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Quality Document

P-01.12 Instructions for Suppliers Performing Design Analysis (F4E-QA-114)

The present document defines requirements for the suppliers performing design analysis and calculations

Approval Process			
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Change Log			
P-01.12 Instructions for Suppliers Performing Design Analysis (F4E-QA-114) (22FR5T)			
Version	***Latest Status***	***Issue Date***	***Description of Change***
v1.0	Signed	11 May 2010	
v2.0	Signed	17 February 2015	Major update of the document content and scope.
v2.1	In Work	27 March 2015	Review Comments integrated
v2.2	Signed	07 May 2015	Review Comments Integrated
v3.0	Signed	18 June 2015	Aligned with QA 113
v3.1	Signed	18 June 2015	Typo correction
v3.2	In Work	16 July 2015	Comments included from re-view
v3.3	Approved	21 July 2015	Minor Typo
v4.0	Approved	21 December 2020	New major version. The document is updated to implement requirements of IO L2 Procedure for Analyses and Calculations, which was made applicable to F4E through the MPA dated 24.07.2019 (F4E_D_2HTRUM) and respective L3 instructions for different types of analyses used by F4E matter experts as separately standing requirement documents. The structure of the document is aligned with the structure adopted by QA-115. The document was a subject to the pre-review in F4E IDM with the involvement of main stakeholders: https://idm.f4e.europa.eu/?uid=2MBADZ (this document is attached) .

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SUPPLIER STANDARD

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Document title:	**Requirements for F4E Suppliers Performing Design Analysis and Calculation Activities (QA-114) (P-01.12)**

Areas and functions

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Document Owner	ENG HoU (P-Y. Chaffard)
Process Group and Context:	Compliance Programme
Function(s) concerned:	All Operational Roles, in particular during the contract implementation: • The Technical Project Officer for the follow-up of technical, management and quality requirements. • F4E Suppliers and supply chain.

Purpose

This document identifies the management, quality and technical requirements to be respected by F4E Suppliers performing Analyses and Calculation activities to ensure that those activities supporting the existing, modified, or proposed design of structure, system, or component meet the applicable specific technical requirements, that their outputs are reliable and that their documentation is auditable.

Scope

These requirements are applicable for all F4E Suppliers and contractors, and shall be applied to analysis and calculation activities supporting the design of all components of all quality classes.

These requirements are mandatory in the following cases:

- when A&C are required to document that an existing, modified, or proposed SSC will meet design or operational requirements.
- when A&C are required or planned to be retained as a design verification and validation.
- when A&C constitute alternative calculations (see definition) for completing design verification of an SSC.
- when A&C are required by other ITER and F4E procedures.

These requirements are not mandatory for preliminary or scoping calculations that are to be superseded by later analyses.

This document is complementing the requirements of P-01.14 Supplier Project Management and Quality Requirements (F4E-QA-115) (22F8BJ) and (if applicable) P-01.07 Supplier Nuclear Safety Management Requirements (F4E-QA-113) (22JRQY).

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1. Applicable (AD) and Reference Documents (RD)*

Applicable Documents (AD)

AD01. ITER Coordinate Systems (ITER_D_2A9PXZ)
AD02. Load Specifications (LS) (ITER_D_222QGL)
AD03. SOP-01.37 CAD Data Exchange Transfer (25AL73)

Reference Documents (RD)

RD 01. Codes and Standards for ITER Mechanical Components (ITER_D_25EW4K)

Specific to Mechanical/ Structural Analysis

RD 02. Guideline - Comments on the determination of limit load and plastic collapse load with RCC-MR code (29HG4D)

RD 03. Guideline - Comments on the different approaches to obtain stress range for fatigue assessment (29ESQW)

RD 04. Guideline - State of the art on stress linearization procedures (2993DT)

RD 05. F4E-QA-114 Guidelines for Finite Element Models and Macros (26W8J4)

RD 06. F4E Template - Structural Integrity Report (2GJYNF)

RD 07. F4E-QA-114 Template - Finite Element Model Cover Sheet (25VQ7G)

RD 08. F4E-QA-114 Template - F4E Reviewer Checklist for Mechanical/Structural Analyses (25U6BS)

Specific to Dynamic Analysis

RD 09. F4E Guidelines for Fast Transient Dynamic Analyses (2NQC2D)
RD 10. Template for Dynamic Calculations on Structures and Equipment (2KMAK3)
RD 11. Template for Dynamic Calculations on Structures and Equipment (2KMAK3)

Specific to Seismic Analysis

RD 12. Guidelines for seismic design, analysis and qualification of complex industrial and nuclear facilities against sesimic hazard (26R65J)
RD 13. Template for Seismic Calculations for equipment and/or supports (25J77B)
RD 14. Technical Specification for the Seismic Qualification of Active Electrical and Mechanical Components (24DN59)

Specific to Thermal Analysis

RD 15. QA 114 - F4E Instructions for Thermal Analysis (2LA9ZE)
RD 16. Template for Thermal Analysis (2LUPUS)

Specific to Computational Fluid Dynamics Analysis

RD 17. F4E-QA-114 Guideline - CFD Analysis (ITER_D_VUEEDB v1.0) (F4E_D_29DTCL)
RD 18. Best_Practice_Guidelines_for_the_use_of_CFD_in_Nuclear_Reactor_Safety_Applications (2Q236K)
RD 19. CFD_Analyst_Checklist (2E64LV)
RD 20. CFD_Reviewer_Checklist (2E7WJF)
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RD 22. CFD_Technical_Checker_Checklist (2EQJ2J)
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RD 24. Guidelines for ElectroMagnetic analyses (25LAD7)
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RD 26. F4E-QA-114 Template - Reviewer Checklist - Electromagnetic Analyses (2HWY26)
RD 27. F4E-QA-114 Template - Independent Verification Checklist - Electromagnetic Analyses (2HWX6C)
RD 28. F4E-QA-114 Template - Technical Checklist - Electromagnetic Analyses (2HWW57)
RD 29. F4E-QA-114 Template - Report - Electromagnetic Analyses (2HWYE8)

Specific to Nuclear Analyses

RD 30. F4E-QA-114 Guideline - Nuclear Analyses (26NR86)
RD 31. F4E Template - Nuclear Analysis Checklists (25U3EF)
RD 32. F4E Template - Nuclear Model Cover Sheet (25VEXY)

Softwares

RD 33. ANSYS Mechanical User's Guide v19.2 or newer.
RD 34. ANSYS Mechanical APDL Theory Reference v19.2 or newer
RD 35. Ansys Fluent, User's guide, release 17.2 or newer
RD 36. Ansys Fluent, Theory guide, release 17.2 or newer

*Note: for F4E documents the latest approved version is applicable.

2. Definitions and Acronyms

Analyses and Calculations	Intentionally not defined	A&C
Alternative calculations	A method of design verification executed by the performer of the analyses/calculations or by independent peer reviewers using different model(s) or different methodologies to confirm correctness of original analyses or calculations. Recommended when the analysis/calculation models and methodologies are complicated/difficult to be verified or in case of a large relevance to the design justification. Source: IO definition rephrased	
Analyses	The term refers to the study and work performed for the qualitative or quantitative evaluation of engineering data or physical parameters that supports the development and justification of SSC design. Analyses may be supported by calculations. Source: IO definition rephrased	
Calculations	Quantitative computations to determine the value of a quantity or a physical parameter (such as flow rate, temperature, stress, or neutron flux) performed with the use of different tools and documented in following forms: hand calculations, spreadsheets, Math-Cad files, finite element models and associated computer output. Source: IO definition rephrased	
Calculation software	Computer programs, procedures, rules and associated documentation and data for resolution of the mathematical model using a computer or programmable device. This software includes (but not limited to) software used in programmable devices such as calculators, purchased (e.g. Math-Cad, Excel, etc.) or developed software, software layers, macros, routines, operating parameters, or data tables. The data referred to in this definition do not include the input and output data for the subject calculation. Source: IO definition rephrased	
Computational Fluid Dynamics	Intentionally not defined	CFD
Computer Aid Design	Use of computer software to aid in the creation, modification, analysis, or optimization of a design	CAD
Conceptual Model	An abstract representation of a physical system whose behaviour is governed by a set of mathematical equations and which is used to derive an approximate response of the physical system under study for specific domain of application (e.g. electromagnetic, structural dynamics, thermal, etc. response)	
Contract Tracker System	The Contract Tracker System is the application of the F4E Contract Management Platform (CMP) dedicated to the exchange and traceability of documents, correspondence and meetings between F4E and the Supplier in the frame of contract grants and international agreements (framework contracts and partnership agreements) execution. Source: P-02.29 F4E-Supplier Documentation Exchange (23CKVU v2.1)	CTS
Deliverable	Any good or service completed by the Supplier in the frame of the contract signed with F4E. E.g. hardware, documentation, software etc. - Document Deliverable: Any document produced by the supplier in the frame of the contract and provided to F4E. - Physical Deliverable: hardware or software produced by the supplier in the frame of the contract and provided to F4E. Source: Deliverable Acceptance PM-04.20 (former PM-63) Deliverable Acceptance (262PUA) (provided only the applicable part of the definition)	
Data Exchange Task	Set of tasks to manage the exchange of CAD data between IO, F4E and suppliers within the ITER project. Each data exchange task is identified with a number and it is link with a form which describes the purpose of the exchange and the set of CAD data exchanged.	DET
Electro-magnetic	Intentionally not defined	EM
Finite Element Method	General purpose numerical method well suited to solve engineering and physics problems in areas such as structural mechanics, heat transfer, fluid flow, mass transport, and electromagnetics	FEM

Independent calculations	Calculations performed by persons, who did not participate directly in the execution of the study in question, to confirm the correctness of the original analyses. Shall be performed using a different calculation approach or software. Source: IO definition rephrased	
Independent peer reviewer	A qualified (SQEP) individual not involved in the original A&C, in any of its validation or decision-making related to the original work, and other than the reviewer(s), who performs the Independent Peer Review to identify oversights, errors, conceptual deficiencies, and other potential problems. The independent peer reviewer may belong to: - The same organisation/company as the Performer, but in this case evidences of the "independent status" of the reviewer shall be available to F4E. - Other organisation than a supplier (contracted by the Supplier or F4E) - F4E or IO Source: IO definition rephrased	
ITER Organization	F4E Customer	IO
Model	The conceptual, mathematical, and numerical representations of the physical phenomena needed to represent specific real world conditions, process, and SSC. A computational model is a computer implementation of the mathematical model, usually in the form of numerical discretization, solution algorithm, and convergence criteria. Source: IO definition	
Monte Carlo N-Particle	Transport code	MCNP
Performer	A suitably qualified and experienced (SQEP) individual or team, who carries out the calculation task according to the technical specification, performs self-checks and produces the reporting documentation. Source: IO definition	
Qualification	Process of demonstrating whether an entity is capable of fulfilling specified requirements (IO Software Qualification Policy)	
Quality Assurance	Intentionally not defined	QA
Quality Class	Intentionally not defined	QC
Reviewer or Technical Checker	An individual or group of individuals (SQEP) selected to verify the correctness of all or specific aspects of the analysis insofar as the stated objectives are concerned. Reviewers/Technical Checkers shall be sufficiently qualified by education and/or experience on the specific aspect they have to verify. Reviewer/Technical Checker activity includes, among other tasks, the verification that the calculation models are adequate for the purpose of the analysis and that the data are correctly implemented in the models. Source: IO definition rephrased	
SI	International System of Units	SI
Suitably Qualified and Experience Person	Term equivalent to the International Atomic Energy Agency concept of 'competence' defined as "the ability to put skills and knowledge into practice in order to perform a job in an effective and efficient manner to an established standard".	SQEP
Systems, Structures, Components	Intentionally not defined	SSC

Technical checking	A critical review of the analysis or calculation by a qualified individual (SQEP) to verify that the analysis or calculation is performed correctly and that it satisfies the stated objectives. The technical checking includes, among other tasks, a verification that the calculation models are adequate for the purpose of the analysis and the data in the analysis models are correctly implemented. Source: IO definition	
Tokamak Global Coordinate System	Intentionally not defined	TGCS
1D, 2D, 3D, 0D	One-, two-, three-dimensional, non-dimensional	
Unique Identifier	String of alphanumeric characters that uniquely identifies a SSC or any of its parts	UID
Validation	Is the process of determining the degree to which an analysis model is an accurate representation of the real world from the perspective of the intended uses of the model. This also includes experimental confirmation of some parts of the model or the entire model as required. Source: IO definition rephrased	
Verification	The process of determining that a computational model accurately represents the underlying mathematical model and its solution. Source: IO definition rephrased	
Verification and Validation	Intentionally not defined	V&V

3. Contracts involving PIC/PIA activities

F4E-QA-114-GEN-NS-01	For all Contracts involving PIC/PIA activities, the Supplier shall apply requirements of P-01.07 Supplier Nuclear Safety Management Requirements (F4E-QA-113) (22JRQY) in addition to all requirements defined in this document

4. Compliance Matrix to QA-114

F4E-QA-114-GEN-CM-01	The Supplier shall submit to F4E (together with PQMP, but as a separate document) the Compliance Matrix* demonstrating the compliance to the requirements of this document (QA-114): (1) At the level of the Framework Contract (requirements related to Supplier´ organization and handling of deliverables). (2) At the level of the Specific Contract (the first version together with the Analysis Plan) The compliance matrix shall be fully completed by the time of the submission of ADP. *The template for the compliance matrix is to be generated based on the list of the requirements (Excel file) Compliance matrix (2QJMW9)

5. Requirements to Supplier's Organisation and Process for Performing Engineering Analyses Activities (ORG)

F4E-QA-114-ORG-PRO-01	The Supplier shall establish an internal procedure to execute A&C activities (drafted and reviewed by SQEP) and include it into the Project and Quality Management Plan (PQMP) of the contract.
F4E-QA-114-ORG-PRO-02	The performer, reviewer/ technical checker and independent peer reviewer of analyses in the Supplier organisation shall be the SQEP.
F4E-QA-114-ORG-PRO-03	The Supplier´s procedure shall describe at least the following: (1) process followed to carry out A&C activities (2) organizational and technical means to carry out A&C (3) levels of control deployed to fulfill the Control Plan requirements (or cross-reference to PQMP if the information provided there).
F4E-QA-114-ORG-PRO-04	The Supplier procedure shall envisage at least the following Performer´s responsibilities: (1) Use the appropriate reporting format for the analysis or calculation as defined in the technical specification. (2) Use only applicable input data derived from the valid reference source. In case of uncertainties in the input data (non-certified input data) or the methodology - report these uncertainties and the impact on the conclusions. (3) Perform the analysis or calculation in accordance with the requirements contained in the technical specification (4) Use validated analysis methods for their use in the specific application (5) Details and justifies the assumptions made (6) Present results to demonstrate that the acceptance criteria (by F4E requirements or selected Standards) are met and safety limits are respected indicating the achieved margins. (7) Carry out self-checks and sensitivity studies to address potential inconsistencies, errors or uncertainties and to check or to demonstrate

	the accuracy of the results. (8) Document the analysis as per requirements of the Chapter 7 of this document.
F4E-QA-114-ORG-PRO-05	The Supplier procedure shall envisage at least the following Reviewer/ Technical Checker responsibilities: (1) check that the A&C package comply with the technical requirements; (2) Check that the calculation model is appropriate to the purpose of the analysis and reflects correctly the geometrical data and the interfaces of the system under investigation; (3) check that the basic approach, assumptions, subject-specific data (such as loads), and equations or formulae applied are appropriate (4) check that input data are consistent with requirements or validated by referenced sources. If a calculation has numerous input and output values, the technical checker/ reviewer can select a representative sample of the total input and output values for review. In these cases, he/ she shall report the values selected in the review documentation (5) check that all references cited are retrievable and applied correctly (e.g. references such as e-mails and phone call records shall be annexed to the report) (6) check that the calculations are mathematically correct (7) if alternative calculations are used as checking method by the reviewer, these shall be documented and archived (document, software and models) (8) check that the conclusions are consistent with the A&C approach, assumptions, input, and acceptance criteria (9) check that the software is validated for the scope of the analysis, submit comments resulting from the review to the performer for resolution and after the implementation of comments by the performer checking that comments are addressed (10) fill the applicable F4E checklist template as evidence of the performed review and reference it in the control plan. If agreed with F4E TPO the Performer's report may be reviewed in track changes and such document shall be used as evidence of the review performed (instead of the checklist)
F4E-QA-114-ORG-PRO-06	In case the Independent Verification is in the scope of the contract, the Supplier procedure shall envisage at least the following Independent Peer Reviewer responsibilities. (1) execute a review of the completed A&C that includes: a) check that design or analysis phylosophy is sound b) check that A&C approach is reasonable and appropriate c) check that all assumptions are substantiated and justified d) check that the correct systems, materials, loads, etc. are considered e) check that all inputs are correct f) check that mathematical formulations and/or models are appropriate and contain sufficient details g) check that the outputs are coherent with inputs and assumptions h) check that the acceptance criteria used are appropriate. i) check that the conclusions are representative of the outputs (2) submit comments resulting from the review to the performer for resolution and after the implementation of comments by the performer checking that comments are addressed

	(3) fill the applicable F4E checklist template as evidence of the performed review and reference it in the control plan. If agreed with F4E TPO the Performer's report may be reviewed in track changes and such document shall be used as evidence of the review performed (instead of the checklist)
F4E-QA-114-ORG-PRO-07	The Supplier procedure shall envisage at least the following Performer's Manager or Supervisor responsibilities: (1) ensure the technical quality of the A&C by checking that they have been performed according to the company's processes (2) ensure that the deliverables comply with the specifications (3) approve all the deliverables

6. Requirements to Supplier's Analysis Plan (ANP)

6.1. General Requirements (GEN)

F4E-QA-114-ANP-GEN-01	Before the start of each calculation/analysis activity the Supplier shall develop and submit for F4E approval as a separate document a specific **Analysis Plan** describing as a minimum (if not specified otherwise in the technical specification): (1) Purpose, scope and objectives of analyses (2) Schedule of Analyses (3) Analysis method and the justification of the analysis method (4) Calculation and Modelling Tools (including Verification and Validation methods) (5) Input Data Management (6) Codes and Standards (7) Required output (8) Compliance with the requirements of analysis-specific chapter of this document.

6.2. Analysis Method (MET)

F4E-QA-114-ANP-MET-01	The Supplier shall **select** the **analysis method** on the basis of its **appropriateness** to the specific application from the perspective of the intended use of the results, the required accuracy and conservatism. The analysis method may also include the application of codes, standards or other established procedures.
F4E-QA-114-ANP-MET-02	The selection of an analysis method for a specific application shall be justified. In particular, the Supplier shall carry out studies to determine the **sensitivity** of analytical results to the assumptions made, the rules used, and the methods of calculation.

6.3. Calculation and Modelling Tools (CMT)

F4E-QA-114-ANP-CMT-01	The Supplier **shall submit to F4E** for agreement, before the start of activities, the list of modelling tools (including all details - e.g., Finite Element method, Computational Fluid Dynamics,…) and calculation software to be used during the implementation of the contract, and seek to F4E acceptance. The Supplier shall only use **validated modelling tools and verified calculation software and only for the intended purpose**. The computer package shall be used in its intended and **validation domain**.
F4E-QA-114-ANP-CMT-02	If a validated analysis software package has non-negligible **uncertainties** when used properly, the uncertainties shall be covered either by performing sensitivity studies or by applying a suitable safety factor to the results.
F4E-QA-114-ANP-CMT-03	The Supplier shall provide to F4E the **basis of verification and validation justification**, code inputs and all supporting documentation at the Kick-of-Meeting

	(if not available by KoM, with the Analysis Plan).
F4E-QA-114-ANP-CMT-04	**ANSYS** is the recognised F4E software used for thermo-mechanical, seismic, dynamic, electomagnetic and CFD analysis. Use of other analysis software shall be requested and granted by F4E in written. In case of coupled analysis (for example, thermo-mechanical analysis), the Supplier shall seek the approval of the use of specific software from F4E. *This requirement is not applicable to Nuclear Analysis.
F4E-QA-114-ANP-CMT-05	**MCNP** or **D1SUNED** shall be used for radiation transport simulations. **FISPACT** or **ACAB** shall be used for activation calculations. D1SUNED shall be used for computation of shutdown dose rate responses (SDDR) from neutron activation of materials. Records of the correct installation of these codes may be required by F4E, in which case they shall be provided. For other codes to be used in these types of analyses, it shall be only after prior agreement by F4E. Agreement will require at least that the code shall be qualified according to ITER requirements. *This requirement is only applicable to Nuclear Analysis.
F4E-QA-114-ANP-CMT-06	Analysis software and its installation on the computer used for the analysis shall be **qualified and verified.** Records of the correct installation of these software packages may be required by F4E. When existing, ITER qualification requirements shall be used.
6.4. Codes and Standards (COD)	
F4E-QA-114-ANP-COD-01	The Supplier shall follow the **codes/standards** specified by F4E in the contract
F4E-QA-114-ANP-COD-02	The Supplier shall **assess the applicability, adequacy and sufficiency of the codes and standards** specified by F4E. When a specific code or standard is used, its assumptions, limits and conditions shall be verified and documented in the Analysis Plan.
F4E-QA-114-ANP-COD-03	If a code/standard is not specified in the contract, the Supplier shall respect the following **rules** when applying codes and standards: (1) For ITER Mechanical Components, the code/standard selected shall be in line with [RD 01] (2) Only established national or international codes and standards shall be used for design of structures, systems, and components. The codes and standards shall be used for an application belonging to their scope and their limit of application (3) The combination of different codes and standards for a single aspect of a structure, system or component shall be avoided. If avoidance is not possible they shall be justified when used. (4) The selection of codes shall be justified on basis of its appropriateness to the specified application and it shall be accepted by F4E
F4E-QA-114-ANP-COD-04	A number of **ITER references** exist to provide reference specifications of some of the input data and standards needed **for nuclear analyses** (reference models & sources, irradiation scenario, dose factors), which F4E will provide. They shall be used when possible and applicable and agreed with, or even specified by, F4E. Deviations from or modifications to this reference data may be needed, even specified by F4E, in which case they shall be fully recorded and justified. *This requirement is only applicable to Nuclear Analysis.

F4E-QA-114-ANP-COD-05	Use of **reference models** shall be made when possible and applicable. The version of the reference model used must always be reported. *This requirement is only applicable to Nuclear Analysis.
F4E-QA-114-ANP-COD-06	The **material data** (chemical composition and density) for the detailed portions of the model relevant to the specific analysis application shall be the same as in the reference models when possible and applicable. If new materials are used, the analyst shall implement new material descriptions and provide references for these. When available, measurements of the chemical composition shall be used. For activation analyses the correct impurity levels are required. *This requirement is only applicable to Nuclear Analysis**.**
F4E-QA-114-ANP-COD-07	Referenced, validated and recommended **nuclear interaction data** for fusion applications in radiation transport, activation, radioactive decay and nuclear responses shall be used in all cases. Only in the case of missing data, e.g. for exotic isotopes, different sources might be used in which case they shall be reported. *This requirement is only applicable to Nuclear Analysis.
6.5. Required Output (OUT)	
F4E-QA-114-ANP-OUT-01	The **required output** of the analysis (responses of interest, data files, computer models, reports, etc) and corresponding acceptance criteria (including spatial and energy resolution for nuclear calculations) shall be clearly identified, agreed with F4E and reflected in the Analysis Plan.

7. General and Analysis-Specific Technical Requirements (TECH) "Y" in the table below means that the requirement is applicable, blank box – not applicable.		structural/mechanical analysis	dynamic analysis	seismic analysis	thermal analysis	computational fluid dynamics analysis	electromagnetic analysis	nuclear analysis
7.1 Root QA Requirements (GEN)		**STRM**	**DYNA**	**SEIS**	**THER**	**CFD**	**EM**	**NUC**
F4E-QA-114-TECH-GEN-01	The Supplier shall follow the **general requirements** contained in this Section, as well as the **specific requirements** defined in this section (7) for the type of analysis to be performed (structural, seismic, dynamic, thermal, electromagnetic, CFD and nuclear). Guidelines on the acceptable methods, tools, model preparations and post-processing are available for each specific type of analysis (see reference documentation). In case a requirement is not applicable, it shall be justified in the analysis documentation (eg. compliance matrix), unless the list of applicable requirements is specified in the technical specification.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
7.2 Input Data (INP)								
F4E-QA-114-TECH-INP-01	The analysis supplier shall review the **appropriateness** and consistency of the input data available for analysis. Input data shall be traceable and retrievable. The supplier shall inform F4E about the detection of any lack of information or doubt on technical requirements, which may be necessary for the successful performance of the analysis. A specific chapter in the analysis plan/ in the final report or note shall summarize all the input data.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-INP-02	If there are **uncertainties** associated with the input data, the input data shall be considered in a conservative manner. This may require that more than one calculation is performed.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-INP-03	**Safety Importance Class** (SIC) of the SSCs shall be clearly presented with a clear explanation and classification on the events inducing the loads. The classifications can be specified in the System Load Specification (SLS) document and explicitly referred by the analysis report.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-INP-04	The **Seismic Class** (SC) of the SSCs shall be clearly presented with a clear explanation and classification of the level of functionality and structural integrity during or after a seismic event. The classifications can be specified in the System Load Specification (SLS) document and explicitly referred by the analysis report.			**Y**				

7.3 Conceptual Model and Analysis Method (MOD)								
F4E-QA-114-TECH-MOD-01	The **conceptual model** shall represent the physical reality in a sufficiently complete (geometry, materials, loads...) and accurate manner to cover the intended purpose of the analysis. To ensure the fulfillment of the requirement F4E-QA-114-TECH-MOD-01, the Supplier shall clearly define the **intended use** of the model.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-MOD-02	Appropriate and valid* analysis **method(s)** shall be used. Hand calculations and computer analyses are valid analysis methods, as long as they are used in an appropriate manner and domain. * In particular, a valid analysis method makes engineering predictions with adequate confidence for the intended use.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-MOD-03	Assumptions used in the analysis shall be traced in the analysis plan or in the analysis report, and consistent or conservative with respect to the engineering design and constrains. Justifications shall be given for each relevant simplification or assumption. Relevant omissions shall be accounted for by means of sensitivity/uncertainty analysis.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-MOD-04	**Guideline** reference documents for dynamics and seismic give some guidance for the applicable methodologies. For any specific methodology chosen from those introduced in the Guidelines, the associated requirements in this document shall be respected.		**Y**	**Y**				
F4E-QA-114-TECH-MOD-05	Selection of the **turbulence model** shall be done in consistency with the flow type, the available mesh and the nearwall treatment; otherwise, a proper justification has to be provided.					**Y**		
F4E-QA-114-TECH-MOD-06	When using **SDDR** analysis tools based on the D1S method and its limited set of adapted nuclear data, their appropriateness for the application at hand shall be demonstrated. Separate activation calculations (for example with FISPACT) shall be conducted to determine if all significant activation reactions and dominant nuclides are included. **Pathway** analysis of the production of the dominant nuclides shall be reported.							**Y**
F4E-QA-114-TECH-MOD-07	The choice and type of **variance reduction**, if any, shall be appropriate to the problem at hand and not introduce solution bias.							**Y**
F4E-QA-114-TECH-MOD-08	The geometry, material allocations and densities of the model must account for the plant state corresponding to the intended purpose of the analysis.							**Y**
F4E-QA-114-TECH-MOD-09	Methods based on definitions of local magnetic field and its time derivative shall not be applied to components that are located inside the bioshield.						**Y**	

7.4 Geometry (GEO)								
F4E-QA-114-TECH-GEO-01	The Supplier shall use the up-to-date CAD input data for the specific analysis application transferred by F4E through a **DET** or, after agreement with F4E, in other traceable manner.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-GEO-02	When applicable, the **uncertainty** in the geometry, e.g. due to tolerances, shall be considered.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-GEO-03	**Deviations** from the current approved design geometry shall be justified. The quantitative effect of the deviations on the results shall be estimated, and considered in the conclusions of the analysis.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-GEO-04	All geometry **approximations** (i.e. differences between the input data and the representation used in the simulation program) must be described, including comparative images and relevant dimensions.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-GEO-05	The use of **density adjustments** to preserve mass and account for volume changes during the implementation of geometry approximations ("optical thickness" approximation) is not recommended but, if performed, a description of how the densities were derived shall be provided.							**Y**
F4E-QA-114-TECH-GEO-06	**Homogenisation** of solid and void geometry is not acceptable. As many streaming paths as practical must be preserved; streaming paths which are not preserved must be reported. Homogenisation of strongly absorbing together with strongly scattering materials (e.g. steel with water) shall be avoided as much as possible; otherwise an assessment of the systematic effects must be performed and reported. Other homogenisations (materials with similar nuclear properties, e.g. different steels) are not recommended but are acceptable provided that: (i) the derivation of the material mix from the original component design is reported, and (ii) the homogenisation does not degrade the spatial resolution so that features of a similar size (within a factor of ~5) to the tally volumes are not lost. The tally volume refers to either cells used for tallying or individual voxels in a mesh tally.							**Y**
F4E-QA-114-TECH-GEO-07	When **integrating** a specific model in the ITER reference model, the following precepts shall be followed: (i) The structure of the integrated model shall follow that of the reference model. Use of headers shall be made for identification of the different sections of the specific model: cells, surfaces, material definitions, source specification, variance reduction, tallies, problem set-up. (ii) Modifications introduced to the reference model to enable integration of the system-specific model shall be kept to a minimum in order to preserve the standardizing nature of the ITER reference models. Any modifications to the system-specific and reference models (e.g. new/modified cells, new materials) shall be suitably commented so as to facilitate understanding of the nature and purpose of the changes. (iii) Traceability of model development and integration shall be retained by use of comment indexation by author and date; to this end, the use of version control (manual or software-based) is recommended. In the case of software-based version control, the change log shall be provided together with the model.							**Y**

7.5 Material Properties (MAT)								
F4E-QA-114-TECH-MAT-01	Materials shall be properly **listed** and referenced to material databases, material repositories or applicable codes and standards.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-MAT-02	The analysis shall also consider the **uncertainties** in material properties. A practical way of ensuring this during the design phase is to reference and use the minimum and/or maximum values specified in the applicable Structural Design Criteria.	**Y**	**Y**	**Y**				
F4E-QA-114-TECH-MAT-03	The **properties** required to perform the analysis shall be documented, including their dependencies (e.g. temperature, magnetic field etc….) if relevant for the analysis.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-MAT-04	When defining **material cards**, the analyst shall state if atomic or mass fractions were used. If material cards are isotopically separated, the chemical composition by element shall be reported so that comparison with references is possible.							**Y**
F4E-QA-114-TECH-MAT-05	When composing **mixtures of materials**, the analyst shall describe how all mixtures were derived. This description shall include the volumes and densities of all materials used in the derivation.							**Y**
F4E-QA-114-TECH-MAT-06	The **densities** of all materials shall be reported. If amended densities are used to account for homogenisations and/or for the presence of voids which are not modelled explicitly, the analyst shall describe how the amended densities were derived. Densities of all materials shall be corrected for temperature and pressure appropriate to the operating regime of the component.							**Y**
F4E-QA-114-TECH-MAT-07	Additional **prescriptions** for geometry and material representations of models to be used in **reference models**, and defined in the reference model documentation, shall also be observed.							**Y**
7.6 Boundary Conditions and Input Loads (BCL)								
F4E-QA-114-TECH-BCL-01	All generalized input loads (forces, displacements, temperature, etc.) and load combinations used for the analyses shall come from the relevant and approved **Load Specification**.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-BCL-02	When applicable and in accordance with the Load Specification, single load cases and load combinations shall be properly **identified**. In case some loads are not applicable for the component, a proper justification shall be done. Regarding the load combinations, it is possible to propose envelopes as well, provided that a proper justification is included in the analysis documentation.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-BCL-03	The **input seismic loads** shall be clearly defined. Reference documents for the definition of the seismic loads, if any, shall be approved by F4E (please refer chapter 8 of the seismic guideline).			**Y**				
F4E-QA-114-TECH-BCL-04	The **input dynamic loads shall be clearly defined and analysed**. Reference documents for the definition of the dynamic loads shall be approved. The frequency content and the spatial distribution		**Y**					

	of the input load shall be analyzed in details.							
F4E-QA-114-TECH-BCL-05	If any structure symmetry or special **boundary conditions** are used, they must all be described and justified	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-BCL-06	If any repeated structures or block structures or special **boundary conditions** such as reflecting surfaces are used, they must all be described. An assessment of systematic errors introduced by these techniques must be included in the report of the analysis. The tally definitions and renormalisations must be adequately explained to show that no systematic errors are introduced.							**Y**
F4E-QA-114-TECH-BCL-07	The **correctness of the intended source spatial and energy distribution** must be demonstrated with tallies and/or graphical illustration of the source events.							**Y**
7.7 Units (UNI)								
F4E-QA-114-TECH-UNI-01	All analyses shall be performed using **S.I. units** (m, s, W, etc…) and derived units. The only exception to this rule is that degrees Celsius may be used instead of Kelvin.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
7.8 Mesh, Element Types and Element Shapes (MSH)								
F4E-QA-114-TECH-MSH-01	The choice of **element type, shape and order** shall be justified. The element types, shape and order shall be selected taking into account the type of analysis that shall be done and the type of results that need to be obtained (e.g. avoidance of shear locking, 1st vs 2nd order, etc.)	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-MSH-02	**Mesh quality** check shall be performed. Mesh quality summary must be included in the analysis documentation: total number of elements, including number by element type, aspect ratio, parallel deviation, maximum angle, jacobian ratio, warping factor, etc…	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-MSH-03	If **poor quality elements** have been identified by the check, their use shall be justified. Warning elements shall be minimized as possible. They shall not be localized in areas where the local structural assessment is to be performed.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-MSH-04	**Error elements** are not acceptable. Warning and error thresholds shall be clearly reported if they are non-default.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-MSH-05	**Mesh refinement** near the wall shall be in accordance with the skin depth effects of eddy currents in proximity of the surface of the components under analysis.						**Y**	
F4E-QA-114-TECH-MSH-06	**Mesh refinement** near the wall shall be in accordance with the chosen model for Near Wall Treatment (consistent y+ value and/or number of cells).					**Y**		

F4E-QA-114-TECH-MSH-07	**Sensitivity** to mesh design and refinements shall be carried out in order to define the right level of discretization and assess the uncertainty level of the retained grid; otherwise, a proper justification has to be provided.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
7.9 Solution Settings (SOL)								
F4E-QA-114-TECH-SOL-01	The numerical solver **settings** chosen for the analysis shall be appropriate for the analysis and properly documented. Sensitivity to the solution setting shall be evaluated and reported.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-SOL-02	In case of transient analysis, the **time step and the algorithm** used for the time-integration (explicit, implicit or semi-implicit) shall be chosen in accordance to the stability and accuracy requirements.		**Y**	**Y**	**Y**	**Y**		
F4E-QA-114-TECH-SOL-03	If **structural damping** is used, it shall be demonstrated that damping has been applied as intended (eg. for dynamic analyses).		**Y**	**Y**				
F4E-QA-114-TECH-SOL-04	Thermal load shall be defined by localized or distributed heat sources and imposed temperature or imposed thermal flux at boundaries or part of component. The loads can be **steady-state or transient**.				**Y**	**Y**		
F4E-QA-114-TECH-SOL-05	The choice of type, dimensions and resolution of the **tally** result, including mesh tallies and tally multiplier cards, must be reported and appropriate to the required output and responses.							**Y**
F4E-QA-114-TECH-SOL-06	The **normalisation of tallies**, be this via tally multipliers or post-processing, shall be appropriate for both the fusion power and any modelling approximations or boundary conditions that may have been used, such as the use of reflecting planes.							**Y**
7.10 Stress Classification and Categorisation (SCC)								
F4E-QA-114-TECH-SCC-01	The Supplier shall identify by plots of **Tresca or Von Missess** stress, the most stressed areas of the component analysed, in order to identify those which could be critical during the Code assessment. Applicable for steel structures.	**Y**	**Y**	**Y**				
F4E-QA-114-TECH-SCC-02	When assessing **Code stress limits**, the Supplier shall determine the membrane, membrane plus bending, peak and total stress values (stress categorization) of the most critical areas. Stress classification lines or planes shall be used for this purpose. Applicable for steel structures.	**Y**	**Y**	**Y**				
F4E-QA-114-TECH-SCC-03	Location and direction of **stress classification lines** or planes shall be carefully justified by the Supplier, for the damage mode under study. Applicable for steel structures.	**Y**	**Y**	**Y**				
F4E-QA-114-TECH-SCC-04	**Stress classification path** shall run across the wall thickness. Applicable for steel structures.	**Y**	**Y**	**Y**				
F4E-QA-114-TECH-SCC-05	Additionally, in order to perform the Code assessment, the Supplier shall evaluate the **nature of the**	**Y**	**Y**	**Y**				

	stresses obtained, primary or secondary, in terms of the potential damage over the component under study (stress classification). Applicable for steel structures.							
7.11 Verification and Validation of Analyses								
7.11.1 Verification of Numerical Results (VNR)								
F4E-QA-114-TECH-VNR-01	The **convergence** shall be demonstrated with balances and sensitivity studies (numerical parameters, residuals criteria, under-relaxation factors and time step); otherwise, a proper justification has to be provided.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
7.11.2 Mass and Surface Check (MSS)								
F4E-QA-114-TECH-MSS-01	When model mass is relevant for the physics analysed, a **mass budget check** (or volume check) and a surface check (for the main interfaces) shall be done to verify that the analysis model adequately represents the component analysed and reported.	**Y**	**Y**	**Y**	**Y**	**Y**		**Y**
F4E-QA-114-TECH-MSS-02	Significant differences or **deviations** identified in mass, centres of gravity, volumes, or surfaces shall be justified. Evidence of comparison of the analysis model and simplified CAD shall be provided.	**Y**	**Y**	**Y**	**Y**	**Y**		**Y**
F4E-QA-114-TECH-MSS-03	A **detailed mass check** shall be performed if inertial effects are relevant to the analysis.The total mass, centre of gravity, and second moments of inertia shall be reported. For complex structures it is necessary to perform this check on a component level.		**Y**	**Y**				
F4E-QA-114-TECH-MSS-04	A **balance and comparison of the masses** in the design and in the analysis model must be performed and presented. For analysis of components inside the bio-shield, a deviation in material masses greater than 2% is not acceptable. Deviations of between 2% and 0.1% are acceptable only for preliminary, conceptual and pre-conceptual design stages. Deviations of less than 0.1% are generally acceptable. For components outside the bio-shield, a deviation in masses between the input CAD models and the radiation transport models of less than 2% is acceptable.							**Y**
F4E-QA-114-TECH-MSS-05	The **geometry must be free from errors** i.e. all space must be defined once and only once. There must be no obvious errors observed in the MCNP plotter (red dotted lines). A lost particle probability in a “void” model, with an inwardly directed spherical cosine source of R=20 m which covers and floods the entire geometry, of better than 1 in 10^7 is acceptable provided that it is estimated with <30% statistical uncertainty and that none of the errors are close to any tally region. If a different source size and/or geometry is used, the acceptable lost particle probability shall be scaled accordingly.							**Y**
7.11.3 Check of Simplified Load Cases (SLC)								

F4E-QA-114-TECH-SLC-01	It shall be checked whether the analysis model gives expected results on **simplified load cases** (easy to identify and understand; gravity load case, for instance).	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
7.11.4 Check of Reaction Forces (RFM)								
F4E-QA-114-TECH-RFM-01	It shall be checked whether the **balance of relevant analysis results magnitudes** (for instance, reactions on the boundaries and constraints in the form of forces or fluxes) of the analysis model correspond to what is expected. Summary tables with magnitude, sign, directions (as applicable) shall be provided for relevant load cases in order to verify that the intended loads are correctly applied. The distribution of loads and the load paths are to be checked for consistency too.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-RFM-02	In the special case that the **applied loads** cancel each other out, e.g. internal pressure in pressure vessels or restrained thermal expansion, it shall be verified that the magnitude of the applied loads is approximately correct.	**Y**	**Y**	**Y**	**Y**			
F4E-QA-114-TECH-RFM-03	When **complex structures** made of several sub-structures are considered, the resulting **interface forces and moments** shall be checked for each sub-structure. The point(s) considered for the calculations of the moment(s) shall be reported.	**Y**	**Y**	**Y**			**Y**	
F4E-QA-114-TECH-RFM-04	When **complex structures** made of several sub-structures are considered, the resulting thermal loads and thermal flux shall be checked for each sub-structure.				**Y**			
7.11.5 Check of Input Interpolated Loads (IIP)								
F4E-QA-114-TECH-IIP-01	When **coupled field analyses** are carried-out, some of the input loads of one field analysis come from the results from another analysis (electromagnetic, thermal, nuclear, dynamic, etc.). The load interpolation between dissimilar meshes shall be carefully performed, explained, validated on cases similar to the considered case and documented. The method used to transfer the load shall ensure the global and local equilibrium of the system.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-IIP-02	The consistency across the **different physics** models shall be assessed and justified by comparing integral values (resulting thermal loads, heat flux at interface, total resulting force, total resulting moments, forces and moments at interfaces, etc…) of the relevant magnitudes involved.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
7.11.6 Check of Contacts (CON)								
F4E-QA-114-TECH-CON-01	If interface elements are used (mechanical contacts, fluid interface elements), it shall be demonstrated that the **behaviour** of the elements is as intended (according with the applicable physics, penetration, status at during the analysis, pressure, fluxes...).	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	

F4E-QA-114-TECH-CON-02	Particular attention to the **mesh discretization in interface areas** shall be taken to avoid unrealistic results or non-convergence issues.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-CON-03	In contact areas, **pressure or flux density distributions** shall be reported.	**Y**			**Y**			
F4E-QA-114-TECH-CON-04	If thermal contact elements are used, **thermal contact conductance (TCC)** values shall be properly reported and justified. Thermal fluxes in contact areas shall be reported.				**Y**			
7.11.7 Checks of Submodeling (SUB)								
F4E-QA-114-TECH-SUB-01	When **submodeling techniques** are used in the scope of an analysis, particular attention shall be paid to the selection of cut boundaries by explaining and documenting the criteria determining their selection. The cut boundaries shall be far enough away from a results concentration region. It shall be verified that this assumption is adequately satisfied.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	
F4E-QA-114-TECH-SUB-02	The appropriateness and correctness of **interface loads** (displacements, temperatures, vector and scalar potentials...) in cut boundaries shall be explained and documented by comparing relevant load fields in the global model and in the submodel(s).	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-SUB-03	It shall be verified that the **global behaviour** of the global model is consistent with the behaviour of the submodel (for applicable physics).	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-SUB-04	For **load-history-dependent** problems (for example, when elastoplastic materials exist), the boundary conditions from the global model shall be considered at multiple substeps to simulate the load history dependency in the submodel analysis.	**Y**	**Y**	**Y**	**Y**		**Y**	
7.11.8 Comparison with Alternative Calculations and Checks (ALT)								
F4E-QA-114-TECH-ALT-01	A verification of calculated results with **alternative calculations** can be requested for to support the analysis. Alternative results can be obtained with any of the following methods: (1) A hand calculation (usually the analytical result of a simplified conceptual model). (2) The same analysis performed with a different, already verified model that is validated to be suitable for the analysis task (3) By performing a comparable analysis independently (or referring to a previous independently performed analysis). Being performed independently means that it is performed by a different analyst based on comparable input data such as geometry, material properties and thermal loads. The mesh, the boundary conditions, and load application must be created anew, and the element types, real constants, and solution settings must be chosen anew, i.e. not copied from the original analysis.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**

	(4) Additionally, the conclusions must be drawn independently from the independent analysis results. (5) All methods have in common that the results are obtained in an alternative way that bypasses possible sources of error and uncertainty in the analysis.							
F4E-QA-114-TECH-ALT-02	If alternative calculations are performed, their **limitations** must be stated, along with the consequently chosen uncertainty factor. An essential part of a simplified calculation is the justification of the conceptual model that the calculation is based on.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-ALT-03	All **equations** supporting the calculations shall be reported. A reference shall be given for any non-trivial analytical formulas used. To improve the clarity it is recommended to use an equation editor. Data tables and other information shall also be included.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
F4E-QA-114-TECH-ALT-04	The accuracy of the results obtained with the analysis model shall be **checked** by the performer of the analysis. Acceptable verification methods are defined in the requirement F4E-QA-114-TECH-ALT-01. The results of these verifications shall be reported in the analysis report.	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**
7.11.9 Check of Monte Carlo Statistics (MCS)								
F4E-QA-114-TECH-MCS-01	All results of **Monte Carlo** transport calculations, including mesh-tallies, shall be accompanied by their corresponding **statistical error**. These errors shall be controlled: (1) For most engineering parameters, errors below 10% are generally acceptable. In standard cell tallies this applies to the tally itself; in mesh-tallies it applies to all areas of the problem space important to the analyses at hand. (2) For SDDR more stringent control is necessary; the statistical error in the neutron field used for determination of decay gamma sources should be less than 5% in all areas important to the analyses at hand. (3) Point detector tally errors shall be below 5%. (4) The MCNP statistical checks of conventional tallies, and the macroscopic behavior of mesh-tally errors, shall be monitored and reported.							**Y**
F4E-QA-114-TECH-MCS-02	Discussion of the **uncertainty and sensitivity of results** to input parameters, methods, assumptions and modelling limitations shall be provided to a level of detail commensurate with the design stage and the importance of the analyses at hand. The use of safety factors to account for uncertainties shall be considered.							**Y**

8. Requirements to Supplier's Deliverables (DEL)	
8.1. Requirements to the Format and Contents of Supplier Deliverable Documents (DOC)	
F4E-QA-114-DEL-DOC-01	Each report issued by the Supplier shall be **self-supporting and auditable**, written in a clear and comprehensible manner, and contain enough information (text, figures, tables, equations, references to assumptions, standards, input data used etc.) to allow its verification by an expert in the field.
F4E-QA-114-DEL-DOC-02	Unless formally agreed otherwise with F4E, applicable **templates of checklists** shall be used for reviews and technical checks.
F4E-QA-114-DEL-DOC-03	The document issued by the Supplier shall include **at least the following information**: (1) Analysis or calculation title (2) Document identifier (including revision/ version number) (3) Performer's name and date of completion (if performer is not an employee of the company, provide the performer's company name, address, and phone number) (4) Identification of the analysis or calculation subject matter (5) Executive summary recalling the purpose of the analysis and its main conclusions (6) The safety, quality, seismic, vacuum and other classification as specified in the technical specifications of the SSC and its unique identification (7) The title (reference) or overview of the selected established procedure for engineering analyses (8) Selected calculation method and its applicability and adequacy justification (9) Assumptions and their applicability justification (10) Analysis or calculation input data and their sources to ensure full input traceability (11) All references with the document UID and revision/ version number (12) Acceptance criteria and references to their applicability (13) Analysis or calculation details (14) Result uncertainty assessment, including the derivation and applicability of safety factors if necessary. (15) Conclusions drawn from the analysis and possible recommendations (16) References cited by the analysis or calculation
F4E-QA-114-DEL-DOC-04	In case of use of **calculation software** the Supplier shall add the following information: (1) Software product name and version (2) If validation/ verification was done as part of the calculation, include the test problem(s), validation results, conclusions and, in case, resolutions of deficiencies
F4E-QA-114-DEL-DOC-05	In case of use of **codes & standards** the Supplier shall clearly specify in the analysis report the applicable section, subsection and paragraph of the code/ standard used as well as the applicable version identified by the year (e.g. RCC-MR edition 2007)
F4E-QA-114-DEL-DOC-06	Analysis reports shall be **titled** such that the scope of the analysis (component, PBS, loads) is described as well as possible within the confinement of a reasonable number of characters.
F4E-QA-114-DEL-DOC-07	The report templates/**table of contents** can be completed depending on the specificity of the analysis. It is recognised that analysis reports can serve a wide range of purposes, and that a fixed list of section headings is not always appropriate. The author(s) shall add additional sections if these are required.
F4E-QA-114-DEL-DOC-08	The Supplier shall clearly identify, reference and justify in the analysis report the use of additional **input data** by reference to established physical data, experiment or other appropriate means.

F4E-QA-114-DEL-DOC-09	A "**Summary of results**" section shall be included in all reports to facilitate the top level review of the analysis results.
F4E-QA-114-DEL-DOC-10	All **references** in the analysis report shall be accessible, applicable and appropriate.
F4E-QA-114-DEL-DOC-11	Reference documents used for the analysis (the ones not provided by F4E) shall be stored by the Performer in **CTS** (or be publically available), approved, and include the version numbers. Note: if the reference document cannot be provided due to commercial/ confidentiality restriction, it shall be mentioned in the report.
F4E-QA-114-DEL-DOC-12	Analysis reports shall be provided to F4E in **.pdf** format **and** in Microsoft Word (**.docx**) format to facilitate the review process.
F4E-QA-114-DEL-DOC-13	If not specified otherwise in the technical specification of the contract (or specific contract), deliverables shall be submitted to F4E as per applicable requirements of QA-115 listed in the Annex A of the contract.
8.2. Requirements to the Review Circuits of Supplier's Deliverables (REV)	
F4E-QA-114-DEL-REV-01	Supplier deliverables shall undergo the following levels of review: 1. Self-check by the Performer: verification that the contractual requirements assigned to the analysis are effectively met 2. Review by reviewer/technical checker not involved into the completion of the task 3. Review by independent peer **for QC1 and QC2 deliverables** Note: If the activity is classified as PIA, it requires the Technical Control (TC) in the meaning of the French Order dated 07.02.12. The TC substitutes the review by the independent peer and is conducted according to P-01.07 Supplier Nuclear Safety Management Requirements (F4E-QA-113) (22JRQY) .
F4E-QA-114-DEL-REV-02	The Supplier shall ensure that evidences of all performed reviews are available to F4E.
F4E-QA-114-DEL-REV-03	**All reviews of A&C documents** shall be made by using "track-changes" function, comments or colours (or any other similar editing method) while reviewing document.
8.3. Requirements for the Submission of Models, Macros and Associated Computer Data (MMD)	
F4E-QA-114-DEL-MMD-01	All analysis models, including their corresponding **Model Cover Sheets** duly filled in (if requested), input and result files, routines, and mesh quality summaries shall be delivered to F4E in the controlled and tracebable manner as requested by F4E (through ftp, R-disk etc) together with the report in the form of a **self-consistent package.** F4E shall be able to repeat all the calculations performed by the Supplier using this package.
F4E-QA-114-DEL-MMD-02	Upon agreement with the F4E TPO, analysis data can be, in order to save space, **stored without the results files** if the time to re-compute them is reasonable.
F4E-QA-114-DEL-MMD-03	The **metadata** (all information inherent to the analysis data necessary to indentify the analysis) shall be included in F4E's model database.
F4E-QA-114-DEL-MMD-04	The analysis models in the database shall be in a **ready-to-run** state. The number of manual operations required to rerun the analyses shall be reduced to the strict minimum. Any manual operation that is required to rerun the analyses shall be described either in the analysis report or in a specific document attached to the model.
F4E-QA-114-DEL-MMD-05	The analysis models shall be as **clearly and quickly as possibly understandable by a third party** to facilitate their review. For this purpose all the files/ macros shall be properly commented and well organised using folders with self-explanatory names. A "READ ME" file describing the full analysis landscape. All text shall be written in English.
F4E-QA-114-DEL-MMD-06	When multiple formats are available to **save/ archive** a model, the user shall choose: - The one that future versions of the software is most likely to be able to open.

	- The one that is the most exhaustive in terms of what is stored. - The one that eases the most its modification later on.
F4E-QA-114-DEL-MMD-07	For analyses performed with **ANSYS APDL** the supplier shall deliver to F4E: - All pre-processing input files (plain text *.txt or similar) for building all the analysis models and for applying the boundary conditions, loads, etc. - All database files (*.db, *.cdb or similar) implementing the model geometry, material properties, loading and boundary conditions. - All input files (plain text *.txt or similar) needed to perform all the post-processing activity. These input files shall comply with the minimum F4E requirements that will be circulated to the Supplier as part of the input data. - All results files (*.rth, *.rst files or similar), when agreed with F4E. *This requirement is not applicable for Nuclear Analysis
F4E-QA-114-DEL-MMD-08	For analyses performed with **ANSYS Workbench** the supplier shall deliver to F4E: - All files shall be transferred in a compressed (archived) project file. Results files may be included if the size of the resulting file is reasonable. - The project file shall contain all input data necessary to successfully re-run all analysis cells within the project. - All geometry files that are used as source data for preprocessing (in Design Modeler or Space Claim) shall be included in its original form in the user_files folder within the project folder structure. - All APDL scripts that are used at some point in the analyses (pre/run/post) shall also be included. *This requirement is not applicable for Nuclear Analysis