Authorised equipment operated to approved procedures. Management of equipment (e.g. no vacuum pumps exhausting into clean area)	Trained personnel Powder free latex or nitrile outer gloves for the handling of clean equipment	Daily Cleaning of work area including floors and surfaces.	
3&4	House Keeping	Trained personnel. Powder free latex or nitrile outer gloves for the handling of clean equipment	Daily cleaning of area.	

(13) Packaging specifications

For the packaging of equipment after manufacture, refer to Section 29 “Packaging and Handling of Vacuum Equipment” of IVH [3]. The packaging conditions shall, in principle, be as follows.

- All packages shall be enclosed in polyethylene containers filled with dry air having a moisture content of less than 4000 ppm, the outside of which shall be clearly labeled as VQC equipment in English.
- Ensure pipe interfaces are protected.
- If using tape for protection and packaging of austenitic stainless steels, use tape(s) that satisfies the leaching limits for chlorides (15ppm) and fluorides (10ppm).
- After any tape has been removed, acetone or a similar solvent shall be used to remove all traces of the adhesive.
- Packing workers shall wear clean, powder-free latex or nitrile gloves and clean white overalls.

5.4. Specification of manufacturing process

Figure 15 to Figure 21 show a plan of the manufacturing process of EMM, and processes A to C in these figures are the special processes. The explanations of the special processes are given below. In principle, the machining oils and cleaning solutions described in IVH Appendix 4 [15] shall be used in the manufacturing processes.

Process A: Welding

The type of welding of cooling pipes is a butt welding, and an automatic welding machine will be used. The non-destructive inspection for the welding part must meet the criteria specified in ISO 5817 quality level B (defect size d ≤ 0.2s, max 2 mm (s: throat thickness of butt weld), etc.).

Process B: HIP (Hot Isostatic Pressing)

HIP process is applied to manufacture mirror mount assembly in order to bond a heatsink, a cooling pipe and a mirror mount. Nineteen mirror mount assemblies are manufactured in the same batch, and one of them is a sample that is used for destructive inspection.

Process C: Adjustment of mirror angle

Targets for laser position are used in order to adjust the mirror angles. The targets are set at the position of the vacuum windows and the retroreflectors. Mirror angles are adjusted so that the laser light beam passes through the center of the target. Shims are inserted between the mirror mount and the rods to adjust the mirror angle.

Figure 15 to Figure 21 are schematics of the manufacturing process, and detailed explanation is given by Reference [16]. The manufacturer can propose another manufacturing process by the manufacturing readiness review.

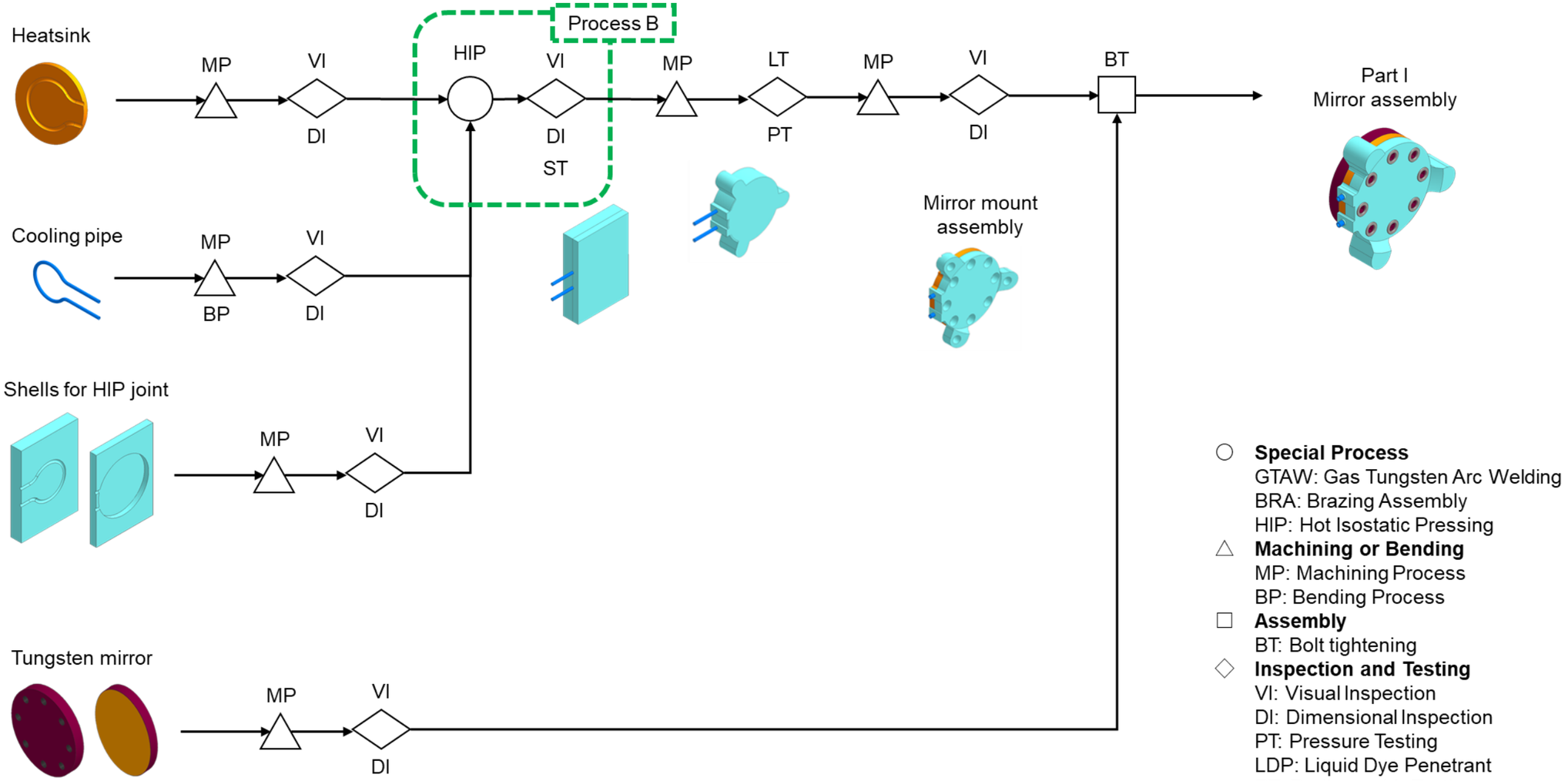


Figure 15 Manufacturing process of EMM (1/7)

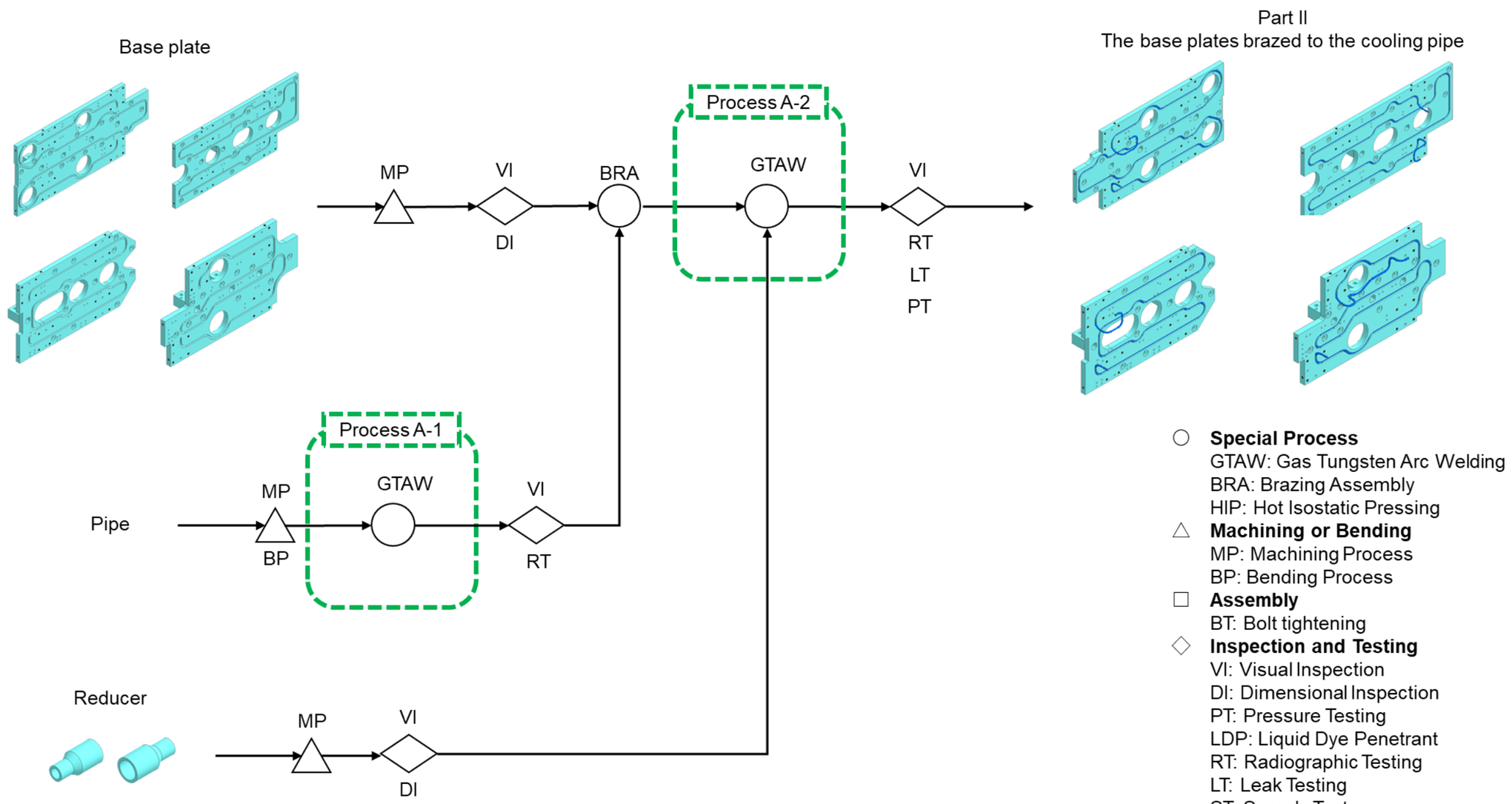


Figure 16 Manufacturing process of EMM (2/7)

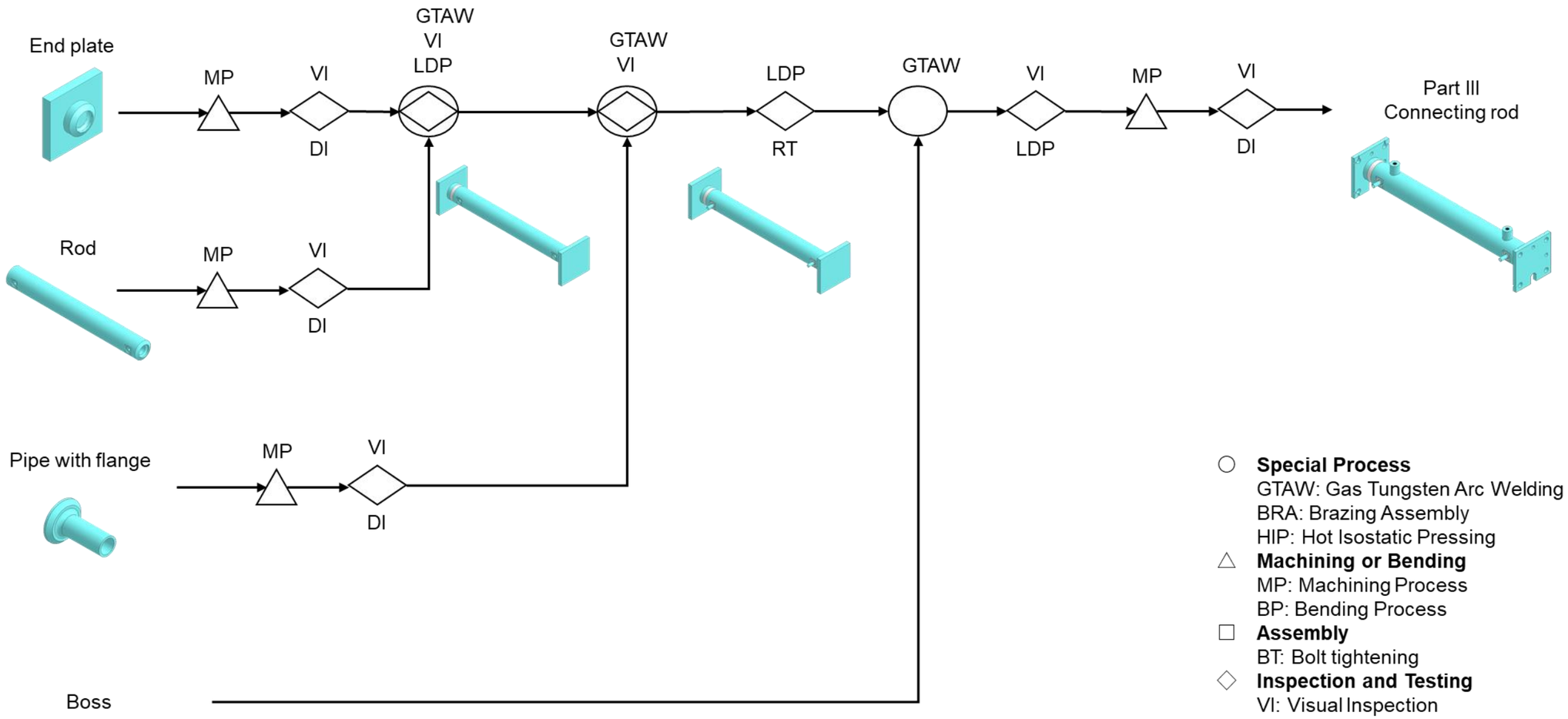


Figure 17 Manufacturing process of EMM (3/7)

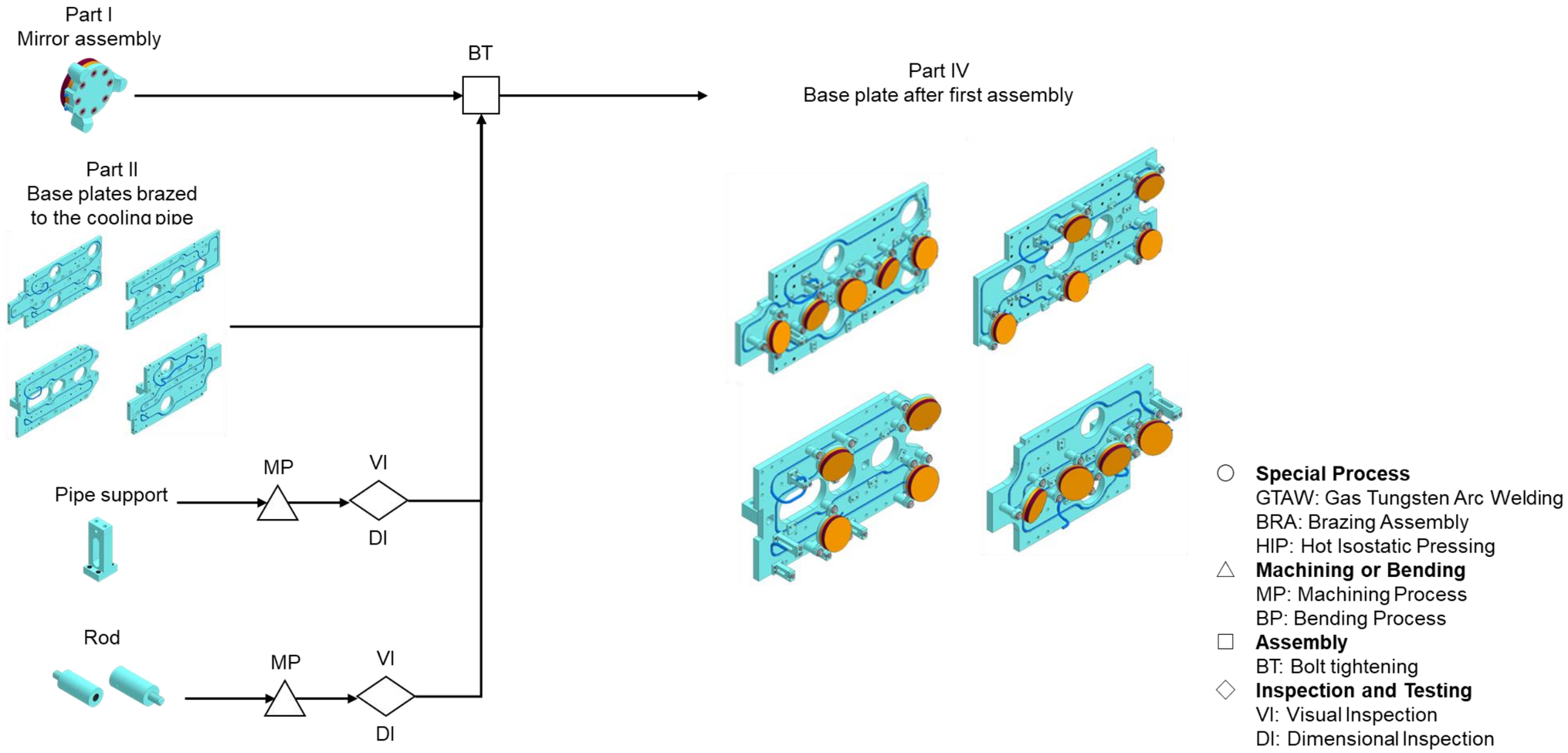


Figure 18 Manufacturing process of EMM (4/7)

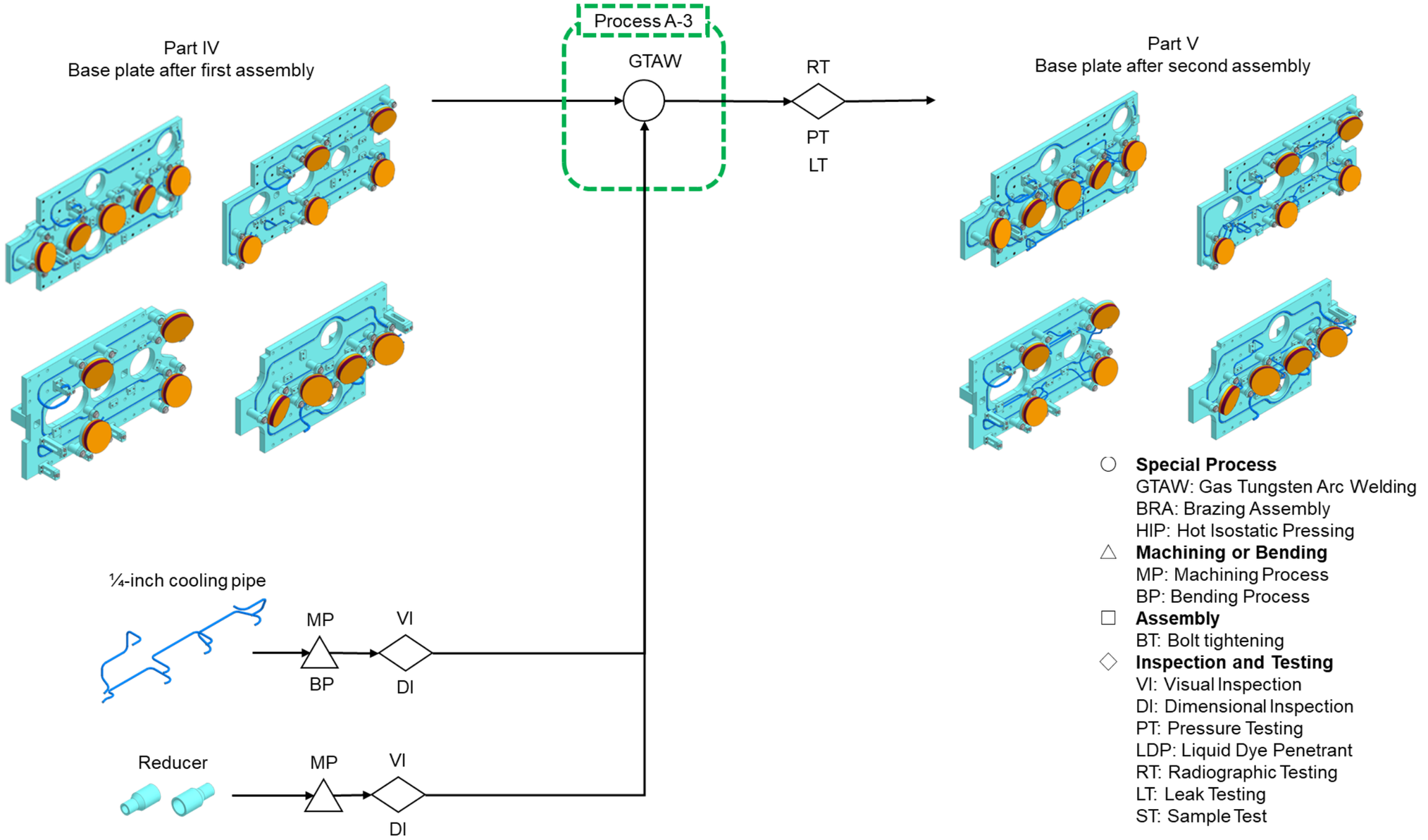


Figure 19 Manufacturing process of EMM (5/7)

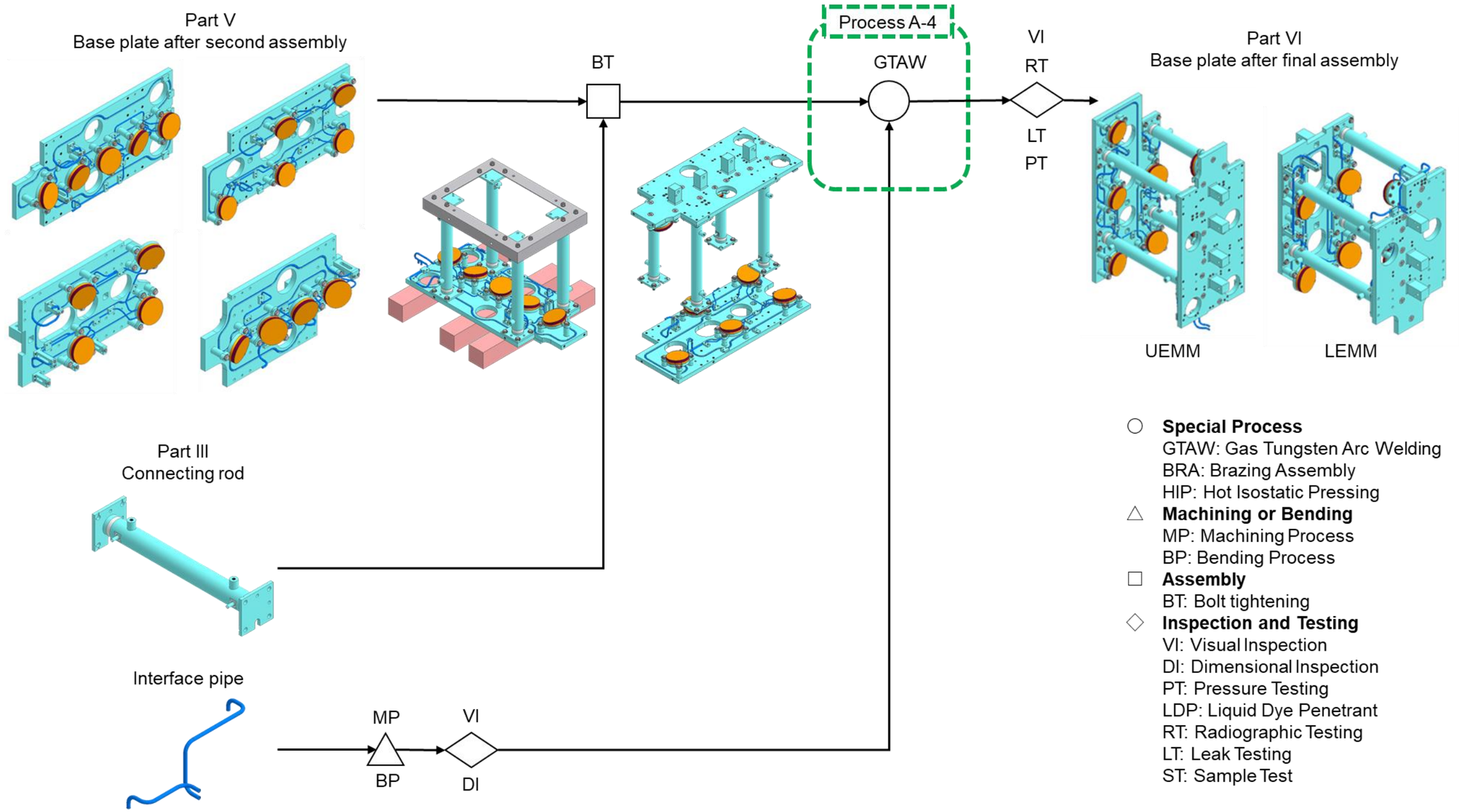
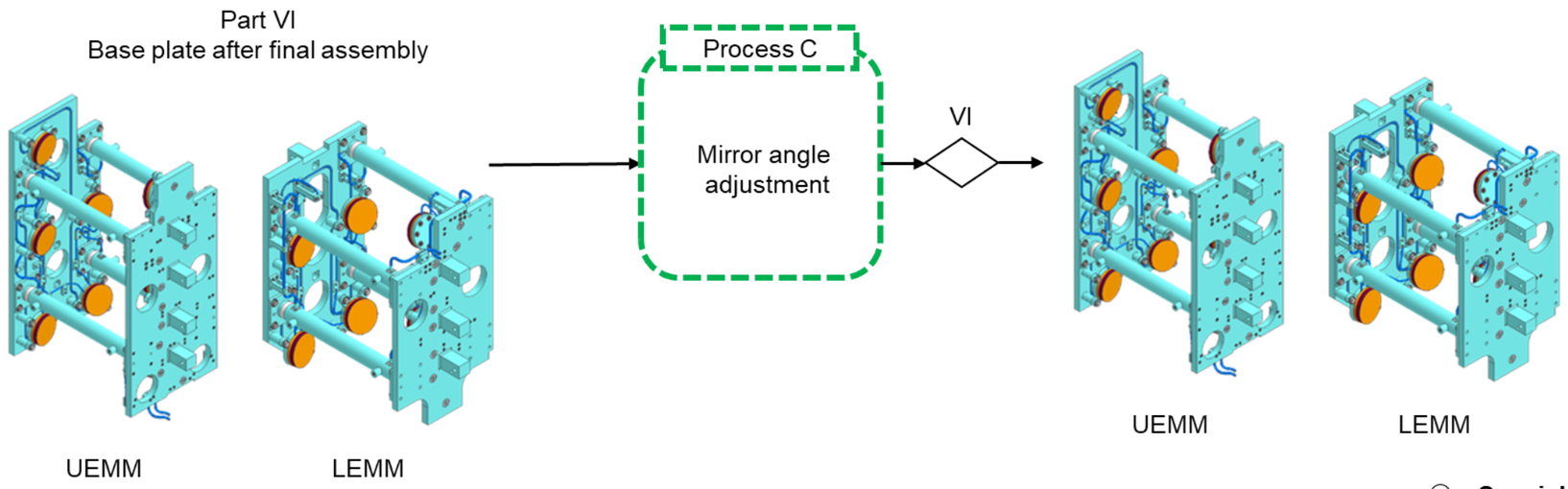


Figure 20 Manufacturing process of EMM (6/7)



○ **Special Process**
GTAW: Gas Tungsten Arc Welding
BRA: Brazing Assembly
HIP: Hot Isostatic Pressing

△ **Machining or Bending**
MP: Machining Process
BP: Bending Process

□ **Assembly**
BT: Bolt tightening

◇ **Inspection and Testing**
VI: Visual Inspection
DI: Dimensional Inspection
PT: Pressure Testing
LDP: Liquid Dye Penetrant
RT: Radiographic Testing
LT: Leak Testing
ST: Sample Test

Figure 21 Manufacturing process of EMM (7/7)

JADA-55342DE0101-1
ITER_D_696XRM

Technical Description of PoPola Mirror Modules in Equatorial Port Plug 10

ITER Project Japan Domestic Agency

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Change log

Brunch no. (date) (IDM version)	Change description
- (20 Oct 2021) (696XRM v1.0)	First version
1 (19 Jan 2022) (696XRM v1.1)	– Explanation about RH operation in the hot cell facility are added to Section 9.
	–

Table of Contents

Abbreviations:

See ITER_D_2MU6W5 for abbreviations that are standard in ITER. Other special abbreviations are given below.

- EMM: EPP Mirror Module
- EPP: Equatorial Port Plug
- ESP: French regulation for Pressure Equipment
- ESPN: French regulation for Nuclear Pressure Equipment
- FIR: Far Infrared Ray
- HIP: Hot Isostatic Pressing
- LEMM: Lower EMM
- PoPola: PBS.55.C6 Poloidal Polarimeter
- StIR: Structural integrity report
- UEMM: Upper EMM

Reference:

[1] sub-SRD-55.C6, ITER_D_WYPRU9
[2] Technical Specification, ITER_D_696KB9 (or JADA-55342TS0106)
[3] Interface sheet with EPP10, ITER_D_UDPYGC
[4] SDC-IC, ITER_D_222RHC
[5] Load specifications, ITER_D_QWUFY2
[6] ITER Vacuum Handbook, ITER_D_2EZ9UM
[7] Components Classification BOM, ITER_D_RBZBEQ
[8] Optical Analysis and Design of PBS.55.C6 PoPola, ITER_D_RC2LB5 (or JADA-55332TS0022-1)
[9] Drawing of Mirror Modules in EPP10: ITER_D_5R3R6W
[10] Assembly drawing: to be uploaded to SMDD
[11] Structural Integrity Report, ITER_D_3DYHEQ
[12] Chit resolution report for PoPola CDR Chit #17 “Effect of potential bending of the flat plasma-facing mirrors”, ITER_D_UVR9CH
[13] Factory qualification test plan, ITER_D_69765M (or JADA-55342PL0101)
[14] 55.C6- Test Plan in PPTF for EP10 system ITER_D_WSSRAR (or JADA-55342TS0013)
[15] Maintenance and inspection plan, ITER_D_RTP6D8 (or JADA-55342TS0035)
[16] Remote Handling Compatibility Assessment of PBS.55.C6 PoPola, ITER_D_RRNUR9 (or JADA-55332TS0029)
[17] Decommissioning plan, ITER_D_RU2C32 (or JADA-55332TS0039)
[18] 55 C6 Manufacturing Assessment of PoPola Mirror Modules in Equatorial Port Plug 10, ITER_D_696RYF (or JADA-55342TS0102)

1 Introduction

The primary aim of the PoPola is to measure the change of polarization of injected far-infrared (FIR) laser light in order to identify the profile of plasma current, or equivalently safety factor. There are thirteen PoPola measurement channels to accomplish this measurement task. Each channel is comprised of a set of optical components that launch a laser beam from Equatorial Port Plug 10 (EPP10) or Upper Port Plug 10 (UPP10) across the plasma to a retroreflector. Figure 1 and Figure 2 show an overview of the PoPola viewing chords and the PoPola in-vessel components, respectively. Especially, components in the scope of this documents are the mirror module in EPP10. It is called EMM (EPP Mirror Module) and consists of two parts. The upper part is called UEMM (Upper EMM), and the lower one is called LEMM (Lower EMM).

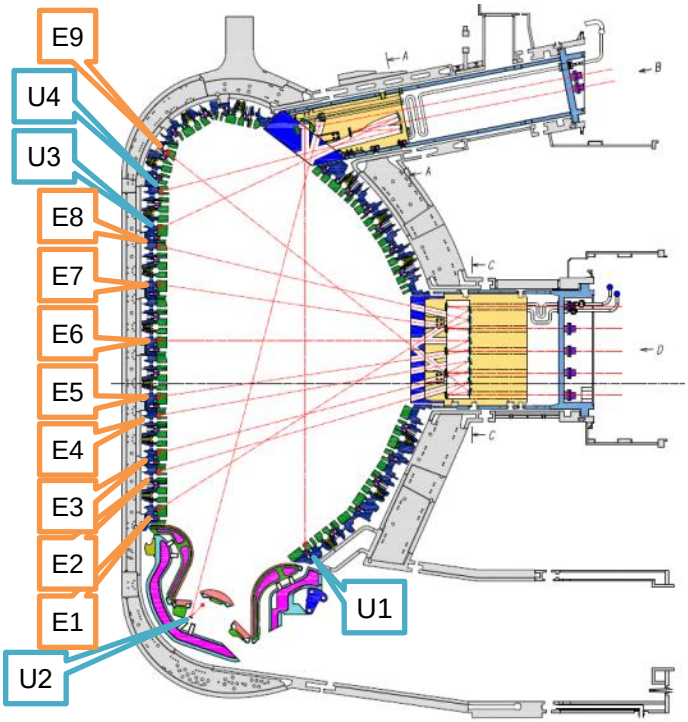


Figure 1 Overview of PoPola viewing chords

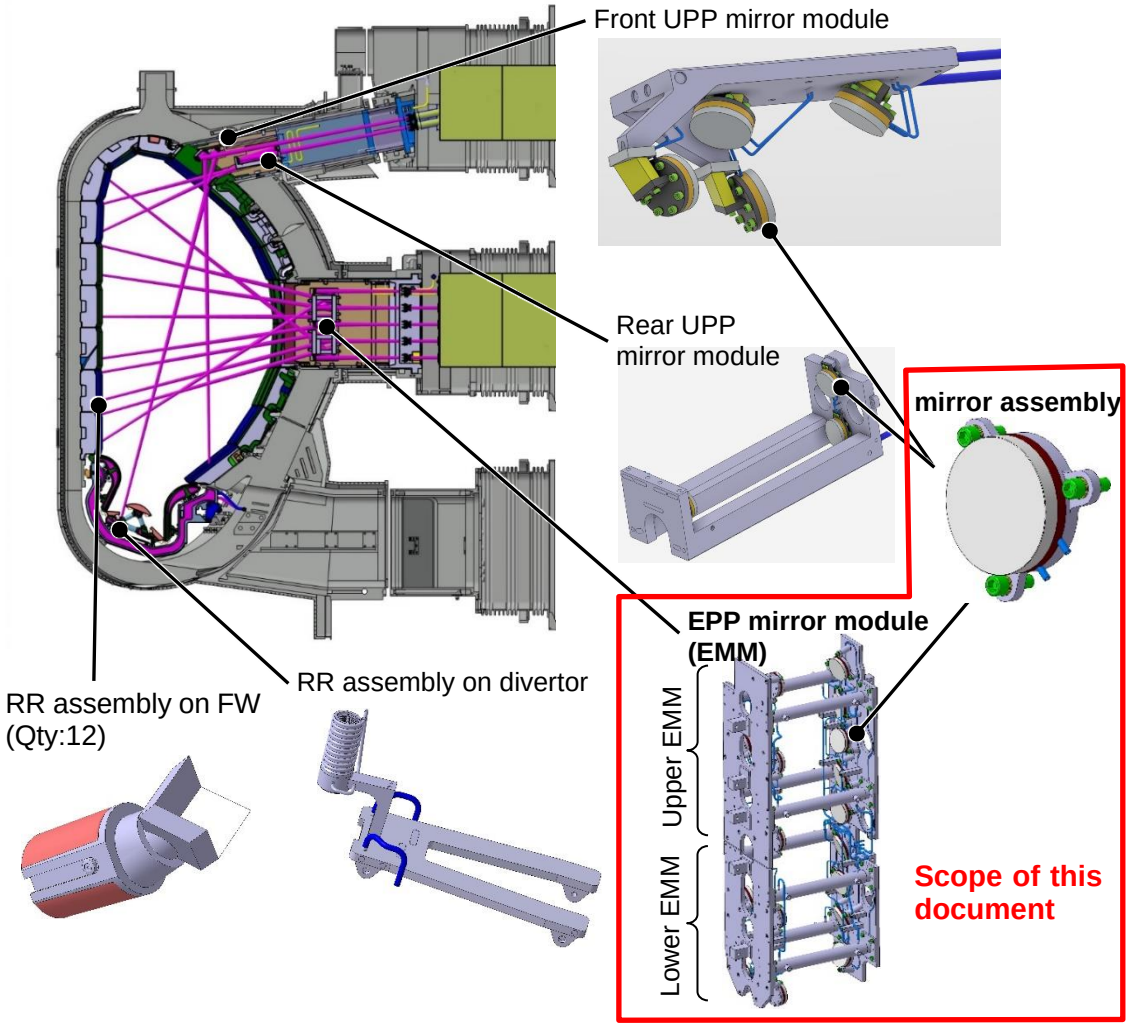


Figure 2 PoPola in-vessel components

2 Purpose

The purpose of this document is to provide design description of UEMM and LEMM.

3 Scope

As explained in Section 1, the components in the scope of this documents are UEMM and LEMM. Figure 3 and Figure 4 show the CAD images of them. Section 5 provides detailed explanation on the component design.

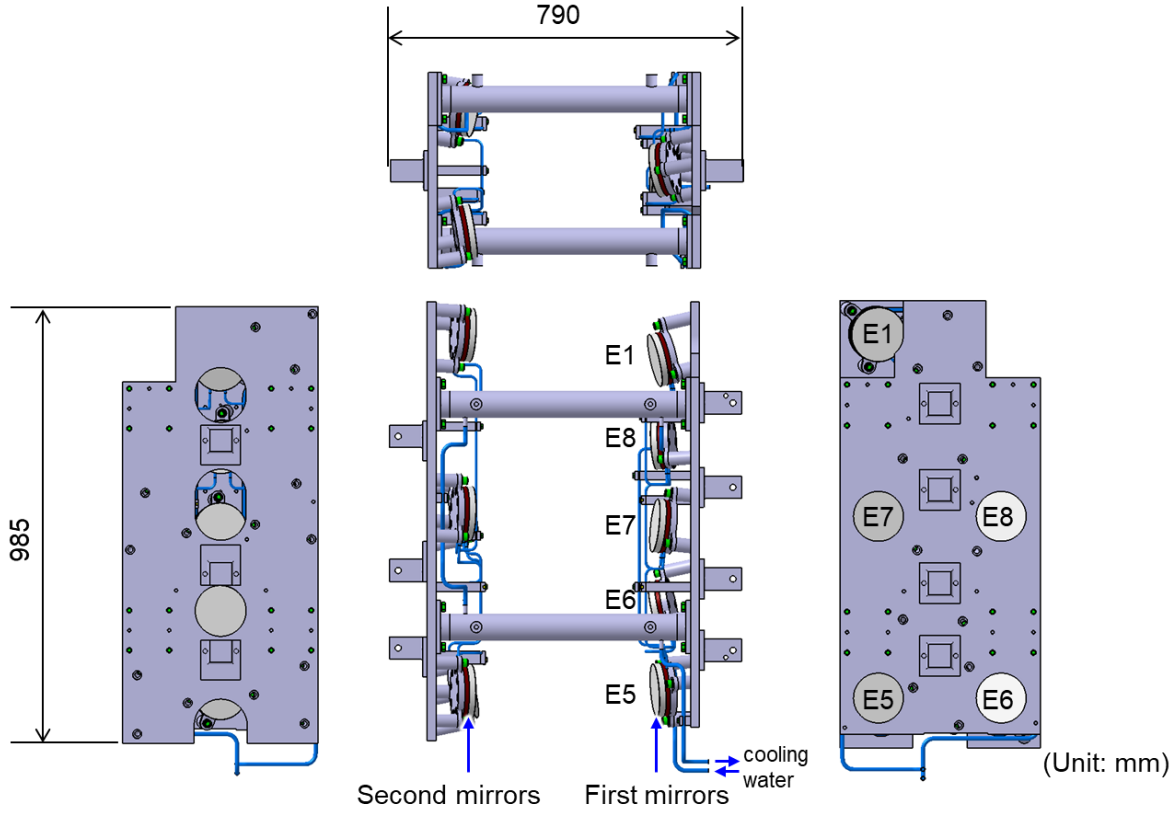


Figure 3 UEMM (Upper part of EPP Mirror Module).

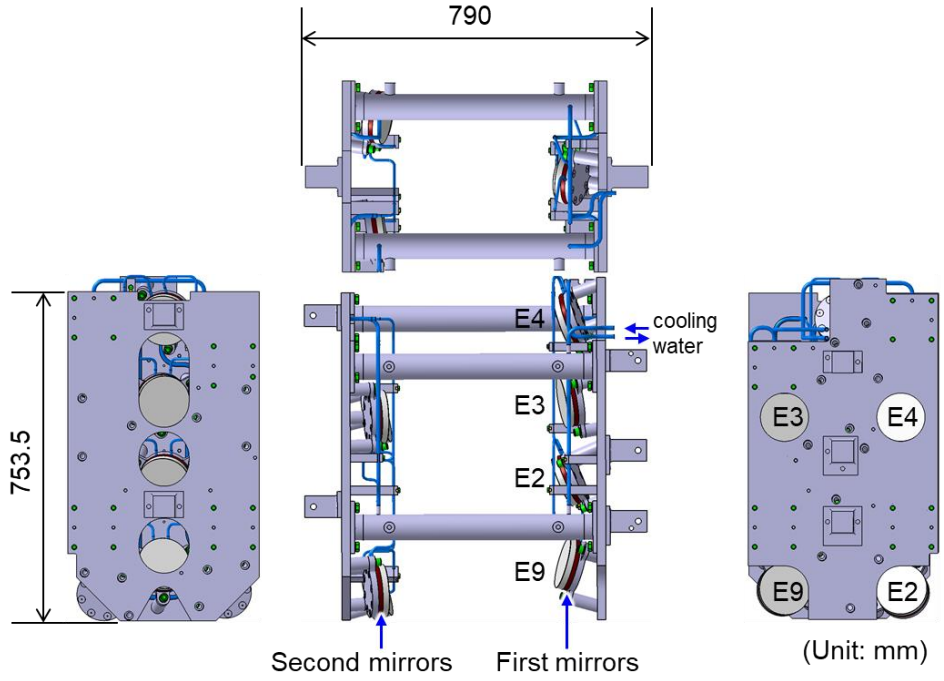


Figure 4. LEMM (Lower part of EPP Mirror Module).

4 Requirements

Applicable documents regarding the requirements are as follows.

- sub-SRD-55.C6 [1]
- Technical Specification of PoPola Mirror Module in Equatorial Port Plug 10 [2]
- Interface with EPP10 [3]
- SDC-IC (for design) [4]
- RCC-MRx 2012 (for manufacturing)
- ITER Vacuum Handbook [6]
- Load specifications [5]

The EMM's functions are as follows.

- To transmit the FIR laser beam.
- To transport the nuclear and radiation heat loads from EMM to cooling water.
- To ensure the confinement of the cooling water.
- To achieve low outgassing rate described in ITER Vacuum Handbook [6].

The document, "Technical specifications of PoPola Mirror Module in Equatorial Port Plug 10" [2], provides detailed specifications necessary for achieving the functions above.

Requirements given by ITER guidelines such as ITER Vacuum Handbook depend on the classification of the component. "Components Classification BOM" [7] provides the component classification, which are shown in Table 1.

Table 1 Classification table of UEMM and LEMM (Copy from BOM [7])

Safety Class	Safety Function	Seismic Class	Quality Class	Vacuum Class	RH Class	ESP/ESPN
Non-SIC	N	NSC	QC2	VQC-1A	RH-3	Cat 0

5 Design Description

Nine viewing chords pass through EPP10. Each viewing chord is transmitted by using two fixed mirrors called as M1 (or first mirror) and M2 (or second mirror). Thus, 18 mirrors are mounted in EPP10 in total. Mirrors of E1, E5, E6, E7 and E8 are included in UEMM, and those of E2, E3, E4 and E9 are included in LEMM. Clear aperture of M1 and M2 are 120 mm. M1 is a flat mirror, while M2 is a concave spherical mirror. Detailed data and justification can be found in "Optical Analysis and Design of PBS.55.C6 PoPola" [8].

5.1 Mechanical components

Both of UEMM and LEMM consist of the same components such as mirror assemblies, connecting rods, baseplates, and pipes. Figure 5, Figure 6 and Figure 7 show overview of components and assemblies. Table 2, Table 3, Table 4 and Table 5 provide the explanation about these components.

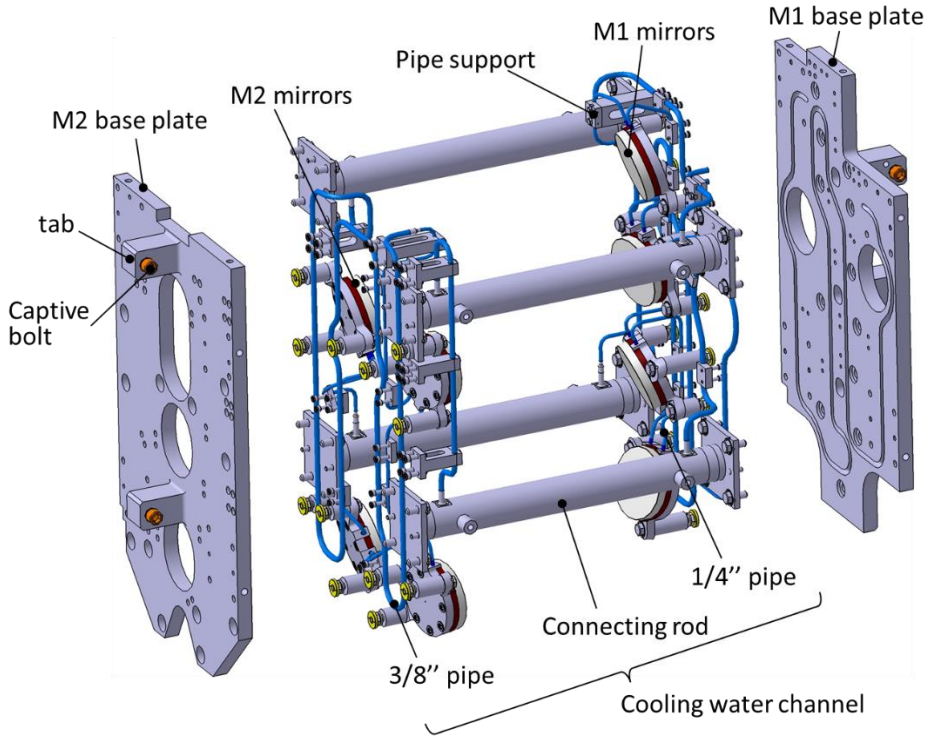
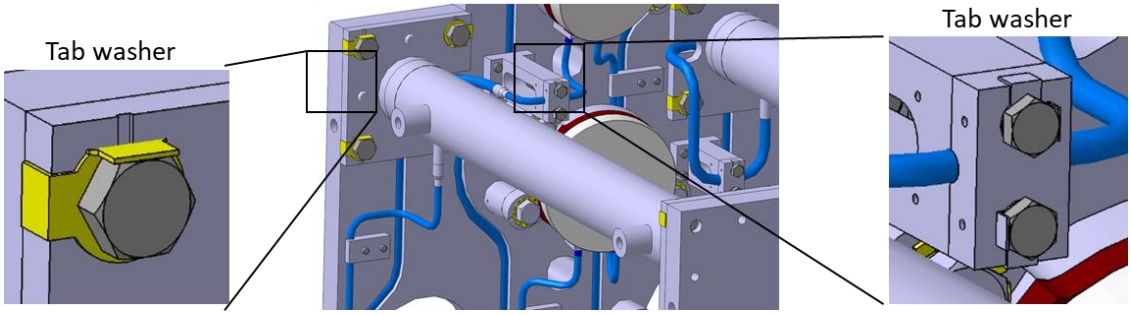
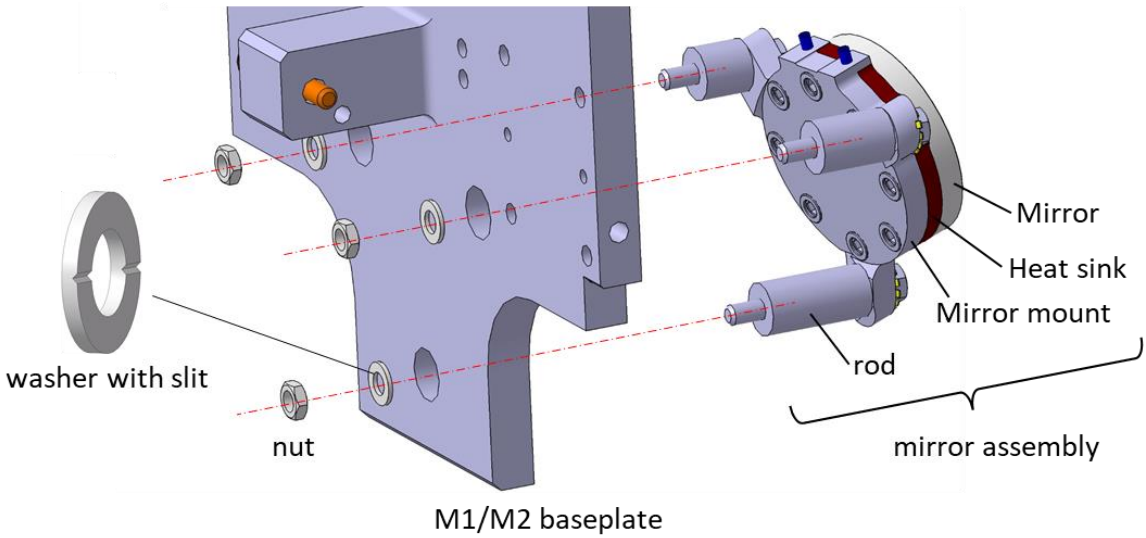


Figure 5. Components of EMM



(a) Fixation of connecting rod and 1/4'' cooling pipe



(b) Fixation mirror assembly

Figure 6. Fixation of components to M1/M2 baseplate.

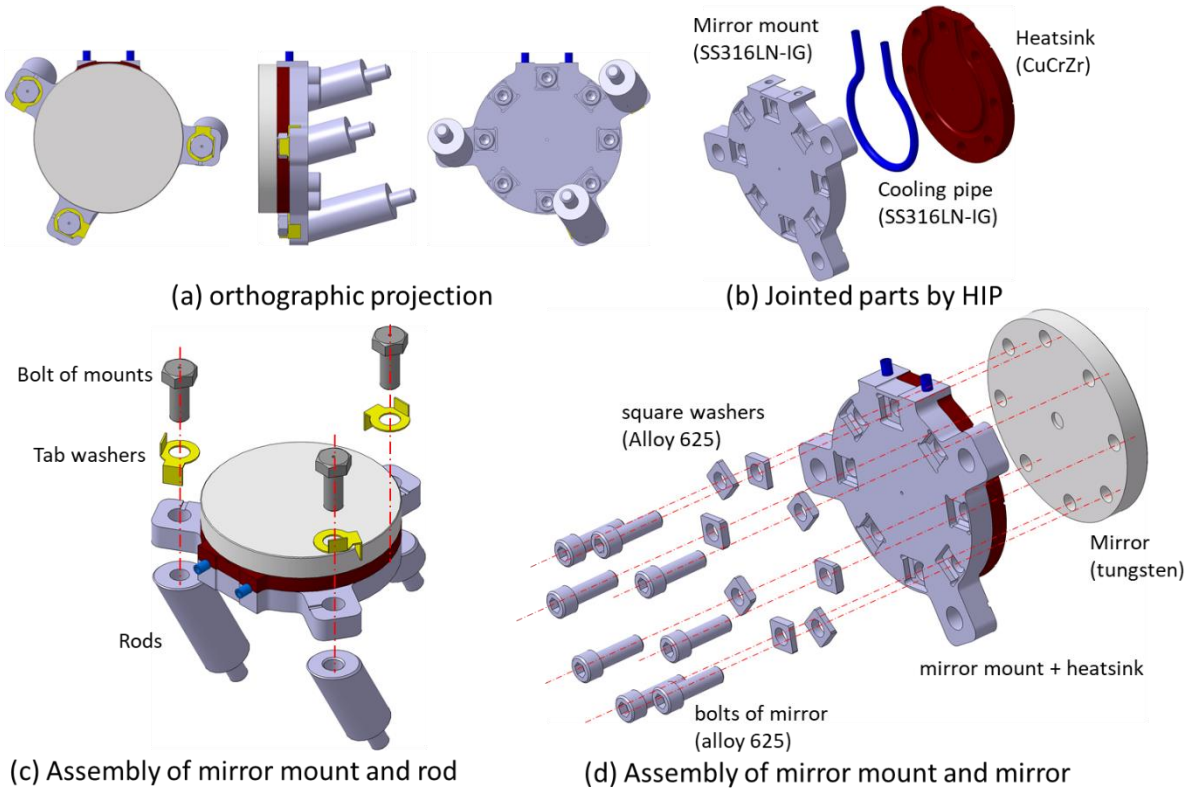


Figure 7. Components of mirror assembly.

Table 2 Connecting rods, M1 base plate and M2 base plate

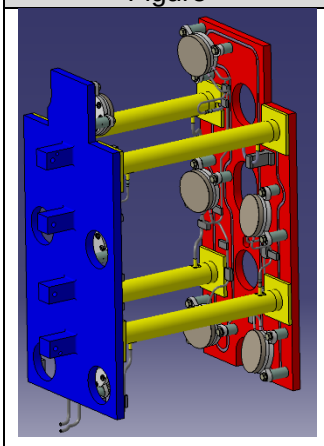
Figure	Colour code	Name	Description	Material
	_yellow_	Connecting rods	– Connected to M1 base plate and M2 base plate with bolting. – To transport cooling water through the inside of the rods.	SS316L(N)-IG
	blue	M1 base plate	– Connected to DSM with bolting. – Connected to first mirror assemblies with bolting	SS316L(N)-IG
	red	M2 base plate	– Connected to DSM with bolting. – Connected to second mirror assemblies with bolting	SS316L(N)-IG

Table 3 Mirror, heatsink, cooling pipe, mirror mount, rod and bolts

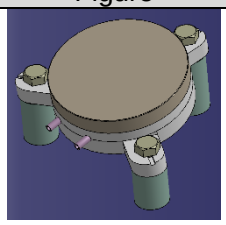
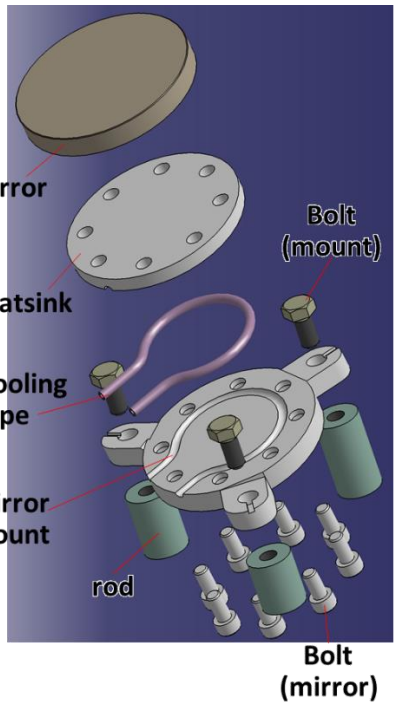
Figure	Name	Description	Material
 	Mirror	– To reflect laser beam. – The mirror is pressed toward the heat sink with a contact pressure of 3.5 MPa by bolting. – The mirror can slide on the heatsink within the clearance between a through hole of heatsink and a bolt.	Pure tungsten
	Heatsink	– Jointed to both the cooling pipe and the mirror mount by HIP. – Holes are through holes for “bolt (mirror)”.	CuCrZr
	Cooling pipe	– 1/4 inch pipe. – Jointed to both the heatsink and the mirror mount by HIP.	SS316L(N)-IG
	Mirror mount	– Jointed to both the cooling pipe and the mirror mount by HIP. – All holes are through holes for both “bolt (mirror)” and “bolt (mount)”.	SS316L(N)-IG
	Rod	– Connected to mirror mounts and M1/M2 base plate by bolting.	SS316L(N)-IG
	Bolt (mount)	– To connect the mirror mount and the rods. – Pretention: 12.5 kN – Tab washers are omitted in the left figure.	Alloy 625
	Bolt (mirror)	– To connect the mirror mount and the mirror. – Pretention: 5 kN – Square washers are omitted in the left figure.	Alloy 625

Table 4 Cooling pipes

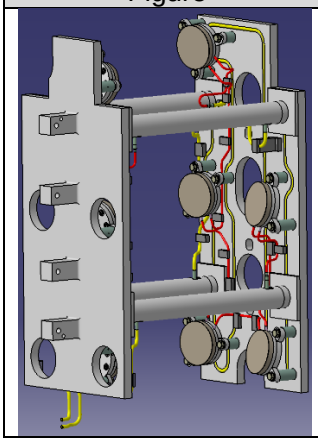
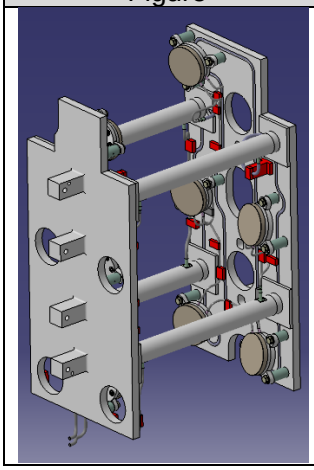
Figure	Colour code	Name	Description	Material
	_yellow_	Cooling pipe	– 3/8-inch pipe. – Blazed to M1/M2 base plate	SS316L(N)-IG
	red	Cooling pipe	– 1/4-inch pipe.	SS316L(N)-IG

Table 5 Pipe support

Figure	Colour code	Name	Description	Material
	red	Pipe support	– To support cooling pipes. – Fixed to M1/M2 base plate by bolting. – Bolts and lock washer are omitted in the analysis model.	SS316L(N)-IG

5.2 Interfaces

UEMM and LEMM have interface with EPP10, which is defined in the interface sheet [3].

Mechanical interface

EMM is fixed to DSM by bolting (see Section 8). The positions of the bolt fixation are labelled as IF01 to IF12. Figure 8 shows the definition of the IF01 to IF12. The bold size is M12, while the diameter of the through hole of the tab of EMM is 16 mm. Clearance between bolt and hole is 2 mm. The clearance of 2 mm can lead the misalignment of ± 0.2°. The optical analysis [8] shows that the misalignment of ± 0.2° is acceptable.

During plasma operation, the interfacing points moves because of thermal expansion of DSM. According to the interface sheet [3], the horizontal gap and the vertical gap between IF04 and IF12 become wider by 1.67 mm and 1.72 mm, respectively. This thermal expansion can be absorbed by the 2-mm clearance between the interfacing bolt and the holes of the EMM tab.

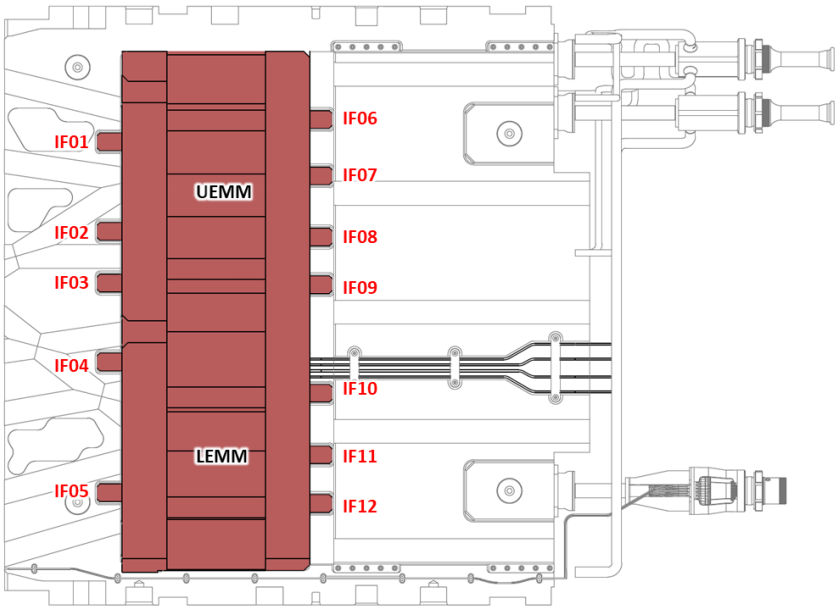


Figure 8 Definition of interfacing points.

Engineering service

Cooling water is provided by EPP10, and there is no electrical interface between EMM and EPP10. Detailed values such as temperature and pressure of the cooling water are given in the interface sheet [3].

5.3 Prevention of Bolt Loosening

Four counter measures are implemented to prevent loosening of bolt.

- The first one is to use tab washers (see Figure 6 (a) and Figure 7).
- The second one is to use Nord lock washers for the captive bolt of the tab (see Figure 12). A tab washer is not used for the captive bolt because it is difficult for a remote-handling tool to fold and unfold the tab washer in assembly and disassembly in the hot cell facility.
- The third one is to carry out dot welding to “square washer” that is shown in Figure 7(d). Figure 9 shows how to lock the bolt. Since the bolt is welded to the square washer (see Figure 9 (a)), the bolt cannot rotate. The square washer fits in with the groove of the mirror mount. It can slide in the radial direction of the mirror but cannot rotate. The gap between the square washer and the groove is 0.1-0.2 mm (see Figure 9 (b) and (c)). It should be noted that, since the thermal expansion of the heatsink and the mirror mount is larger than that of tungsten mirror, the radial slide of the square washer is necessary for avoiding bending stress of the bolt.
- The fourth one is to carry out dot welding to the nut in Figure 6 (b) to the rod of the mirror assembly.

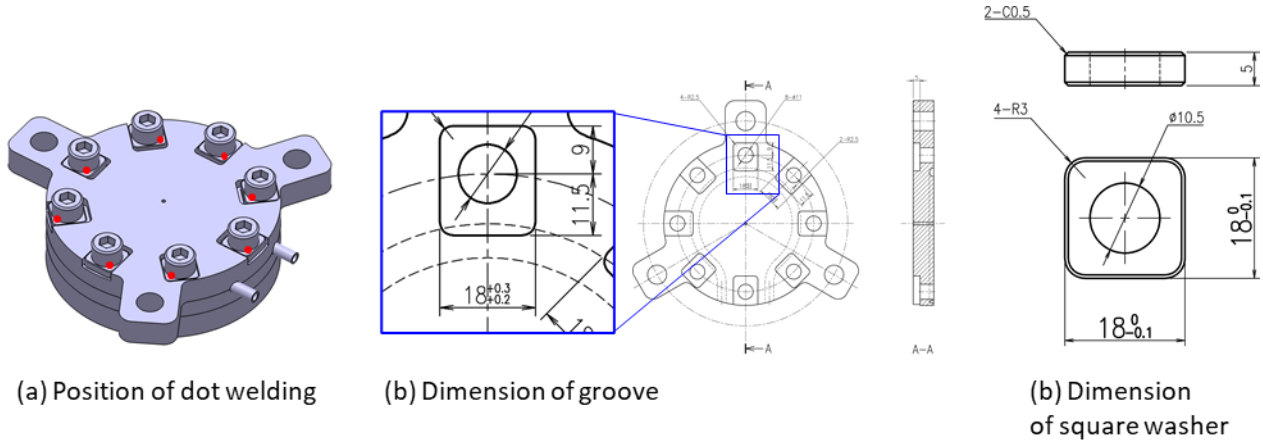


Figure 9. Mechanism of how to avoid the loosening of the bolt that is used to fix the tungsten mirror. The square chamfered washer can move in the radial direction of the mirror, but cannot rotate.

5.4 Prevention of Trapped Volume

In order to prevent trapped volume, a various kind of counter measures are implemented.

- The captive bolt on the tab (see Figure 5) has a through hole of diameter of 2 mm.
- The bolt of the mirror (see Figure 7(d)) has a through hole of diameter of 2 mm.
- The washer in Figure 6 (b) has a slit.
- Threaded holes have a through hole of diameter of 2 mm, and surfaces to contact with a washer have slit. Figure 10 shows examples of the holes and slits to prevent trapped volume.

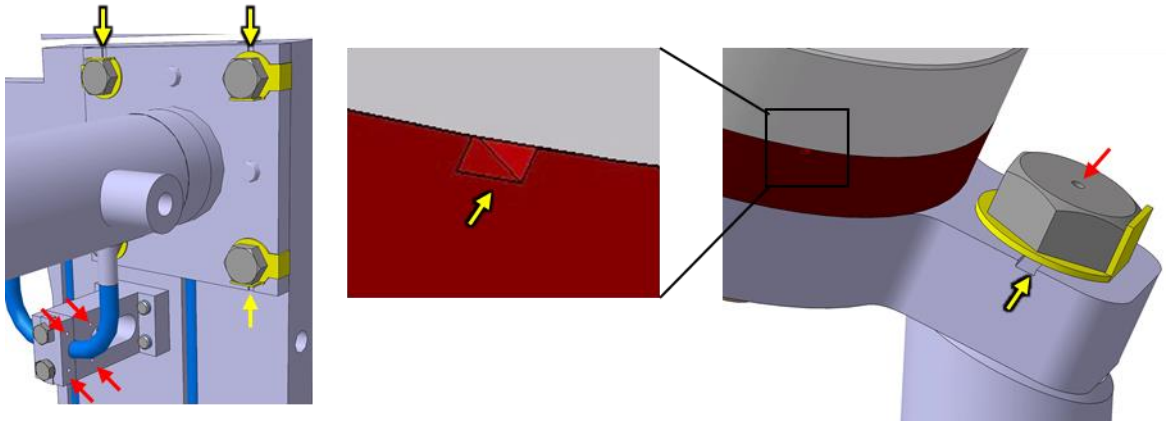


Figure 10. Holes (red arrow) and slits (yellow arrow) to prevent trapped volume.

5.5 Drawings and BOM

The documents below also provide the information about the design.

- Components Classification BOM for CCR [7]
- Component drawing [9]
- Assembly drawing [10]

6 Design Justification

This section provides evidence to support the design shown in Section 5.

Document title	Remarks
Optical Analysis and Design of PBS.55.C6 PoPola [8]	The report [8] shows that the size, the curvature radius and the position of the in-vessel mirrors are

	properly designed for minimizing the loss of laser power.
StIR [11]	StIR shows that all design criterion specified in SDC-IC are met.
Section 7 “Manufacturing”	Manufacturability is described in Section 7 of this document.
Steam ingress test (UVXNCU)	The report, UVXNCU, shows that the reflectivity of tungsten at infrared region does not change owing to the steam ingress test.
Chit resolution report for PoPola CDR Chit #17 “Effect of potential bending of the flat plasma-facing mirrors” [12]	The report [12] evaluated the effect of the thermal deformation of the plasma-facing mirror. According to the evaluation of optical analysis, When M1 and M2 deformation is 20 μm or less, the decrease in laser power returning to the diagnostic room is less than 20%. The analysis for the preliminary design the expected deformation of the mirror is 8 μm and the decrease in the laser power is acceptable.

7 Manufacturing

A report [18] concluded that the design explained in Section 5 is manufacturable by clarifying all the manufacturing process.

Before starting the manufacture of the production to be delivered to ITER, factory qualification tests shall be carried out. The factory qualification test plan is Reference [13]. The foreseen tests for EMM are to evaluate outgassing rate, to qualify welding procedure and to qualify HIP procedure.

At the time of writing this document, cutting oil, cleaning fluid are not determined yet. The cutting oil and cleaning fluid will be specified by a contractor who will be determined after tendering the construction of PoPola retroreflectors. If the contractor would specify a special fluid, the acceptance for use of the fluid will be checked by ITER Vacuum responsible officer in accordance with ITER Vacuum Handbook.

8 Assembly and Installation

Assembly of EMM to DSM

UEMM and LEMM are attached to DSM by bolting. DSM of EPP10 is called “clamshell type” and consists of two parts. Both UEMM and LEMM are fixed to one side. Figure 11 and Figure 12 illustrate how to fix UEMM or LEMM to DSM. M12 bolts made of Alloy 625 are used for fixation, and the bolt pretension is 8 kN.

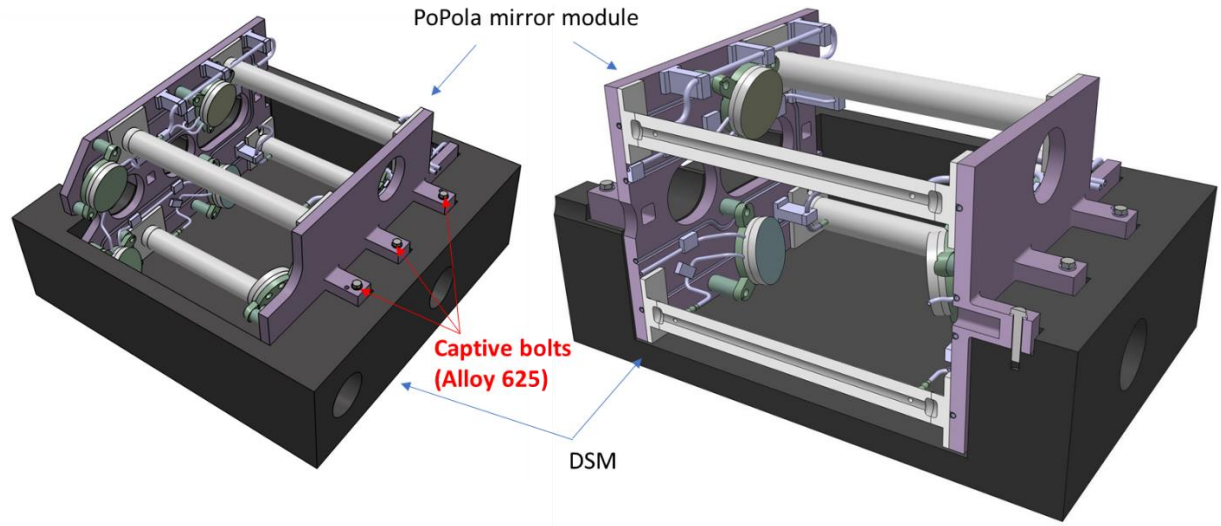


Figure 11. Bolt fixation to connect UEMM and LEMM to DSM.

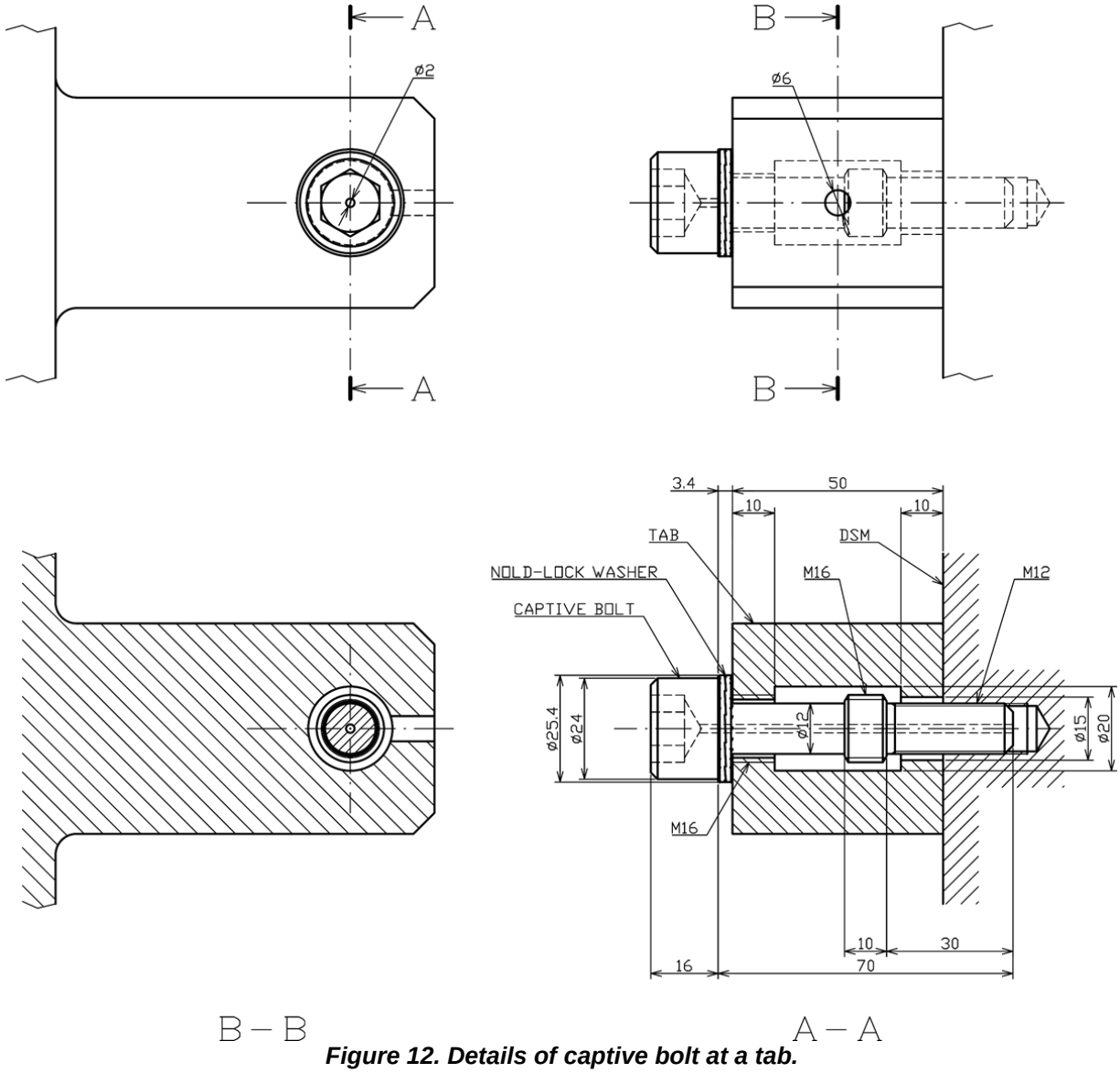


Figure 12. Details of captive bolt at a tab.

PPTF test after assembly

Reference [14] is a document about PPTF test. Major functional test at PPTF is to confirm the alignment of the mirror positions and the mirror angles. The visible laser beam will be injected from the vacuum windows, and it will be checked whether the visible laser beam will be transmitted to the right place of the target in the PPTF tank.

9 Operation, Maintenance and Decommissioning

Operation plan

Since the mirror modules are passive component, there is no operation plan.

Maintenance and inspection plan ([15], [16])

There is no preventive maintenance scheduled in EPP10.

The corrective maintenance is to replace EMM in the hot cell facility. Figure 13 shows disassembly process int the hot cell facility. After open the DSM, an operator will loosen the captive bolt, will attach a special lifting frame to threaded bosses and will lift up the EMM. The special lifting frame (red one in Figure 13) has an interface that RH gripper can hold. By using this interface, a crane swing that would happen when a crane starts lifting can be prevented. When assembling a new EMM, the operator will follow the disassembly procedure in the opposite order. These operations can be carried out by using RH tool in the hot cell facility.

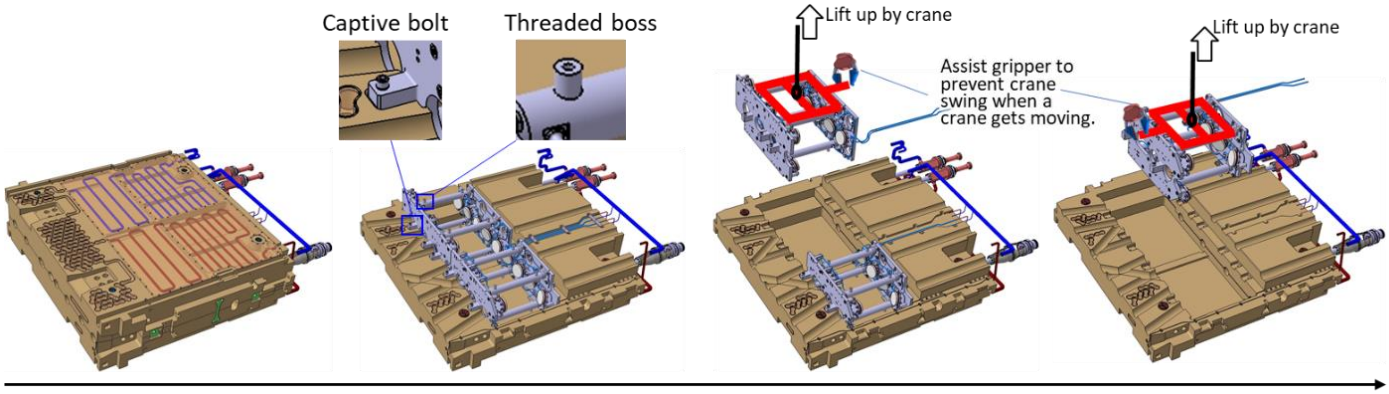


Figure 13. Disassemble process in the hot cell facility.

Decommissioning plan [17]

EMM will be transferred to and stored in a radwaste storage in a manner that EMM will be mounted on DSM.

10 Supplementary materials

10.1 Abandoned design for movable mirror

Movable mirror

In the early stage of preliminary design phase, the design team tried to design a movable mirror. Figure 14 shows the concept of the movable mirror. The design team made electro-magnetic analysis under the condition of Bt = 3.6 T, Bz = -0.9 T, Br = 0.07 T and dBz/dt = 60 T/s.The EM s showed that the moment of 520 Nm was applied to a gimbal mount. Thus, the rigid flexible pivot is necessary for enduring plasma disruption (internal plate thickness of the flexure pivot needs to be 4mm). The design team did not find design solution including pneumatic actuator that was able to move the gimbal with the rigid flexure pivot.

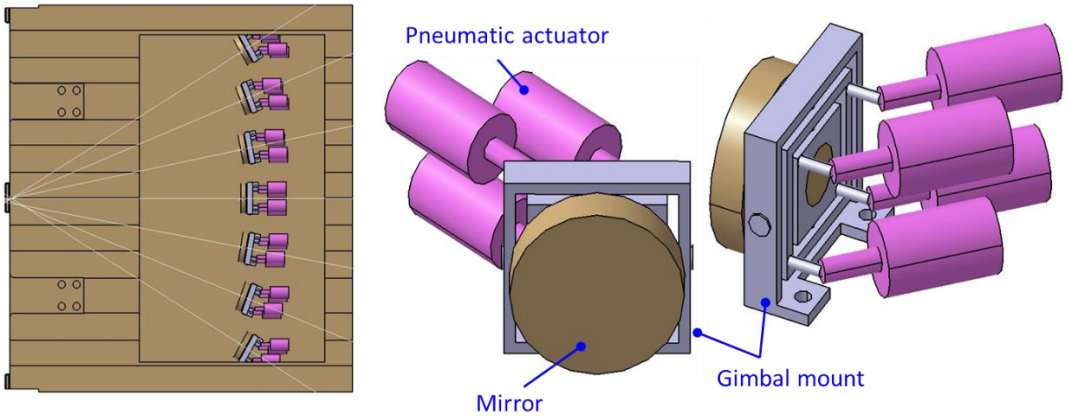


Figure 14. One of abandoned design - movable mirror -

10.2 Abandoned designs to fix cooling water pipe.

After the study shown in Section 10.1, the design team focused on design of a fixed mirror. The next issue is to determine the design to fix a SS cooling pipe to a tungsten mirror.

Tungsten mirror + internal SS pipe

The design team assessed the design that a SS cooling pipe is embedded inside a tungsten mirror by using HIP technique. The aim of this design is to perfect thermal contact between tungsten and SS. The thermal structural analysis show that high stress occurs at the boundary between the tungsten mirror and the SS pipe during baking. This is because the thermal expansion of the SS pipe is larger than that of hole inside the tungsten mirror.

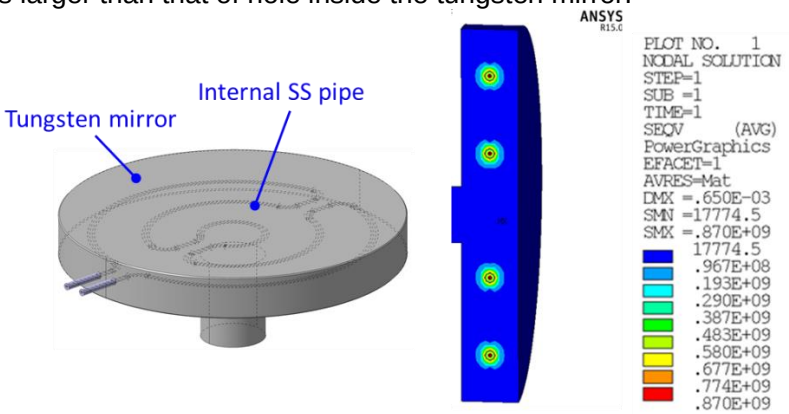


Figure 15. One of abandoned design - tungsten mirror + internal SS pipe -

Tungsten sheet + SS base plate + internal SS pipe

The design team assessed the design that a SS cooling pipe is embedded inside a SS base plate that a tungsten sheet is attached to. The thickness of the tungsten sheet is supposed to be 20-100 μm. The aim of this design is to reduce the stress around in the SS cooling pipe in the previous design, “Tungsten mirror + internal SS pipe”. The thermal structural analysis show that high stress occurs at the boundary between tungsten sheet and SS base plate. This is because the thermal expansion of the SS base plate is larger than that of tungsten sheet.

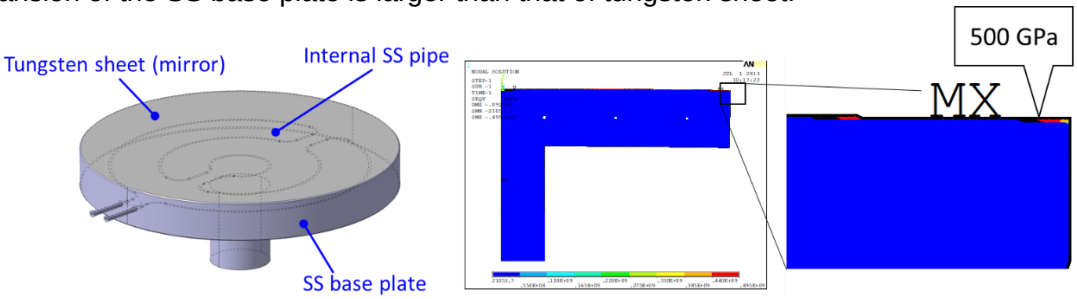


Figure 16. One of abandoned design - tungsten sheet + SS base plate + internal SS pipe -

Tungsten mirror with interlayer (no bolting)

Next, the design team assessed the design that a copper interlayer is jointed to both a tungsten mirror and a SS cooling pipe by HIP technique. The aim of this design is to absorb the difference of thermal expansion of tungsten and SS by using copper interlayer and is to avoid usage of bolts that could be loosen during repetition of thermal expansion. The thermal structural analysis show that high stress occurs at the boundary between the tungsten mirror and the copper interlayer. This is because the thermal expansion of the copper inter layer is larger than that of tungsten mirror.

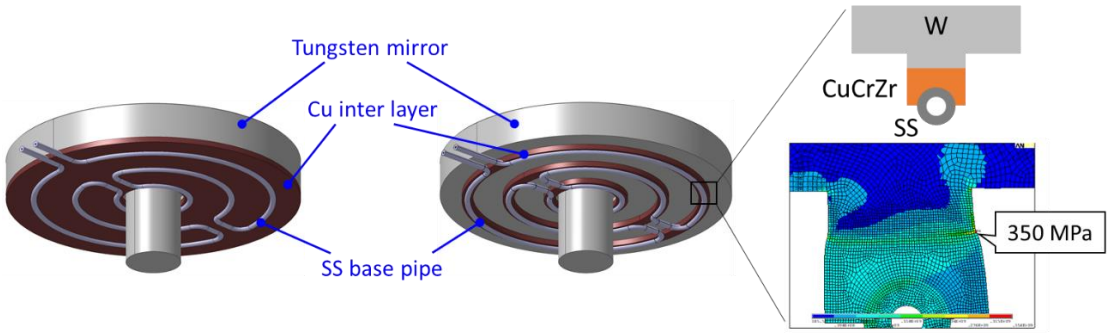
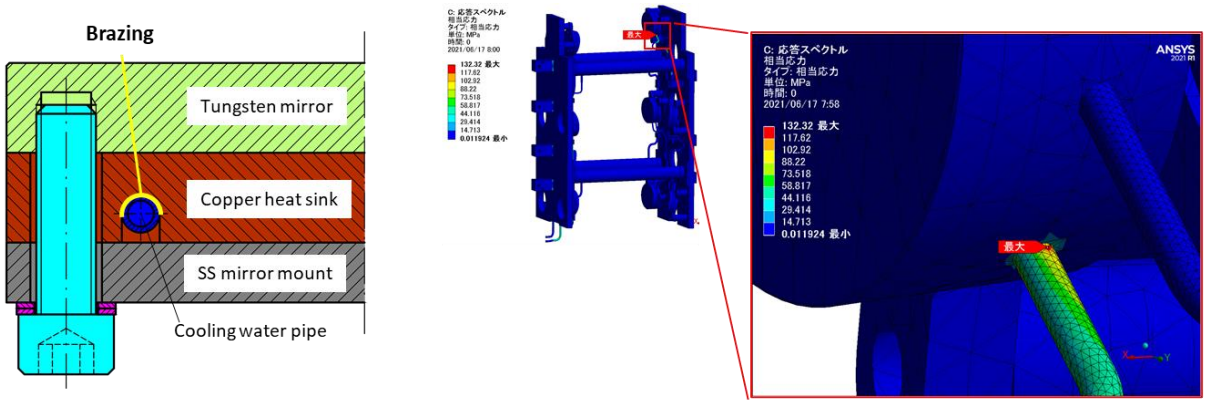


Figure 17. One of abandoned design - Tungsten mirror with copper interlayer -

Bolt + brazing

After studying the above designs, the PoPola design team finally decided to use bolts. Figure 18 (a) shows the initial design to use the bolts. The function of the bolt is to fix a tungsten mirror, a copper heatsink, and a SS mirror mount. Comparing Figure 18 to Figure 17, the SS mirror mount is clearly added to the mirror assembly. The function of the SS mirror mount is a mechanical interface between the tungsten mirror and the PoPola in-EPP10 mirror module.

In the initial design that uses the bolts (i.e. Figure 18 (a)), a brazing technique was employed to join the copper heatsink and a cooling water pipe. The issue of this initial design is the structural integrity assessment of the brazing joint. Figure 18 (b) shows von-mises stress of the abandoned design during VDE. This high stress occurs because of vibration of the cooling pipe. Since Figure 18 (b) is the results of the initial design, the support of the cooling pipe is not optimized, and the vibration of the cooling pipe is not minimized. Even though the von-mises stress at the root of the cooling pipe can be reduced by optimizing the cooling pipe support, there is still a question whether the reduced stress is low enough for ensuring the brazing joint. So, the PoPola design team decided to reject the brazing technique.



(a) Brazing joints (abandoned design)

(b) Von mises stress of the abandoned design during VDE

Figure 18. One of abandoned design – Brazing the cooling water pipe -

10.3 Abandoned design to fix mirror mount to base plate.

In Section 10.2, the design of the mirror including cooling channel was fixed. The remaining item to be designed is fixation of the mirror to a support structure (i.e., M1 or M2 baseplate in Figure 5). The design team decided to use rods to fix them. The rod is fixed to M1 or M2 baseplate by a nut, but not by welding. This is because thermal deformation of M1 or M2 baseplate owing to welding is not predictable and can be as large as unacceptable. Since welding joint is not used, there are three design options to fix the mirror to M1 or M2 baseplate by using the rod as shown in Figure 19. It should be noted that the mirror surface is not parallel to M1 or M2 baseplate. This unparallel leads to complex shape of the mirror mount or the rod. In Figure 19 (a), the shape of the rod is simple, while the shape of the mirror mount is so complex that it is difficult to inspect the dimension. In both Figure 19 (b) and (c), the shape of the mirror mount is simple, while the shape of the rod is complex. In Figure 19 (b), the male thread is not coaxial to the rod. On the other hand, in Figure 19 (c), the threaded hole is not coaxial to the rod. Finally, the design of Figure 19 (c) is employed because the mirror mount is simple, and the rod can be placed to a pilot bore of M1 or M2 plate.

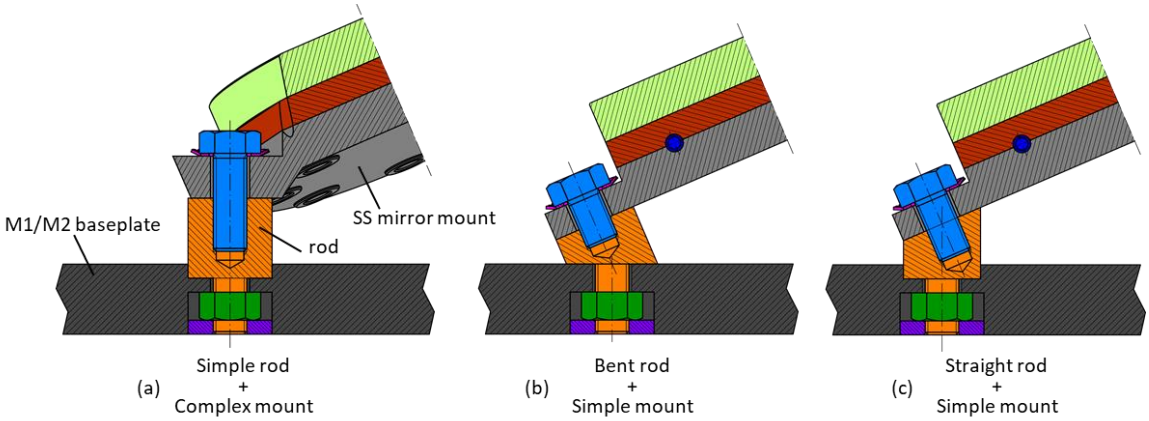


Figure 19. Design options to fix SS mirror mount to base plate.