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# PIA Guideline

The purpose of this document is to provide guidelines to F4E Suppliers of PIC for the activities which will be assessed as Protection Important Activities under the INB Order within their scopes of work

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| | *Name* | *Action* | *Affiliation* |
| *Author* | **Wouters P.** | **01 October 2015:signed** | **F4E-A140** |
| *Co-Authors* | | | |
| *Reviewers* | **Chaffard P.- Y.**<br>**Rodrigues D.** | **01 October 2015:recommended**<br>**08 October 2015:recommended** | **F4E-A90**<br>**P-MSOI** |
| *Approver* | **Jucker P.** | **09 October 2015:approved** | **F4E-A140** |
| *RO: Rodrigues Diogo (F4E)* | | | |
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# PIA Guideline

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## Part 1

### Purpose

1. The purpose of this document is to provide guidelines to F4E Suppliers of PIC and / or for the activities which will be assessed as Protection Important Activities under the INB Order within their scopes of work.
2. Before reading this document it is essential the instructions in F4E-QA-115 [Ref 2] have been understood

### Scope

3. The scope of this document covers all the contracts where PIC or Defined Requirements are concerned.

### References

[R1] French Order of 7 February 2012 - *République Française - Arrêté du 7 février 2012*. (http://www.french-nuclear-safety.fr/References/Regulations/Order-of-7-February-2012)

[R2] F4E-QA-115 – 'Supplier Quality Requirements' (F4E-D-22F8BJ)

[R3] F4E-QA-113 – Propagation of Safety Requirements in the Supply Chain ( F4E-D-22JRQY)

[R4] List of ITER-INB Protection Important Activities (IO_D_PSTTZL)

### Definitions

| | | |
|---|---|---|
| Protection Important Activities | (as defined in the French Order – 07 February 2012)<br>*Activity important for protection of the interests mentioned in L. 593-1 of the environment code (public safety, health and welfare, protection of nature and of the environment), i.e. activities participating in the technical or organisational provisions mentioned in the second paragraph of article L. 593-7 of the environment code, or that could affect them.* | PIA |
| Defined Requirement (Safety) | Requirement assigned to a protection-important component so that it may perform the function, with the characteristics expected, provided for in the demonstration mentioned under the second paragraph of Article L.593-7 of the Environmental Code (PIC SDR), or assigned to a protection- important activity so that it may fulfil its objectives as regards this demonstration (PIA SDR). A defined requirement can be attached to a PIC or to a PIA. | SDR<br>(PIC SDR)<br>(PIA SDR) |

4. All definitions are in the document F4E-QA-115

### Terminology

| | |
|---|---|
| CFD | Computational Fluid Dynamic |
| FEA | Finite Element Analysis |
| FMEA | Failure Modes and Effect Analysis |
| HAZID | Hazard Identification |
| HAZOP | Hazard and Operability Report |
| HVAC | Heating, Ventilation and Air Conditioning |
| INB | Installation Nucléaire de Base (Nuclear Facility) |

| | |
|---|---|
| ITER | International Thermonuclear Experimental Reactor |
| M | Mechanical |
| NCR | Non Conformity Report |
| PFD | Process Flow Diagram |
| P&ID | Process and Instrumentation Diagram |
| PIA | Protection Important Activity |
| PI | Protection Important |
| PIC | Protection Important Component |
| QD | An identifier used at Cadarache for the buildings related safety functions |
| RAMI | Reliability, Availability, Maintainability and Inspectability |
| RPrS | Rapport Préliminaire de Sûreté |
| SSC | System, Structure or Component |

## Protection Important Activities – High Level

5. The INB Order of France (Arrêté 07 février 2012) introduces and defines the concept of Protection Important Activities.

6. F4E flows down these requirements concerning PIA through two documents. These are issued with the contracts that F4E places with Suppliers to F4E. The two documents are;

- F4E-QA-115 – Supplier Quality Requirements [R2]
- F4E-QA-113 – Propagation of Safety Requirements in the Supply Chain [R3]

7. These activities occur through the entire lifecycle of the PIC and each part of the lifecycle form the main PIA. These are;

- Design,
- Manufacturing,
- Delivery (including transport) and storage,
- Installation,
- Testing and Commissioning,
- Operations and Maintenance,
- Disposal by surveillance, sentencing and waste packaging.

8. The guide list of PIA for the Supplier to consider when producing the detailed Quality Control Plans is at Part 2 of this document.

## Defined Requirements (Safety) for PIA (PIA SDR)

9. The Defined Requirements (Safety) (SDR) for PIA are the requirements which guarantee the process.

10. Examples of such requirements are;

- Regulatory requirements, (via the F4E contract)
- Requirement enforced by the RPrS (via the F4E contract),
- Specific customer requirement (via the F4E contract),
- Requirement enforced by a design code or a construction code, (via the F4E contract)

- Requirement enforced by an applicable norm or standard, (via the F4E contract)
- Any supplementary requirement requested by a Regulatory Body (via F4E instruction).

### Definition

11. For the "Defined" term to have a meaning there must be a specific numeric or comparative value linked to the requirement. Such examples are;

- Criteria,
- Parameter,
- Tolerance,
- Graph,
- Chart

## Protection Important Activities – Detailed Guidance For Suppliers and F4E

12. Within the scope of F4E activity the PIA can be understood to be an activity which justifies directly or could directly affect a nuclear safety attribute identified by IO. These are called Defined Requirement (Safety) to avoid confusion with project defined requirements and this is consistent with the terminology in [R2], [R3].

13. For Suppliers with limited experience of designing or manufacturing for nuclear projects the identification of PIA is not a straightforward task. To assist Suppliers and give clearer guidance to select activities that are PIA (as required in F4E-QA-115 [R2]), a list of activities which could be PIA is at Part 2.

14. This list takes account of the ITER PIA Guidance document [R4] and forms a basis for achieving agreement between F4E and its Supply Chain as to which activities are PIA and their identification in the Quality Control Plans which are required to be presented to F4E by the Supplier.

15. The reason that it is stated at paragraph 13 that these activities ***could*** be PIA is because the same activity – even under the same contract – but performed for a component which has no Defined Requirement (Safety) or for an analysis which does not demonstrate or justify a Defined Requirement (Safety) will not be PIA.

16. Some examples are discussed in the next four sub paragraphs to assist in understanding why activities are considered PIA.

17. Examples for "Common and administrative activities" are the traceability, tracking and keeping of documented records relating to the performance of a structure, system or component (SSC) to perform a safety function. If these are lost or altered and the lost information for example concerns a verification activity, to demonstrate a Defined Requirement (Safety), then others who may need to refer to those details will be unable to proceed during commissioning, operations or maintenance and the resulting SSC will not perform as required by the Safety Demonstration.

18. Examples for "Design" are activities which will allow unforeseen failure modes to be present within the design, or that will, if they are incorrectly executed, allow the specification of inadequate design margins. Examples are calculation notes, failure analysis, layout drawings, general arrangement drawings, technical specifications.

19. Examples for "Civil Construction" or "Mechanical Production and Manufacturing" are activities which if they are incorrectly performed will allow the material properties to change from those that are required. Examples are processes which change the material state or the material lattice, for example, cooling or welding, forging. Other examples are chemical processes which may change the required performance of the product.

20. Examples for "Delivery" activities are those which may lead to undetected overload or overstress of the product during transport .. .

21. In addition to these activities which are the prime process, the final activity to check, verify or validate the prime process activity is also a PIA, if the prime process is a PIA.

22. The supplier will be very well aware of the detailed activities in his “scope of work” (design, manufacturing, delivery, commissioning…). He will record the detailed activities in the Quality Control Plans. The guidance list of PIA thus serves as guidance for the Supplier to identify the activities which he considers are PIA using the list as guidance. F4E officers will check and approve the completed Quality Control Plans.

23. This list is guidance, if the Supplier considers there are missing activities or inspections, the Supplier shall inform F4E who will update this guidance.

# Part 2 GUIDE LIST OF PIA

## It is reminded that this list of possible PIA is not exhaustive

### COMMON and ADMINISTRATIVE ACTIVITIES RELATED TO PIC SSC

- Maintenance of an up to date Supplier Quality System where they relate to components with a safety function
- Staff qualification
- Personnel training related to Nuclear and Radiation Safety
- Change tracking and Configuration Management Deviation requests
- Management of non-conformities, remedial actions preventive and corrective actions,
- Writing of documents related to PIA's and PIC's including specifications for contracts
- Propagation of the defined requirements in the contracts
- Surveillance of the propagation of the defined requirements in the chain of external contractors
- Technical monitoring actions
- Recording activity

### DESIGN ACTIVITIES RELATED TO PIC SSC TO PRODUCE -

- Basis of Design Document
- Design description including material properties, load limits
- Design Validation
- Design Verification
- Calculation of forces and loads (internal and external) acting on / within the component
- Calculation of flows, pressures, thermal transfers and gradients, thermal shock, fluid pressure pulses
- Calculation of magnetic field strengths, magnetic resistance,
- Calculation of electro-magnetic fields and components resistance
- Radiological calculations for shielding, dose uptake
- Neutronics calculations
- PFD
- P&ID
- HAZOP
- HAZID
- FMEA
- General Arrangement Drawings
- Layout Drawings
- Radiological shine path drawings
- Electrical Single Line Diagrams
- Electrical cable termination schedules and / or diagrams

- Electrical system fault calculations, load factor calculations
- SIL demonstrations
- RAMI
- Technical specifications writing for Protection Important Components or Systems
- Fault calculations such as load drop, FEA for missile impact,
- Models and model programmes performing;
- FEA, CFD, Radiological, RAMI, neutronics, electrical systems analysis,
- Preparation of manufacturing specifications for systems and components including PIC components,
- Writing of manufacturing specifications and purchasing technical specifications
- Writing of sub-contract specifications

## CIVIL CONSTRUCTION OF PIC SSC

- Activities to achieve concrete properties for structures which have a nuclear safety confinement function and activities to achieve concrete properties for individual PIC components such as walls and floors with a safety function.

  These activities could include:
  - Traceability of all materials in the formation of the PIC component.
  - Rebar connection and termination in accordance with drawings
- Forming of walls, slabs and basemats of buildings with safety requirements
  - the regulation of formwork,
  - all the concrete delivery (mixing, pouring & flowing) activities,
  - sampling activities, to determine concrete properties such as strength, elasticity
  - control of environmental conditions during the process,
  - concrete finishing activities (no cracking larger than specification)
- Additional activities to form radiological shield walls
  - mixing activities,
  - all the concrete delivery (pouring & flowing) activities,
  - sampling activities,
  - control of environmental conditions during the process,
  - concrete finishing activities (no cracking larger than specification)
  - Ultrasonic or Scintillation Checks to demonstrate finished shield wall is homogenous.
- Laboratory analysis of concrete samples and their reporting.
- Equipment anchor plates installation in accordance with drawings
- For steel framed, clad buildings with safety requirements, the following are PIA
  - erection of the steel frame in accordance with the design drawings
  - erection of cladding (so that it is in accordance with drawings and will not become a missile under aggression)
- Earthing grids installed and connected in accordance with the design
- Demonstration that leak testing of the structure meets relevant requirements

## MECHANICAL PRODUCTION and MANUFACTURING OF PIC SSC

**(includes materials for civil construction)**

- Traceability of materials in the formation of the component.
- Special Process (processes for which the output cannot be verified) for example hot work activities which could influence the material properties - welding,
- Post formation surface treatment activities which could influence the material cleanliness for example
  - Chemical cleaning or passivation activities
  - Surface etching techniques
  - Surface finishing by machine or hand
- Inspection activities to confirm desired properties are achieved;
- All factory tests of PIC assemblies / systems
- Crane hoist wire terminations in critical load path correctly terminated and tested,
- Crane minimum turns on hoist drums designed, installed, witnessed,
- Weld procedures, weld repair procedures and weld qualification procedures,
- Traceability of weld consumables
- Welder qualification
- Non Destructive Examination Techniques
- Calibration of Measuring and Test Equipment
- Factory Acceptance Tests on PIC to confirm each SSC (M, Process or HVAC) meets the relevant Defined Requirement (Safety)

## ELECTRICAL PRODUCTION MANUFACTURING PROPERTIES OF PIC SSC

- Traceability of all materials in the formation of the component.
- Testing of integrated circuit component boards if used in Class B safety systems for SIC components
- Test of MCB protection circuits
- Factory Acceptance Tests on PIC to confirm each SSC (E or C&I) meets the relevant Defined Requirement (Safety)
- Earth leakage checks on ;
  - Switchboards
  - Motor control centres

## DELIVERY and TEMPORARY STORAGE OF PIC SSC

- Load transfers on/off vehicle where there is a risk that the component can be dropped or be collided and thus the safety features damaged in such a way to prevent them performing their safety function at the time of the incident or at a future time.
- Activities which may detect overload or overstress of the product during transport
- Acceptance inspection on arrival at Site
- Environmental conditions and storage conditions control at the temporary storage location

## GENERAL MEASURES DURING CONSTRUCTION AND INSTALLATION OF PIC SSC

- Management of nuisances and the impact on health and safety for effluent and releases
- Surface cleanliness and decontaminability in accordance with the safety requirement

## INSTALLATION OF PIC SSC

- During transportation the selection and placement of detection equipment to identify damage to the safety features in such a way to prevent them performing their safety function at a future time.
- Pre inspection of structure / area – such as;
  - Installation in accordance with design intent / cleanliness,
  - Component fixings have been surveyed / inspected and accepted.
  - Traceability markings inspection
- Post Installation such as
  - Dimensional and tolerance checks,
  - Weld identity markings inspection in accordance with weld diagrams
  - Surface cleanliness in accordance with specification

## QUALIFICATION AND COMMISSIONING TESTING OF PIC SSC

- Qualification of test of a component can perform its safety function before during and after the chosen qualification test
- Writing detailed test procedures
- Acceptance test performance
- Test reports
- Installation and commissioning tests which demonstrate a defined requirement is satisfied examples could be
  - Pressure tests,
  - Leak tests
  - Interference immunity demonstration
  - Density measurement
  - Equipment functional performance tests

## MAINTENANCE AND OPERATION OF PIC SSC

- Maintenance of the safety functions of Protection Important Components
- Operational checks of the safety functions of Protection Important Components
- Writing the procedures which will control the maintenance and operations of PIC