



**FUSION  
FOR  
ENERGY**

**ITER for Swiss Industry**  
28<sup>th</sup> September 2009, Kultur-Casino, Berne

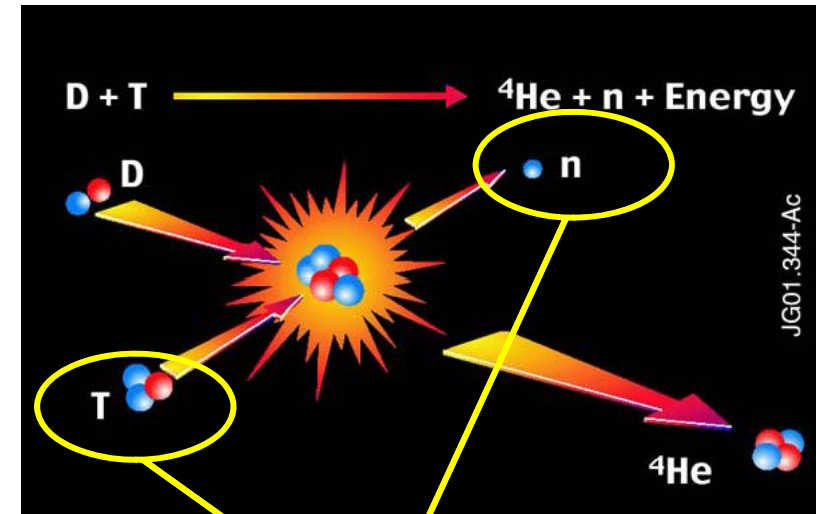
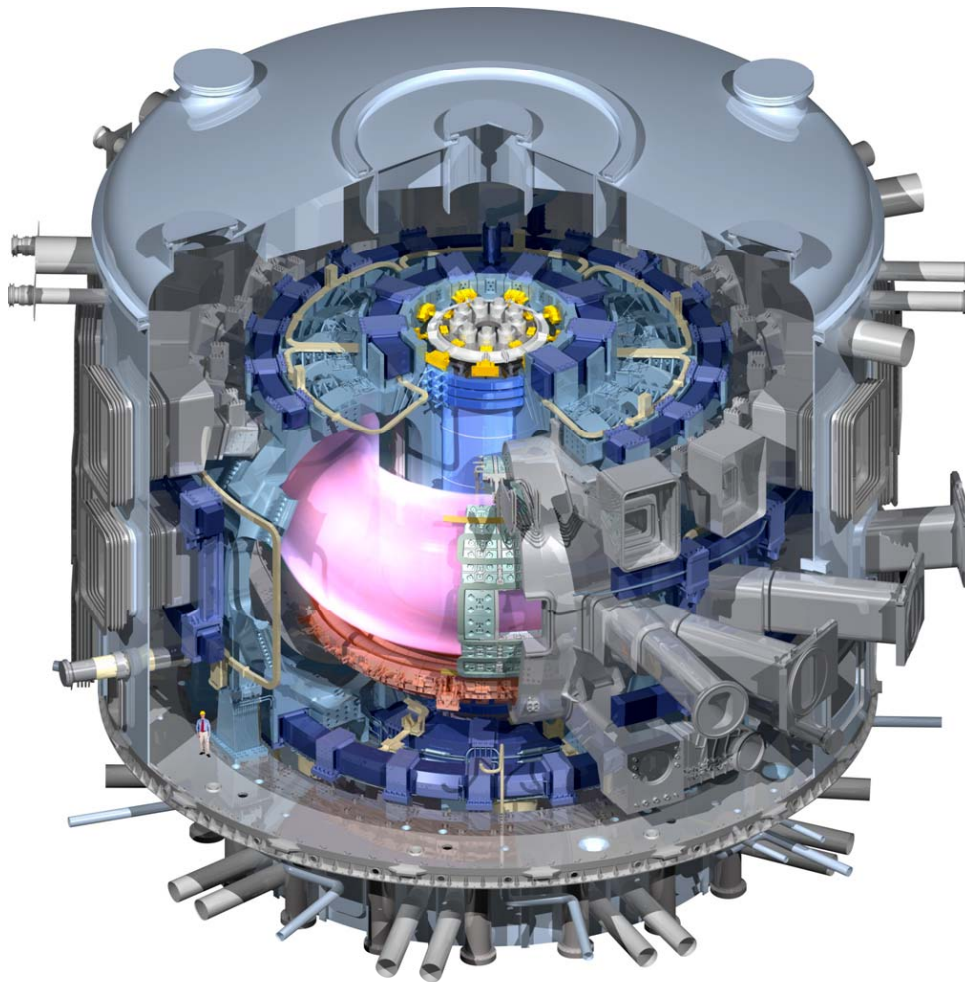
# **QA and Management Specifications in the ITER Project**

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Engineering Support Division – Analysis and Codes

## Issues to address:

- 1. Why Quality Assurance?**
- 2. Why Management Specifications?**
- 3. How to satisfy F4E Management Specifications.**
- 4. Codes and Standards.**

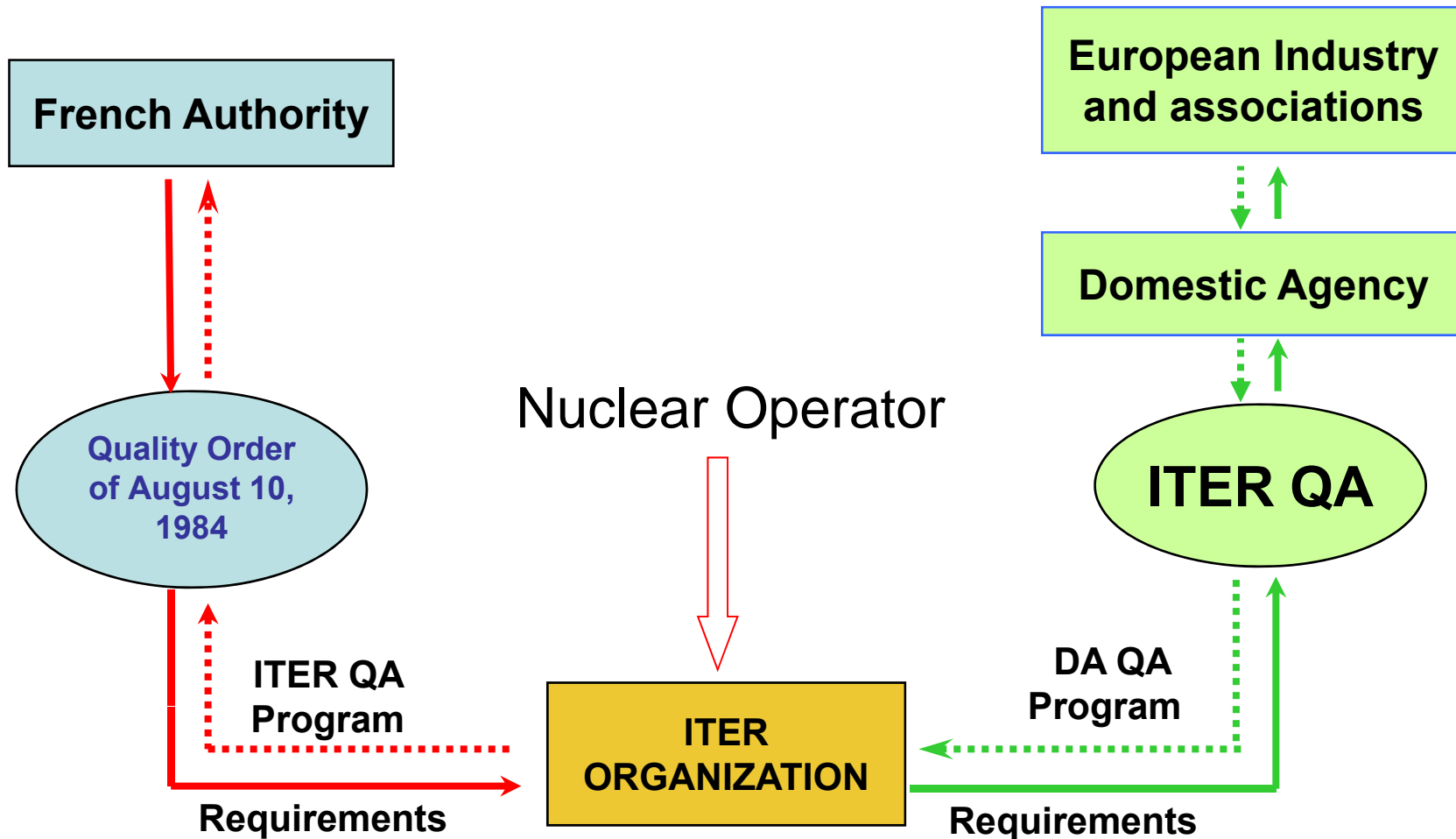
# Why QA?



**Installation Nucléaire de Base**  
according to French Regulation

→ **Order of August 10, 1984,  
Concerning Quality in the design,  
construction and operation of  
Basic Nuclear Installations**

# Why QA?

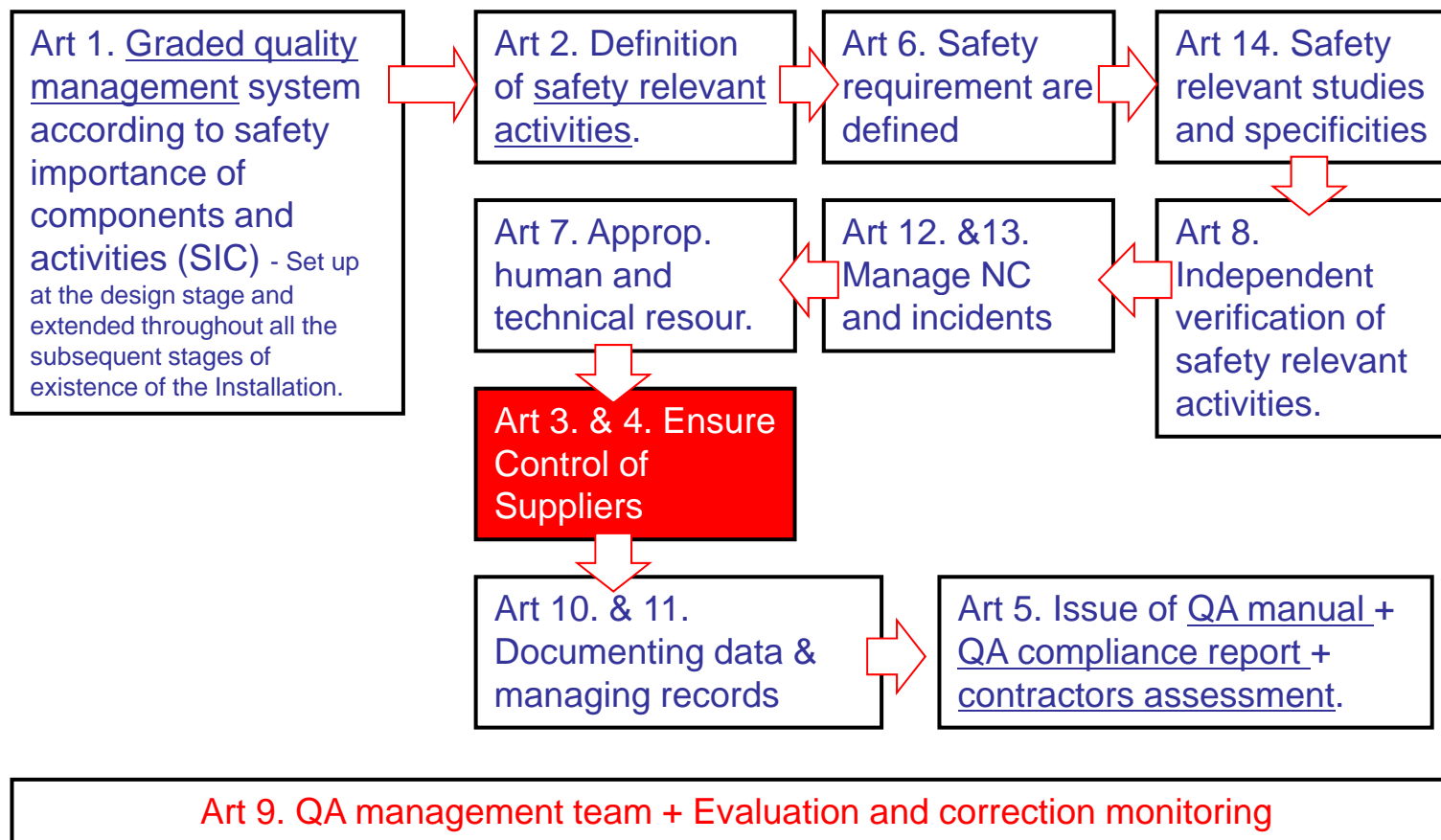


# Why QA?

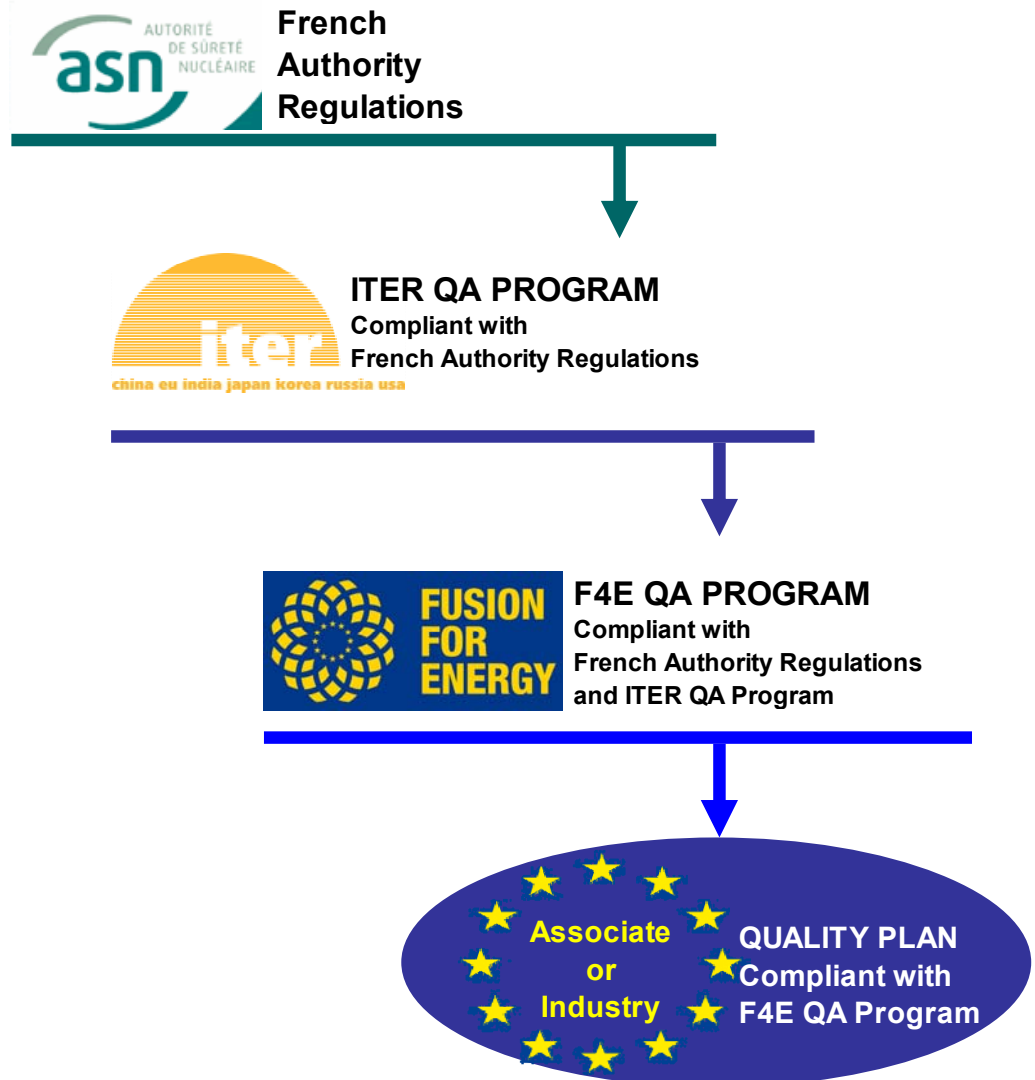


## QUALITY ORDER OF AUGUST 10, 1984 FRENCH REGULATION FOR NUCLEAR SAFETY

The required quality is obtained and maintained on one hand by activities performed and on the other hand by organized and appropriate verification.



# Why Management Specifications?



The control of the technical activities of the suppliers are carried out through three contractual documents:

- The **technical specification** (“what?”) to define the object of the contract (the «as specified» configuration of the product).
- The **management specification** (“how?”) to define the quality requirements to be met by the supplier → **QUALITY PLAN**
- The contract/grant agreement to define the commercial and legal requirements and provisions that are applicable.

# MS – Quality Plan



 <b>FUSION FOR ENERGY</b>	<b>Annex A</b> <b>Management Specification</b>	IDM #	
		Doc. #	
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**8.3. QUALITY PLAN OUTLINE**

*This appendix outlines the main items to be included by the Supplier in the Quality Plan. If a particular section is not applicable, the section still has to be outlined and the reason for the non applicability referenced.*

**QUALITY PLAN**

**IDENTIFICATION**

1. DOCUMENT REFERENCE		1.1 VERSION	
2. F4E REFERENCE		2.1 F4E_RO	
3. F4E CUSTOMER REFERENCE			
4. SUPPLIER			
5. CONTRACT TITLE			
6. GRADED QUALITY LEVEL			

**REQUIREMENTS**

- R1. OBJECTIVES AND DELIVERABLES OF THE CONTRACT
- R2. RESPONSIBILITIES REQUIREMENTS
- R3. PROJECT MANAGEMENT
- R4. CONTROL PLAN
- R5. RESOURCE MANAGEMENT
  - 5.1. SPECIAL PROCESS QUALIFICATION
  - 5.2. STAFF QUALIFICATION
- R6. CONFIGURATION MANAGEMENT
  - R6.1. MANAGEMENT OF CHANGES
  - R6.2. NONCONFORMITY MANAGEMENT
- R7. TIME SCHEDULE MANAGEMENT
- R8. INFORMATION AND DOCUMENTATION MANAGEMENT
- R9. SUBCONTRACTING MANAGEMENT
- R10. ASSESSMENT AND VALIDATION MANAGEMENT
  - R10.1 MEASURING AND TEST EQUIPMENT
  - R10.2 VALIDATION OF ANALYSIS CODES
- R11. ACCEPTANCE AND DELIVERY REQUIREMENTS
- R12. RISK MANAGEMENT
- R13. HEALTH AND SAFETY
- R14. CODES (REGULATORY DOCUMENTS) AND STANDARDS
- R15. [OTHER REQUIREMENTS]

**[COMPLEMENT SUPPLIER SECTIONS]**

- A1. [...]

**TECHNICAL ANNEXES**

- T1. [ANNEX ...]

The dedicated Quality plan describes the operational quality system implemented by the bidder/supplier to ensure that:

- Contract requirements will be met,
- Evidence of such compliance will be maintained.

The Quality Plan shall have a mandatory structure. This makes it easier for all involved to:

- Compare Bidders Quality Plans
- Review Quality Plans
- Detect Missing Items in a Plan
- Propose updates
- Use it during contract follow-up



## AT TENDER LEVEL

- The Bidder shall provide, in its offer a meaningful outline of a dedicated QP with the plans, schedules and explanation of the provisions to comply with the requirements
- The Bidder will be evaluated on the basis of its QP according to the Tender Specs.
- Certification according to international standard is not mandatory (but recommended). Specific requirements can be defined for each contract through the management specification based on the contract complexity.

The Quality Plan shall be referenced as an “outline’ version where:

- Some sections will be addressed as a description of the proposed system
- The remaining sections shall have the description of the Bidder current system.

(To have evidence that all the specific requirement are addressed and all provision for maintaining these requirements have been foreseen by the bidder)

## AT CONTRACT LEVEL

1. **Kick-off meeting** - the Supplier shall provide the **proposed Quality Plan**;
2. The Supplier shall **not begin any work without the QP being approved in writing**
3. During Contract implementation, the Supplier shall update the Quality Plan (or parts of it) as/if required and shall submit it for approval to F4E.

# MS – Graded Quality Level



Quality Implementation within Fusion for Energy projects uses a “Graded Approach” to define and perform quality requirements.

The Quality Classes are defined in: FE-QA-010 - Quality Classification (**where specific requirements for each quality class are provided**)

They are defined on the basis of:

- Safety Importance Class assigned to the item,
- Anticipated impact of item failure or malfunction on plant availability,
- Maturity and complexity related to a risk of failure or malfunction.

Items may belong to one of four (4) quality classes, defined as follows:

<b>Class 1</b>	Any Safety Related class Item <b>OR</b> any item whose failure/malfunction could result in extensive machine downtime
<b>Class 2</b>	Any Non-Safety Related Class Item whose failure could result in major downtime and cost/schedule impacts.
<b>Class 3</b>	Any Non-Safety Related Class Item whose failure could result in limited downtime, cost/schedule impact
<b>Class 4</b>	Commercial Grade Items that are off the commercial shelf purchased item using manufacturers catalogues without the need to provide an engineering specification. No QA Program applicability. A minimum of a Certificate of Conformity (CoC) is required on delivery.

# MS – Control Plan



Matrix with the WBS and the milestones, criteria, key points (hold, acceptance, review, notification, etc).

The Control plan is a sequence of critical operations, instructions and requirements, activities that F4E or its representative intends to observe

Includes the requirements and actors of activities and the status of the operation listed.

Will be used as a Review Matrix by:

- supplier
- F4E

Annex to the Quality Plan  
(Up-to-date status is essential)

ANNEX T1 - CONTROL PLAN

Doc. #		CP_XYZ_D1		Rev. 001		DMS #		F4E_XYZ		
F4E	123T8K0ABC					F4E Customer #:	ITA 12345			
F4E Supplier	SUPLIER XYZ									
Contract ID	1234					Subject:	Sample Model and Sample production			
Supplier		F4E				Notes & solutions				
Prepared by:		Acceptance				* Code: D = Document Review R = Report Required M = Monitor (or Witness) NP = Notification Point APF = Authorization to Proceed Point AP = Hold Point				
Name, Sign & Date		Name, Sign & Date				TPA = Third Party Inspection Authority F4E = F4E or it's representative				
Item No	Specification (procedure, drw, ...)	Standard	Criteria	Verification by			Records (report, NCR, ...)	Observations		
				XYZ Name, Sign & Date	TPA Name, Sign & Date	F4E Name, Sign & Date				
1.0	Quality Plan	--	--							
1.1	Preparation of the Quality Plan	Management Specification	--	R	QIR		QAO	SAMP_QP		
2.0	modelling of supply 1	--	--							
2.1	Gathering requirements specification	Technical Specification	--	R	INV		TRC	SMD_S1		
2.2	Market survey of available modelling software's	Commercial procedure 23	--	R	ENG		TRC	MS_S1		
2.3	Importation of modelling environment and CAD models into the system	--	--	M	INV					
2.4	Testing at the facility	Testing Procedure 1	Class 2.2	R	QIR		TRC	TR_HW1		
2.5	Release Note	QIR25	--	R	TR		TRC	QF_Acces_T4		
3.0	manufacturing of supply 2	--	--							
3.1	Gathering and formalizing specifications	Technical Specification	--	R	ENG		TRC	SMD_S1		
3.2	Market survey of available hardware	Commercial procedure 23	--	R	ENG			MS_S1		
3.3	Engineering Design of suboly 2,	CAD Model	--	R	TRC					
3.4	Review manufacturing drawings	Review Process	--	R	ENG		TBD			
3.5	EC conformity	--	Machine Directive 86/270/C	R	ENG		TBD	TBD		
3.6	Supply 2 assembly	--	--	M	ENG					
3.7	Testing at the facility	Testing Procedure 2	Class 2.1	R	QIR		TRC	TR_HW1		
3.8	Release Note	QIR25	--	R	TR		TRC	QF_Acces_T4		
4.0	Final report	--	--							
4.1	Finalise Quality Plan	Management Specification	--	R	QIR		QAO	SAMP_QP		
4.2	Issue of Final Report	--	--	R	TR		TRC			

# MS - Documentation Schedule



Contract Implementation and Follow-up Documentation.

Up-to-date list of:

- records
- plans/ schedules/ manuals
- drawings/ models
- documents and data expected during the contract and/or essential to perform the task and/or part of the ADP
- Progress Meetings Documentation (decision records)
- Progress Report (usually monthly)
- Final and Intermediate Report

Annex to the Quality Plan

Up-to-date status is essential

**Annex A**

DMS # F4E/200X/DEPT/XXXXXX  
 Call. # F4E-200X-TYP/ANN (DV-GRP)  
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8.8. DOCUMENTATION SCHEDULE FORM

DOCUMENTATION SCHEDULE

Doc. Number:	Issue Number:	Sheet:	of
F4E reference:	F4E Customer ref:		
Supplier:	DMS #:		
Contract ID Ref.:	Item:		

Supplier	F4E	Notes & acronyms
Prepared by: <small>Name, Sign &amp; Date</small>	Approved by: <small>Name, Sign &amp; Date</small>	Acceptance: <small>Name, Sign &amp; Date</small>
Field: distributed for review to the fields of expertise Distribution: A-Approved, H-Information, N-Non Distributed Status: R-Received, W-Waiting, A-Accepted, R-Rejected.		

Document Record ID	Rev.	Title	Responsible for			Field	Date / Expected	Distributed F4E	Archive	Lang	Status
			Prep.	App.	Dist.						

DOCUMENTATION SCHEDULE P. 1/2

Doc. # 123FASQ0ABC DS	Rev. 0.1	DMS #	F4E: XYZ
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F4E reference: 123FASQ0ABC DS	F4E Customer #: ITA 12345
F4E Supplier: XYZ	F4E Contract ID Ref.: 123
Subject: Sample Model and Sample production	

Supplier	F4E	Notes & acronyms
Prepared by: <small>Name, Sign &amp; Date</small>	Approved by: <small>Name, Sign &amp; Date</small>	Acceptance: <small>Name, Sign &amp; Date</small>
Field: Document sent to review to fields of expertise Distribution: A-Approved, H-Information, N-Non Distributed Status: R-Received, W-Waiting, A-Accepted, R-Rejected, P-Pending...		

Document Record ID	Rev.	Title	Responsible for			Field	Date / Expected	Distributed F4E	Archive	Lang	Status
			Prep.	App.	Dist.						
123FASQ0ABC_0001		0[SAMPLE_OP_01]	COR	CEO	CTR	Q	12/15	A	Y	EN	P
123FASQ0ABC_0002		0[SAMPLE_OP_02]	CTR	CEO	CTR	Q	12/15	A	Y	EN	P
123FASQ0ABC_0003		0[SAMP_R_001]	INV	PYB	CTR	PP	12/15	A	Y	EN	P
123FASQ0ABC_0004		0[SAMP_R_002]	INV	PYB	CTR	PP	12/15	A	Y	EN	P
123FASQ0ABC_0005		0[SAMP_R_003]	INV	PYB	CTR	PP	12/15	A	Y	EN	P
123FASQ0ABC_0006		0[SAMP_R_004]	INV	PYB	CTR	PP	12/15	A	Y	EN	P
123FASQ0ABC_0007		0[SAMP_R_005]	INV	PYB	CTR	PP	12/15	A	Y	EN	P
123FASQ0ABC_0008		0[SAMP_R_006]	INV	PYB	CTR	PP	12/15	A	Y	EN	P
123FASQ0ABC_0009		0[SAMP_R_007]	INV	PYB	CTR	PP	12/15	A	Y	EN	P

QA and Management Specifications - J. Izquierdo - September 2009

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# MS - Subcontracting



Subcontractor must be accepted by F4E

Quality Assurance Requirement:

- Quality System, or
- Assessment Report

All major or critical items and activities subcontracted by the Supplier

XYZ SUBCONTRACTING SCHEDULE		DMS #	F4E-XYZ	
		SCS #	123TASK0ABC-SS	
		Page	1 / 1	
		Rev.		
1. F4E reference:	123TASK0ABC	F4E CUSTOMER ref.: IITA 12345		
2. Contract ID Ref.:	123			
3. Supplier:	XYZ			
4. Subject:	Sample Model and Sample production			
Supplier		F4E		
Prepared by:	Approved by:	Acceptance	Notes & acronyms	
Name, Sign & Date D. Jong	Name, Sign & Date T. Jensen	Name, Sign & Date N. Bohr		
Item / Service		Subcontractor		Observations
Identification	Specification	Identification	Qualification	
Code modeling	123TASK0ABC Annex B 3.2	The Modelling Company SA	ISO9001	Certificate Available

# MS – Change Management



**Annex A** DMS # F4E/200X/DEPT/XXXXXX  
 Call. # F4E-200X-TYP-NNN (DV-GRP)  
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**8.7. NONCONFORMITY REPORT**

Section 1 – to be completed by the Supplier

1. NCR Number:  
 1. F4E reference:  
 2. Contract ID Ref.:  
 3. Supplier:  
 4. Item:

5. REQUIREMENT:

6. DESCRIPTION OF:

7. PROPOSED REMEDY:

8. LIST OF ATTACHMENTS:

9. PROPOSED NONCONFORMITY TYPE:  
 MINOR NCR  
 MAJOR NCR

10. CORRECTIVE / PREVENTIVE ACTION:

Supplier Name: \_\_\_\_\_

Section 2 – to be completed by F4E

1. DECISION:

Name: \_\_\_\_\_

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**Annex A** DMS # F4E/200X/DEPT/XXXXXX  
 Call. # F4E-200X-TYP-NNN (DV-GRP)  
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**8.5. DEVIATION REQUEST**

Section 1 – to be completed by the Supplier

DR Number:  
 1. F4E reference:  
 2. Contract ID Ref.:  
 3. Supplier:  
 4. Item:

5. ORIGINAL REQUIREMENT:  
 [always mention the reference doc]

6. DEVIATION PROPOSAL:

7. JUSTIFICATION:

8. LIST OF ATTACHMENTS:

9. IMPACT ANALYSIS:  
 9.1 OTHER ITEMS  
 9.2 SCHEDULE  
 9.3 PERFORMANCE & COST  
 9.4 OTHER:

Supplier's Technical Representative Name: \_\_\_\_\_

Section 2 – to be completed by F4E

Contract Technical RO (WPM) Name: \_\_\_\_\_

1. DECISION:

2. \_\_\_\_\_

Name Signature Date

[ELECTRONIC]

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**Annex A** DMS # F4E/200X/DEPT/XXXXXX  
 Call. # F4E-200X-TYP-NNN (DV-GRP)  
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**8.6. CHANGE PROPOSAL**

Section 1 – to be completed by the Supplier

CP Number:  
 1. F4E reference:  
 2. Contract ID Ref.:  
 3. Supplier:  
 4. Item:

5. ORIGINAL REQUIREMENT:  
 [always mention the reference document (title, number, version) where the requirement comes]

6. CHANGE PROPOSAL:

7. JUSTIFICATION:

8. LIST OF ATTACHMENTS:

9. IMPACT ANALYSIS:  
 9.1 OTHER ITEMS  
 9.2 SCHEDULE  
 9.3 PERFORMANCE & COST  
 9.4 OTHER:

Supplier's Technical Representative Name: \_\_\_\_\_

Supplier's Quality Representative Name: \_\_\_\_\_

Name Signature Date Name Signature Date

[ELECTRONIC TEMPLATE WILL BE MADE AVAILABLE TO THE SUPPLIER]

Divergences are addressed with the following processes:

**Change** – a previously proposed and approved modification to a specified requirement (current approved configuration baselines).

**Deviation** - a previously planned alternative to a specified requirement defined for a specific scope (a limited quantity of product or period of time, and for a specific use).

**Nonconformity** – any condition which does not comply with a specified requirement.

**Multi-code approach is applied for the selection of the Codes for various ITER components:**

- the wide variety of the ITER components and loads which does not allow to use one existing industrial Code;
- the needs to use some advantages of specific existing Codes to cover the particular ITER operational requirements;
- the unique feature of some ITER components (magnet, in-vessels) for which there are no existing Codes and special Codes shall be developed;
- the reduction of cost of equipment due to the procurement sharing with the ITER Members.





In France, the basic regulatory documents do not require specific design and manufacturing Codes, but are documents formulating general Essential Safety Requirements (ESR) and the ways how to fulfil these requirements from technical and legal point of view.

- **Pressure Equipment Directive, 97/23/EC (PED), Directive the French order No 1046, 13th December 1999 concerning pressure equipment (and ammenndmends)**
- **French Order dated 12th December 2005 concerning nuclear pressure equipment**





- ITER components are designed and manufactured following, when possible, existing industrial codes.
- Special additional requirements have been prepared as addendum or technical specifications to the basic selected codes for specific systems
- Following the procurement based on international contributions the reference codes are selected from the ASME codes. ASME has also published documents that provide guides to demonstrate conformity to European requirements
- In some cases European Codes have been or could be selected for special application where the rules better address specific applications.
- During the ITER design phase a large effort has been devoted to the preparation of design criteria for the magnets and the in-vessel components.

# Codes and Standards - Mechanics



Component	PED Category or ESPN category & level	Selected Codes	Comments
Magnets	Magnet structure → no PED Manifolds and piping → PED	Design – Structural Design Criteria - Magnet Manufacturing – Technical specification Acceptance criteria – SDC-MC, based on ASME XI	Notified Body is not involved.
Vacuum Vessel	ESPN: Category IV for pressure and Nuclear Level N2/N3	<u>Metallic parts</u> Design and Manufacturing: RCC-MR 2007 <u>Non-metallic windows</u> Technical specifications	Agreed Notified Body shall check design, manufacturing and conformity.
Blanket System	Blanket Modules – Cat. IV Piping and manifold – Cat. I, Level N3 + TBD	Design – Structural Design Criteria – IVC Manufacturing, inspection: ASME or EN standards (conventional parts) and TechSPecs for other	Agreed Notified Body shall check design, manufacturing and conformity. Divertor case to be considered
Tritium Plant and Detritiation	Categories I-IV, Level N2, N3 or non-nuclear	Design and Manufacturing: - Vessels ASME Section VIII, Div. 2 - Piping ASME B 31.3, Category M - Valves ASME B16.34 -... And Technical Specifications	Conformity with PED/ESPN required, Agrreed notified Body required. Use of EN standards under consideration.
...			

Complete table in “Codes and Standards for ITER Mechanical Components”

# Codes and Standards - Mechanics

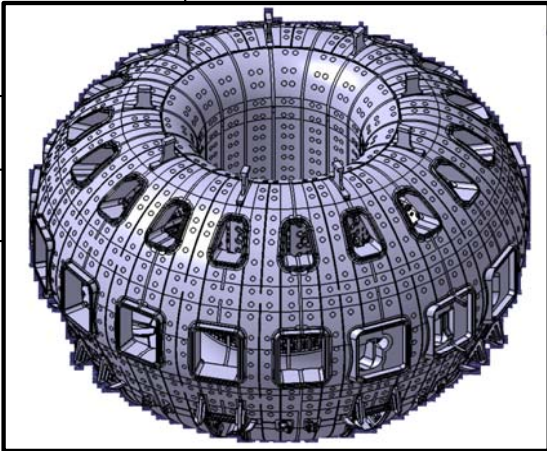


RCC-MR 2002

- Generic - Integrated in the base Code
- Rules for bolts (RB 3280 + A6)
  - Materials
  - Electron Beam and Laser welding
  - Pressure test
  - Rules for box structures (RC3800+RC4000)

- Specific - Appendix A19
- Categorization of welded joints
  - Special rules for permanent attachments sealing welds and Cu coating
  - Use of alternative NDE methods (Ultrasonic Testing and Photo Thermal Camera)
  - Low Co materials

**F4E Active Involvement**



- ← ITER needs - box type structure -
- ← Requirements of ESP and ESPN
- ← Introduction of European (Harmonized) Standards

RCC-MR 2007

To refer as much as possible the international electrical standards issued by the International Electro-technical Commission (IEC).

To facilitate the licensing process by adopting French Standards and European Directives covering the following items:

- installation and operation rules;
- design, manufacturing and testing of components affecting safety (nuclear and personnel) and fire protection.

→ ITER Electrical Design Handbook, Part 3: Codes and Standards

# Codes and Standards - Electrical



SSEN EQUIPMENT	Manufacturing Standard	Indoor / Outdoor Facilities	Site Installation Standard	Nuclear Safety	Personal Safety	Tokamak Complex	Test
MV / LV DISTRIBUTION TRANSFORMERS							
	IEC 60076-1 IEC 60076-2 IEC 60076-... IEC 60296 IEC 60664-1 IEC 61000-5 IEC 61000-6-2 IEC 61000-6-4 HD 538-2 S1 NF C 52-112 / NF EN 50464	IEC 60068-1 IEC 60364	IEC 60076-7 IEC 60364 IEC 60905 IEC 61000-5 IEC 61140 NF C15-100	IEC 60068-3-3 IEC 60780 (SR) IEC 60980 (SR)	IEC 60364-4 IEC 60479 IEC 61140 NF C15-100	IEC 60754 IEC 61249-2-21	IEC 60068-3-3 IEC 60076-1 IEC 60076-2 IEC 60076-... IEC 60076-11 IEC 60664-1 IEC 60754 IEC 61000-6-2 IEC 61000-6-4 IEC 61249-2-21
CIRCUIT BREAKER							
	IEC 60664-1 IEC 60947-1 IEC 60947-2 IEC 61000-5 IEC 61000-6-2 IEC 61000-6-4	IEC 60068-1 IEC 60364	IEC 60364 IEC 60947-1 IEC 60947-2 IEC 61000-5 IEC 61140 NF C15-100	IEC 60068-3-3	IEC 60364-4 IEC 60479 IEC 61140 NF C15-100	IEC 60754 IEC 61249-2-21	IEC 60068-3-3 IEC 60439-1 IEC 60664-1 IEC 60947-1 IEC 60947-2 IEC 61000-4-2 IEC 61000-4-4 ...
...							

## Safety Related Buildings - ITER Structural Design Code for Buildings

- Adaptation of state-of-the-art structural design criteria for civil works
- Specificities of the configurations and loads of a fusion nuclear plant
- Based on the concept of the limit state design used jointly with the method of the partial factors, as stipulated in Eurocode EN 1990
- First part devoted to the design specifications of the safety important buildings of ITER
- Construction rules defined in second part (topography, tolerances, earthworks, concrete works, formwork, reinforcement, base isolation and elastomeric bearings, leak-tight metal parts on containment, etc.).

## No safety related buildings - Application of Eurocode (mainly)

# THANKS FOR YOUR ATTENTION



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