STUK

GUIDE **YVL E.7** / 15 NOVEMBER 2013

# ELECTRICAL AND I&C EQUIPMENT OF A NUCLEAR FACILITY



continues

With regard to new nuclear facilities, this Guide shall apply as of 1 December 2013 until further notice. With regard to operating nuclear facilities and those under construction, this Guide shall be enforced through a separate decision to be taken by STUK. The Guide replaces Guides YVL 5.2 and YVL 5.5.


First edition
Helsinki 2014

ISBN 978-952-309-136-8 (print) Kopijyvä Oy 2014
ISBN 978-952-309-137-5 (pdf)
ISBN 978-952-309-138-2 (html)



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# Authorisation

According to Section 7 r of the Nuclear Energy Act (990/1987), *the Radiation and Nuclear Safety Authority (STUK) shall specify detailed safety requirements for the implementation of the safety level in accordance with the Nuclear Energy Act.*

# Rules for application

The publication of a YVL Guide shall not, as such, alter any previous decisions made by STUK. After having heard the parties concerned STUK will issue a separate decision as to how a new or revised YVL Guide is to be applied to operating nuclear facilities or those under construction, and to licensees' operational activities. The Guide shall apply as it stands to new nuclear facilities.

When considering how the new safety requirements presented in the YVL Guides shall be applied to the operating nuclear facilities, or to those under construction, STUK will take due account of the principles laid down in Section 7 a of the Nuclear Energy Act (990/1987): *The safety of nuclear energy use shall be maintained at as high a level as practically possible. For the further development of safety, measures shall be implemented that can be considered justified considering operating experience, safety research and advances in science and technology.*

According to Section 7 r(3) of the Nuclear Energy Act, *the safety requirements of the Radiation and Nuclear Safety Authority (STUK) are binding on the licensee, while preserving the licensee's right to propose an alternative procedure or solution to that provided for in the regulations. If the licensee can convincingly demonstrate that the proposed procedure or solution will implement safety standards in accordance with this Act, the Radiation and Nuclear Safety Authority (STUK) may approve a procedure or solution by which the safety level set forth is achieved.*

Translation. Original text in Finnish.

# 1 Introduction

**101**. This Guide sets forth detailed safety requirements concerning the electrical and I&C equipment and cables of nuclear facilities, and it describes STUK's supervision and inspection related procedures. Since qualification and maintenance, among other things, require that the electrical and I&C systems be handled at component level, this Guide also sets forth certain system-level requirements, even though it mainly focuses on the component level.

**102**. According to Section 63(1)(3) of the Nuclear Energy Act (990/1987) [1], the Radiation and Nuclear Safety Authority (STUK) is authorised to *require that the nuclear fuel or the structures and components intended as parts of the nuclear facility be manufactured in a manner approved of by the Radiation and Nuclear Safety Authority. STUK is authorised to oblige the licensee or licence applicant to arrange for STUK an opportunity sufficiently to control manufacture of the fuel or such structures and components.*

**103**. According to Section 4(2) of Government Decree (717/2013) [2], *the systems, structures and components that implement or are related with safety functions shall be designed, manufactured, installed and used so that their quality level, and the assessments, inspections and tests, including environmental qualification, required to verify their quality level, are sufficient considering the safety significance of the item in question.*

**104**. According to Section 5(1) of Government Decree (717/2013), *the design, construction, operation, condition monitoring and maintenance of a nuclear power plant shall provide for the ageing of systems, structures and components important to safety in order to ensure that they meet the design-basis requirements with the necessary safety margins throughout the service life of the facility.*

**105**. According to Section 6(1) of the Government Decree (717/2013), *special attention shall be paid to the avoidance, detection and correction of any human error at any life cycle phase of the nuclear power plant. The possibility of human error shall be taken into account in the design of the nuclear power plant and in the planning of its operation and maintenance, so that human errors and deviations from normal plant operations due to human error do not endanger plant safety. The possibility of common cause failures due to human error shall be reduced. The effects of human errors shall be limited by applying a functional defense in depth safety principle.*

**106**. According to Section 12(2) of Government Decree (717/2013), *the levels of defence required under the defence-in-depth principle shall be as independent of one another as is reasonably achievable. Carefully researched, tested and proven high-quality technology shall be employed in the levels of defence-in-depth. The necessary actions to control an event or to prevent radiation hazards shall be planned in advance. When arranging the operations of the licensee's organisation it shall be ensured that operational occurrences and accidents are reliably prevented and that the operational preconditions of the personnel are ensured with efficient technical and administrative arrangements in possible transient and accident conditions.*

**107**. Section 17(1) of Government Decree (717/2013) stipulates that *the design of a nuclear power plant shall take account of external hazards that may challenge safety functions. Systems, structures and components shall be designed, located and protected so that the impacts on plant safety of external hazards deemed possible remain minor. The operability of systems, structures and components shall be demonstrated in their design basis external environmental conditions.*

**108**. Section 18(1) of Government Decree (717/2013) stipulates that *the design of a nuclear power plant shall take account of any internal hazards that may challenge safety functions. Systems, structures and components shall be designed, located and protected so that the probability of internal events remains low and impacts on plant safety minor. The operability of systems, structures and components shall be demonstrated in the room specific environmental conditions used as their design bases.*

**109**. Section 21(1) of Government Decree (717/2013) states that *during construction, the holder of the nuclear power plant's construction licence shall ensure that the plant is constructed and implemented in compliance with the safety requirements and the approved plans and procedures*. .

**110**. According to Section 21(2) of Government Decree (717/2013), *the licensee is obliged to also ensure that the plant supplier and sub-suppliers delivering services and products important to safety operate in compliance with the safety requirements*

**111**. According to Section 22(1) of Government Decree (717/2013), *in connection with the commissioning of a nuclear power plant, the licensee shall ensure that the systems, structures and components and the plant as a whole operate as designed.*

**112**. According to Section 22(2) of Government Decree (717/2013), *at the commissioning stage, the licensee shall ensure that an expedient organisation is in place for the future operation of the nuclear power plant, alongside a sufficient number of qualified personnel and instructions suitable for the purpose.*

**113**. According to Section 26(1) of Government Decree (717/2013), *systems, structures and components important to the safety of a nuclear power plant shall be available as detailed in the design basis requirements. Their availability and the impact of the operating environment shall be supervised by means of inspections, tests, measurements and analyses. Availability shall be confirmed in advance by means of regular maintenance, and preparations shall be made for maintenance and repair to avoid reduced availability. Condition monitoring and maintenance shall be designed, instructed and implemented in a manner that can reliably ensure the integrity and operability of the systems, structures and components throughout their service life.*

**114**. According to Section 29(2) of Government Decree (717/2013), *the management system shall cover all organisational activities impacting the nuclear power plant's nuclear and radiation safety. For each function, requirements significant to safety shall be identified, and the planned measures described in order to ensure conformity with requirements. The organisational processes and operational practices shall be systematic and based on procedures.*

**115**. According to Section 29(4) of Government Decree (717/2013), *the licensee shall commit and oblige its employees and suppliers, sub-suppliers and other partners participating in functions affecting safety, to adhere to the systematic management of safety and quality.*

**116**. The design, manufacture and installation of electrical and I&C equipment and cables of nuclear facilities shall take into account the regulations issued by authorities other than STUK that are in force in Finland. These include safety standards concerning the safety of electrical equipment and occupational safety for electrical work, and the instructions provided by authorities supervising electrical safety (such as standard series SFS 6000: Low-voltage electrical installations, standard SFS 6001: High-voltage electrical installations, and standard SFS 6002: Safety at electrical work), and the regulations and guidelines concerning machine safety. Compliance with the electrical safety and machine safety legislation is monitored by competent authorities.

**117**. Unless otherwise specified in the list of definitions, this Guide shall adhere to the quality management glossary in accordance with the standard [3].

# 2 Scope of application

**201**. This Guide applies to the electrical and I&C equipment and cables of a nuclear facility throughout its life cycle.

**202**. The requirements set forth in the Guide apply to licence applicants, licensees and the plant suppliers and manufacturers in the supply chain of electrical and I&C equipment and cables.

**203**. Since qualification and maintenance, among other things, require that the electrical and I&C systems be handled at component level, this Guide also sets forth certain system-level requirements, even though it mainly focuses on the component level.

**204**. Guide YVL B.1 lays down the general requirements and configuration management of electrical and I&C equipment at the system level.

**205**. The general requirements regarding the management system are discussed in Guide YVL A.3.

**206**. The general requirements for a construction and commissioning of a nuclear facility and modifications of operating plants are presented in Guide YVL A.5

**207**. The general ageing management requirements are provided in Guide YVL A.8. This Guide supplements the requirements pertaining to the ageing management of a nuclear facility's cables.

**208**. The general requirements for utilising operating experience feedback are presented in Guide YVL A.10.

**209**. The requirements for the security arrangements of a nuclear facility are presented in Guide YVL A.11. These may case-specifically have an impact on the requirements of electrical and I&C equipment, such as those concerning an aircraft crash.

**210**. The general requirements for the information security of a nuclear facility are presented in Guide YVL A.12.

# 3 Requirement specification, selection, and procurement of electrical and I&C equipment and cables

## 3.1 General requirements for the requirement specification, selection and procurement of electrical and I&C equipment

**301**. The licensee's supplier evaluation procedures shall cover the assessment of the suppliers of electrical and I&C equipment and cables.

**302**. The licensee's design procedures shall include the procedures for determining location requirements for the use of electrical and I&C equipment and cables.

**303**. The licensee shall have in place procedures for communicating the requirements concerning the electrical and I&C equipment and cables to the organisations and their subcontractors that are involved in the component life cycle.

**304**. The licensee's design procedures shall present procedures for assessing the requirement specification of electrical and I&C equipment and cables in safety class 2 (para. 324).

**305**. The licensee's design procedures shall include the procedures for preparing the preliminary and final suitability analyses of the electrical and I&C equipment and cables.

**306**. The licensee's design procedures shall include the procedures for preparing a qualification plan of the electrical and I&C equipment and cables.

**307**. The licensee's design and procurement process for a safety class 2 or 3 electrical or I&C equipment and cable shall define the documentation to be produced at the various stages of the process. The documentation can be described in the quality plan.

**308**. The licensee shall prepare and maintain a list of the facility's essential accident instrumentation (see Definitions).

**309**. The design, manufacture and testing of electrical equipment and cables in safety class 2 and those electrical components and cables in safety class 3 that are required for accident situations and that have special requirements in terms of endurance of environmental conditions shall be based on Finnish or international electrical equipment standards and, where applicable, on nuclear industry standards and guidelines.

**310**. The design, manufacture and testing of electrical equipment and cables in safety class 3 other than those listed in para. 309 shall employ applicable Finnish or international electrical equipment standards.

**311**. The design, manufacture and testing of I&C equipment in safety class 2 and essential accident instrumentation shall be primarily based on nuclear industry standards and guidelines, if applicable nuclear industry standards exist.

**312**. The design, manufacture and testing of I&C equipment in safety class 3 shall employ applicable international I&C equipment standards.

**313**. The electrical and I&C equipment and cables of a nuclear facility shall be labelled with an easily readable marking that is manufactured from a material capable of withstanding the ambient conditions and stresses at the location of use.

### 3.2 Requirement specification

**314**. A requirement specification shall be prepared when selecting or procuring electrical and I&C equipment and cables in safety classes 2 and 3.

**315**. The requirement specification of electrical or I&C equipment or cable in safety classes 2 and 3 shall indicate the properties required from the equipment or cable at the intended location of use (such as the functional requirements, performance and reliability requirements, requirements set by environmental conditions and operation conditions, and requirements concerning connections, periodic tests, maintenance, information security, qualification, and service life).

**316**. The requirement specification of electrical and I&C equipment and cables in safety classes 2 and 3 shall indicate the safety classification of the component or cable.

**317**. The requirement specification of electrical and I&C equipment and cables in safety classes 2 and 3 shall indicate the seismic classification of the component or cable.

**318**. The requirement specification of electrical and I&C equipment and cables in safety classes 2 and 3 shall indicate the essential safety standards applied to the component or cable and the deviations to their requirements.

**319**. The requirement specification of electrical and I&C equipment and cables in safety classes 2 and 3 shall indicate the requirements regarding the component or cable presented in the quality plan of the system and its components.

**320**. The requirement specification of electrical and I&C equipment and cables in safety classes 2 and 3 shall indicate the requirements regarding the component or cable set forth in the system or component qualification plan.

**321**. The requirement specification of electrical and I&C equipment and cables in safety classes 2 and 3 shall be maintained throughout the design, manufacture and operation period of the system.

**322**. The final requirement specification of electrical or I&C equipment or cable in safety class 2 or 3 shall be detailed enough in order to allow for the traceable verification of the compliance to the requirements in question of the final product.

**323**. The requirements of electrical and I&C equipment and cables in safety classes 2 and 3 shall be unambiguous and shall not contain conflicting information.

The requirements of electrical or I&C equipment or cable in safety class 2 or 3 shall be traceable to

their higher-level requirements (such as system level requirements, facility level concept requirements…)

**324**. The requirement specification of electrical or I&C equipment or cable in safety class 2 shall be assessed by an expert that has not been involved in the design of the item in question. The assessment shall demonstrate that the requirements set for the product meet the higher-level requirements.

**325**. In safety class 2, a report shall be prepared on the assessment of the requirement specification of electrical or I&C equipment or cable (para. 324) presenting the observations made during the assessment and a justified conclusion regarding the accuracy, scope and consistency of the requirement specification.

**326**. The assessment report on the requirement specification of electrical or I&C equipment or cable in safety class 2 (para. 324) shall be updated when the requirement specification is modified.

### 3.3 Configuration management

**327**. The general requirements of configuration management are described in Guide YVL B.1.

**328**. The licensee shall have in place an appropriate configuration management procedure that covers the electrical and I&C systems and their components, software and tools.

**329**. The configuration management procedure of electrical and I&C equipment shall be defined and described in a configuration management plan that defines the implementation of configuration management at the nuclear facility, within a particular functional process or project.

**330**. The configuration management procedures of electrical and I&C equipment shall apply to all finished or semi-finished products within the system/unit, such as equipment, software, documents, support tools and their interfaces throughout their entire life cycle.

**331**. Procedures shall be in place for the implementation of parameter changes in electrical and I&C systems, describing the approval procedures for parameter changes and the procedures for implementing the changes.

**332**. The document, component and software versions of the electrical and I&C systems shall be equipped with unambiguous identifications in order to manage the equipment and software versions and to avoid human error.

**333**. The documentation of the electrical and I&C equipment and cables shall be updated in case of modifications, and the update procedure shall be part of the configuration management procedure.

### 3.4 Suitability analysis

**334**. A preliminary and final suitability analysis concerning the suitability of electrical and I&C equipment and cables in safety classes 2 and 3 for their intended location of use shall be prepared as part of the selection of components for a system or the procurement of a replacement spare part.

**335**. A spare part is not considered an original part, but a replacement spare part in the meaning of para. 334 if:

a. the performance values of the spare part related its safety function have deteriorated
b. the spare part deviates in terms of the way of function, any software part or structural characteristics from the original
c. the spare part does not match the original part in terms of environmental condition endurance
d. the quality management level of the spare part does not fulfil the original level
e. the manufacturer of the spare part has changed.

**336**. A suitability analysis is not required for serially manufactured installation supplies used under normal operating conditions, such as cable clamps, cable joints and cable lugs.

**337**. Suitability analyses concerning electrical and I&C equipment and cables in safety classes 2 and 3 may only be prepared by an expert with

knowledge of the location requirements of the component.

a. Selecting a component and assessing its suitability to a system that is being built is ordinary work for a system designer. During this work phase, in an optimal case, the designer creates the main portion of the documentation for the preliminary suitability analysis in order to document the work and to ensure its traceability.
b. A licensee's conclusion, part of the preliminary suitability analysis (see para. 340), may be created by the author of the preliminary suitability analysis, if he or she belongs to licensee's organisation, or a person belonging to licensee's organisation and having good knowledge of the location requirements of the component.
c. The final suitability analysis may be created by the same author who created the preliminary suitability analysis, or some other person with good knowledge of the location requirements.
d. Assessments of the licensee belonging to the final suitability analysis (see paras 348 and 349) may be created by the author of the final suitability analysis, if he belongs to licensee's organisation, or a person belonging to licensee's organisation and having good knowledge of the location requirements of the component.

**338**. A suitability analysis performed on an electrical or I&C equipment implemented by means of software-based technology shall cover the assessment of software and hardware.

**339**. The equipment description presented in connection with the suitability analyses shall include the descriptions of any software tools used.

#### 3.4.1 Preliminary suitability analysis

**340**. In the preliminary suitability analysis, the licensee shall present a verification-based conclusion on the suitability of the component for its location of use.

**341**. In the preliminary suitability analysis, the suitability of the component or cable shall be verified by comparing the rated values with the requirement specification (see subsection 3.2). In the necessary scope, the following characteristics of the component shall be examined:

- functional features and performance
- reliability
- endurance of environmental conditions
- electrotechnical dimensioning and protection
- operation of the component in case of disturbances or transients in the electrical network
- the applicability of the standards used in the design and manufacture of the component
- testability and maintainability
- service life.

**342**. A description of the component and its operation shall be presented together with the preliminary suitability analysis.

**343**. A report of the manufacturer and the manufacturer's prerequisites for manufacturing the product in question as described in Chapter 4 (Quality management) shall be presented in connection with the preliminary suitability analysis. Special attention shall be paid to the following:

- the manufacturer's organisation
- the manufacturer's competence for manufacturing the product
- the manufacturer's management system, its assessment method and assessment results

**344**. A component quality plan shall be presented in connection with the preliminary suitability analysis, if it has not been submitted to STUK together with the system level documentation (see para. 902).

**345**. The component qualification plan (see subsection 5.2) shall be presented in connection with the preliminary suitability analysis, if it has not been submitted to STUK together with the system level documentation (see para. 904).

**346**. The standards used in case of type testing or type approval process (see section 5.10) shall be presented together with the preliminary suitability analysis.

**347**. The information concerning the accreditation and qualifications of any type approval or testing organisations shall be presented together with the preliminary suitability analysis (for type approval, see section 5.10).

### 3.4.2 Final suitability analysis

**348**. In the final suitability analysis, the licensee shall present a justified conclusion regarding the validation of the component for its location of use under the requirement specification.

**349**. In the final suitability analysis, the licensee shall present a post-factory test licensee's assessment on the component's conformity to requirements (para. 519).

**350**. In connection with the final suitability analysis, the component or cable shall be demonstrated to fulfil its rated values on the basis of the validation. Special attention shall be paid to the following:

- qualification test results (subsection 5.3)
- compatibility with the electrical network (subsection 5.5)
- qualification to environmental conditions (subsection 5.6)
- EMC properties (subsection 5.7)
- analyses related to qualification (subsection 5.8)
- operating experience feedback (subsection 5.9)
- type tests and type approval (subsection 5.10)
- software qualification (Chapter 6)

**351**. In connection with the final suitability analysis of electrical or I&C equipment in safety class 2, an independent assessment of the acceptability of the qualification procedure shall be presented.

**352**. The independent assessment (para. 351) of the acceptability of the qualification procedure of electrical or I&C equipment in safety class 2 may be performed by an expert or organisational unit employed by the licensee but independent of the design of the system in question.

**353**. The use of an expert from an independent external organisation shall be considered for the assessment of the qualification procedures (para. 351) of electrical and I&C systems and components and cables that have a significant impact on nuclear safety.

**354**. The necessary actions taken concerning storage life, service life and ageing monitoring of the components and materials shall be presented in connection with the final suitability analysis.

**355**. If the component in question is not serially manufactured, a summary of the quality management results obtained during manufacture shall be presented together with the final suitability analysis.

**356**. If the component in question is not serially manufactured, a summary of the factory test results shall be presented together with the final suitability analysis.

**357**. The final suitability analysis shall present any deviations from the information presented in the preliminary suitability analysis of the component or cable, and provide justifications for their acceptability.

**358**. An assessment of the design process and manufacturing quality management shall be presented together with the final suitability analysis for the following electrical and I&C equipment and cables:

- electrical and I&C equipment and cables in safety class 2
- components and cables in safety class 3 that are needed in accidents and involve special requirements in terms of their endurance of environmental conditions.

# 4 Quality management of electrical and I&C equipment and cables

## 4.1 General quality management requirements

**401**. Guide YVL A.3 sets forth general requirements for the management system and quality management of a nuclear facility. Guide YVL B.1 sets forth requirements concerning the procedures relating to the management systems that are followed at the system level. Guide YVL A.5 set forth requirements for the construction and commissioning of a nuclear facility. The requirements laid down in these Guides shall be ob-

served when arranging quality management for electrical and I&C equipment and cables.

**402**. The licensee shall prepare general procedures for arranging the quality management in the procurement, design, manufacture, testing, receiving, installation, commissioning, and operation phases of safety-classified electrical and I&C equipment and cables.

### 4.2 Quality management system

**403**. In addition to the general quality management procedures determined for electrical and I&C equipment and cables, a quality plan shall be in place for a safety-classified component or cable by the procurement phase.

**404**. Contents of a quality plan is discussed, in addition to the requirements of this document, also in Guides YVL A.3 and YVL B.1.

**405**. The component quality plan (para. 403) may be part of the common quality plan of a system and its components.

**406**. The quality management of electrical and I&C equipment and cables during the construction of a new facility shall cover the quality management of all the parties involved in the component life cycle up until the start of the facility's commercial operation.

**407**. The quality management of electrical and I&C equipment and cables of an operating facility shall cover the quality management of all the parties involved in the component life cycle.

**408**. The in-service quality management procedures of electrical and I&C equipment and cables shall include the procedures for ensuring and maintaining the quality of periodic maintenance, periodic testing, test results, repairs and modifications, configuration management, spare part replacement, and instrument precision.

**409**. The quality management procedures of electrical and I&C equipment and cables shall ensure that the structure and features of the production batches procured to the facility are in accordance with those of the qualified products.

**410**. The suppliers of electrical and I&C equipment and cables in safety classes 2 and 3 shall have in place a certified management system or a similar management system independently assessed by a third party.

**411**. The management system of the suppliers of electrical and I&C equipment and cables in safety class 2 shall meet the requirements set on management systems in Guide YVL A.3. Where necessary, the licensee may apply the supplementary procedure based on the quality plan and presented in para. 630 of Guide YVL A.3. The application of the procedure shall be justified.

## 5 Qualification of electrical and I&C systems, equipment and cables

### 5.1 General qualification requirements

**501**. The electrical and I&C systems of a nuclear facility and their components and cables shall be suitable for their intended purpose and location of use.

**502**. Safety-classified electrical and I&C equipment and cables shall be qualified for their intended purpose and location of use.

**503**. The qualification of safety-classified electrical and I&C equipment shall be performed by means of a preliminary and final suitability analysis.

**504**. During qualification, the component's maximum storage life and service life shall be identified, after which the qualification shall be performed again or the component replaced, if the operation of the component is required under accident conditions, or if rapidly ageing parts have been identified in the component (see para. 354).

### 5.2 Qualification plan

**505**. The licensee shall prepare a special system or component-specific qualification plan for the validation of electrical and I&C systems, equipment and cables in safety classes 2 and 3.

**506**. The qualification plan shall be prepared in accordance with a procedure part of the licensee's quality management system.

**507**. The qualification plan of electrical and I&C systems, equipment and cables in safety classes 2 and 3 shall discuss the following subareas:

- applicable standards
- design and manufacturing process
- tests
- organisations to be used in the qualification
- analyses
- operating experience feedback.

**508**. The suitability analyses to be prepared shall be presented in the qualification plan of an electrical and I&C system in safety classes 2 and 3.

**509**. Information on any previous type approvals or tests that the licensee wishes to use in the validation shall be enclosed with the qualification plan of electrical and I&C systems in safety classes 2 and 3.

**510**. The qualification plan of electrical and I&C systems, equipment and cables in safety class 2 shall present the procedure whereby the acceptability of the validation procedure of electrical and I&C systems, equipment and cables in safety class 2 is independently assessed (para. 351).

**511**. The qualification plan shall identify all software tools used in the design and implementation of software-based electrical and I&C systems and equipment in safety class 2, such as compilers, code generators, analysers etc.

**512**. The qualification plan shall identify all software-based testing and analysis methods used in the design and implementation of electrical and I&C systems and equipment in safety class 2.

**513**. The qualification plan of electrical and I&C systems, equipment and cables in safety classes 2 and 3 shall be updated, if changes are introduced into the requirement specification such that this affects the qualification, or if information is revealed that may be seen to affect the qualification process and, thus, the qualification plan.

### 5.3 Tests included in qualification

**514**. Test plans shall be drawn up for the qualification tests of electrical and I&C systems, equipment and cables in safety classes 2 and 3.

**515**. The tests shall be performed in accordance with the qualification test plan (para. 514) by independent testers who are independent of the design and manufacture of the electrical or I&C system, component or cable in safety class 2 or 3.

**516**. The qualification test plan (para. 514), the test acceptance criteria and the test results shall be documented in a manner that allows them to be evaluated by the author of the final suitability analysis and, if necessary, by an authority.

**517**. Testing and analyses shall be used to ensure that the electrical or I&C systems or equipment in safety class 2 contain no unnecessary functions that could be detrimental to safety.

**518**. The sufficiency of the electrical and I&C system or component tests in safety class 2 shall be justified, and the coverage of the tests shall be analysed against the requirements and rated values.

**519**. After the factory tests, the licensee shall assess the conformity to requirements of an electrical or I&C system, component or cable in safety class 2 or 3 before the product may be moved to the facility.

**520**. An assessment pursuant to para. 519 shall be appended to the final suitability analysis.

**521**. The schedule for the delivery and installation of an electrical and I&C system, component or cable in safety class 2 or 3 shall be planned in a manner that allows for implementing the modification planning and modifications that may be required after the factory tests in accordance with procedures that are in line with the safety significance of the system or component.

**522**. The final testing of the electrical or I&C systems or components in safety classes 2 and 3 shall be performed at the facility in the actual operating environment.

**523**. Whenever possible, the final testing at the facility (para. 522) shall demonstrate that the electrical or I&C systems, components or cables in safety classes 2 and 3 correspond to the functional and performance requirements set for them.

**524**. The final testing of the electrical or I&C systems or components in safety classes 2 and 3 (para. 522) may in part employ simulation.

### 5.4 Assessment of the design and manufacturing process of electrical and I&C equipment

**525**. A nuclear facility's electrical and I&C equipment and cables in safety classes 2 and 3 shall be designed and documented in a manner that allows for ensuring at the various phases of the design and manufacturing process the correct transfer of the set requirements to the final product that will be taken into use.

**526**. The design, manufacture and testing processes of a nuclear facility's electrical and I&C equipment and cables in safety classes 2 and 3 shall be managed in a manner that allows for ensuring the correct transfer of the set requirements to the final product that will be taken into use.

**527**. The design, manufacture and testing processes of a nuclear facility's electrical and I&C equipment and cables in safety class 3 shall be evaluated in a way that allows for ensuring the correct transfer of the set requirements to the final product that will be taken into use.

**528**. The results of the design, manufacture and testing processes of a nuclear facility's electrical and I&C equipment and cables in safety class 2 shall be independently verified in a manner that allows for ensuring the correct transfer of the set requirements to the final product that will be taken into use.

**529**. The assessment of the design and manufacture process shall be presented in the final suitability analysis according to the requirements laid down in section 3.4.2.

### 5.5 Compatibility with the electrical network

**530**. The effects that the variations of voltage and frequency occurring in the external power transmission grid and the nuclear facility's internal electrical networks have on the equipment of the nuclear facility shall be analysed.

**531**. The variations of voltage and frequency occurring in the external power transmission grid and the nuclear facility's internal electrical networks shall be taken into account in the dimensioning of components.

**532**. The variations of voltage and frequency occurring in the external power transmission grid and the nuclear facility's internal electrical networks shall be taken into account in the qualification of components.

**533**. The qualification of an electrical or I&C equipment in safety classes 2 or 3 shall assess the operation and rise in temperature of the equipment, when its terminals are under the following conditions:

- rated current and voltage continuously
- undervoltages of varying duration, with a simultaneous frequency variation of the most unfavourable type in terms of the component
- overvoltages of varying duration, with a simultaneous frequency variation of the most unfavourable type in terms of the component
- fast voltage transients
- highest input voltage ripple
- for components supplying electrical power, short-circuit scenarios and load start-up current peaks.

**534**. The assessment conducted under para. 533 shall take into account any changes in the load condition of the component as the supply voltage and frequency change.

**535**. The assessment conducted under para. 533 shall assess the startability of a component under voltage disturbance scenarios.

**536**. The qualification for voltage and frequency variations conducted under para. 533 may be performed by means of tests or analyses.

**537**. Analyses may be used when qualifying electromechanical components for the voltage/frequency disturbance scenarios laid down in para. 533.

**538**. The experimental parameters of the component under nominal conditions shall be available when using the method described in para. 537.

**539**. The qualification of components containing electronics for the voltage and frequency variations described in para. 533 shall be based on tests.

**540**. The rise in temperature of the electrical or I&C equipment in safety classes 2 and 3 shall be defined in the nominal state according to the rated values of the component and by using type tests defined in the standards, if the power loss of the component is high enough for the component to be considered to warm up substantially due to the internal power loss.

**541**. When determining the rise in temperature of electrical or I&C equipment connected to a battery-backed direct current network, the trickle charge voltage for a set of accumulators shall be used as the supply voltage.

**542**. The rise in temperature of the electrical and I&C equipment or cable in its nominal state shall be taken into account when qualifying the component or cable to the prevailing environmental conditions.

## 5.6 Qualification to environmental conditions

**543**. The environmental conditions and stresses of a nuclear facility's safety-classified electrical and I&C systems, components and cables shall be defined in all planned operational conditions and during storage and transport.

**544**. The electrical and I&C systems, components and cables shall be of such design that their operability is maintained within the set requirements during their entire planned service life.

**545**. The validation of safety-classified electrical and I&C equipment and cables to the planned environmental conditions and stresses shall be performed by means of tests and analyses pursuant to standards.

**546**. The tests and analyses laid down in para. 545 shall correspond to the combined effects of the most unfavourable operational and environmental conditions possible.

**547**. The selection of structures and materials for electrical and I&C equipment and cables of safety classes 2 and 3 needed during or after accidents shall be such that, for their entire planned service life, their required operating capability in accidents will be in compliance with the set requirements.

**548**. The performance of electrical and I&C equipment and cables needed during or after accidents shall be demonstrated by means of type tests.

**549**. The type tests defined in para. 548 shall form a uniform series of tests during which the same test pieces are subjected to the design basis operating and environmental stresses of the planned location of use.

**550**. Prior to accident condition testing, the test pieces of electrical and I&C equipment and cables shall be artificially aged to correspond to their planned service life.

**551**. The artificial ageing of electrical and I&C equipment and cables shall be carried out in a way that represents actual ageing with an adequate degree of confidence.

**552**. A test of electrical and I&C equipment and cable simulating an accident shall cover exposure to radiation and stresses caused by temperature, pressure and humidity equivalent to accident conditions as well as rapid changes in the conditions.

**553**. The composition of the water used in the test of electrical and I&C equipment and cable simulating an accident shall, as far as possible, be equivalent to water in real accident conditions.

**554**. If there is a possibility of the electrical and I&C equipment or cable submerging in water in

an accident and if it is required to function under such conditions, its capability to function in such a situation shall also be demonstrated.

**555**. The tests of an electrical and I&C equipment and cable simulating an accident shall be designed to verify, with a sufficient degree of confidence, the operability of the component or cable under accident conditions during their entire planned service life.

**556**. If the electrical and I&C equipment or cable must function under severe reactor accidents, it shall be validated by a manner applicable to severe reactor accidents (high temperatures, radiation doses, and hydrogen fires shall be taken into account, for example).

**557**. The seismic tests or analyses related to the vibration tolerance validation of an electrical or I&C equipment or cable shall be performed in accordance with Guide YVL E.6.

### 5.7 Electromagnetic compatibility

**558**. The EMC conformity of electrical and I&C equipment and installations shall be demonstrated by means of EMC tests or analyses pursuant to standards.

**559**. The procedures and technical solutions chosen to protect the nuclear facility's electrical and I&C equipment and installations from electromagnetic disturbances shall be justified.

Protection against electromagnetic disturbance has been discussed in more detail in Guide YVL A.11 and its Appendix A.

### 5.8 Qualification by means of analyses

**560**. The qualification of electrical and I&C systems and equipment shall cover the validation of functional and performance requirements by means of analyses, if the meeting of the requirements cannot be demonstrated by means of other qualification activities.

### 5.9 Operating experience feedback

**561**. An operating experience analysis shall be prepared for the electrical and I&C systems in safety class 2 or 3 and the components thereof.

**562**. The operating experience feedback used in the operating experience analysis of the electrical and I&C systems in safety class 2 or 3 and the components thereof shall be collected following a procedure for which instructions are provided.

**563**. The operating experience analysis of the software-based electrical and I&C systems in safety class 2 or 3 and the components thereof shall also take into account any software used.

**564**. The operating experience analysis of the software-based electrical and I&C systems in safety class 2 or 3 and the components thereof shall also take into account the change and version history of the software.

**565**. The comprehensiveness of the operating experience collection process, the length of the collection period and their significance in terms of the reliability of the data shall be evaluated in the operating experience analysis.

**566**. The operating experience feedback used in the analysis shall be representative of the safety function reviewed.

**567**. The use of operating experience feedback from hardware or software versions, set-ups and operational profiles other than those that are planned to be taken into use for the validation of a system or component shall be justified.

**568**. A component cannot be qualified on the basis of operating experience feedback only.

### 5.10 Type approval

**569**. Type approval shall be acquired for the following equipment:

- I&C system platforms in safety class 2
- software-based I&C priority units in safety class 2
- I&C equipment in safety class 2 to be qualified to accident conditions
- electrical equipment in safety class 2 to be qualified to accident conditions, excluding electric motors and electric valve actuators whose requirements are discussed in Guides YVL E.8 and E.9

- cables in safety class 2 to be qualified to accident conditions
- essential accident instrumentation in safety class 3 to be qualified to accident conditions.

**570**. The prerequisite for the type approval of equipment shall be a type inspection certificate issued by a third party confirming the acceptability of the design and implementation of the equipment against the equipment rated values. A third-party assessment of the type conformity of the quality assurance-based production process, or a third-party certificate of conformity that confirms the type conformity of the manufactured equipment based on product-specific inspection and testing, shall also be required. The type inspection and verification of conformity shall follow modules B and D of Decision 768/2008/EC [5] of the European Parliament and of the Council. Module F may be used instead of module D.

**571**. The third party authorised to perform the type inspection and type conformity assessment of an component shall be a certification body that has been accredited for the conformity evaluation of the applied standards under standard SFS-EN ISO/IEC 17065 [6], or an inspection organisation accredited for a similar task under standard SFS-EN ISO/IEC 17020 [7]. In order to supervise the testing, the certification body or inspection organisation shall have applicable qualifications under standard SFS-EN ISO/IEC 17025 [8]. The certification body or inspection organisation shall also be a notified body appropriate for the task.

**572**. The accreditation decision pertaining to the organisation performing type inspections and type conformity evaluations shall be appended to the preliminary suitability analysis. If the same organisation is to submit multiple type approvals, the accreditation decision may be delivered only once, but a reference to the documentation submitted earlier shall be made in the preliminary suitability analysis.

**573**. In the type inspection, the third party shall inspect the component as a combination of design type and product type as referred to in module B of the Decision [5].

**574**. The type inspection certificate or appendices thereto shall indicate all the information confirmed with a type inspection (technical breakdown) and any limitations on operation required to assess the acceptability of the component for its intended use.

**575**. A document prepared by a third party concerning the approval of the quality system pursuant to module D of the Decision [5] shall be appended to the type approval documentation.

**576**. If module F of the Decision [5] is used, the conformity certificate issued on the basis of product-specific inspections and testing shall indicate the following:

- the unique identifiers of the delivery batch, and the unique identifiers of the components inspected from the delivery batch
- inspections performed and tests supervised by a third party (scope of product-specific inspection) in order to confirm the conformity to requirements of the de-livery batch
- the conformity certificate shall refer to the type inspection certificate, and it shall confirm that the components in the delivery batch correspond to the component type for which the type inspection certificate has been issued.

**577**. The type approval of a component containing software-based technology shall cover the assessment of both software and hardware.

# 6 Qualification of software of safety-classified equipment

## 6.1 Special requirements for software-based equipment

**601**. The publication [4] “Licensing of safety critical software for nuclear reactors, Common position of seven European nuclear regulators and authorised technical support organisations, Revision 2010” presents in great detail some differences between the requirement levels concerning the design, implementation and maintenance of software in different safety classes. The re-

quirements of this publication shall be taken into account, when applicable, in the design of I&C systems and equipment in safety classes 2 and 3.

**602**. The design and implementation of software in safety classes 2 and 3 shall adhere to applicable nuclear industry standards.

**603**. The design of software in safety class 2 systems and equipment shall aim at clarity and simplicity.

**604**. The structure of software in safety class 2 shall minimise the propagation of the effects of a single software error.

**605**. The structure of software in safety class 2 shall enable the verification of the requirements set for the system.

**606**. The program execution cycle of software in safety classes 2 and 3 shall be defined.

**607**. Those software parts that are unnecessary for functional performance shall be identified and their safety significance shall be analysed and taken into account in the design of the system in safety class 2.

**608**. The failure mechanisms of software in safety classes 2 and 3 shall be identified and analysed to a sufficient extent.

**609**. Software-based systems and components in safety classes 2 and 3 shall be equipped with self-diagnostics corresponding to their safety significance and the reliability requirements set by the periodic test interval.

**610**. The coverage of the self-diagnostics and periodic tests of the software-based I&C systems and components in safety class 2 shall be analysed.

**611**. The effects of failures in the self-diagnostics function of a software-based system or component in safety class 2 on the operation of the protection I&C systems shall be analysed.

**612**. The requirements set for software in safety class 2 or 3 shall be derivable in a traceable manner from component or system level requirements.

**613**. Paras 601–612 shall also apply to data transfer and data buses between different software.

## 6.2 Qualification of the system platform software and the application software

**614**. The qualification plan of a programmable system in safety class 2 or 3 (see section 5.2) shall cover the qualification of the system platform software and the application software.

**615**. The type approval of a system platform or component (see section 5.10) shall also cover the system platform software.

**616**. For system platforms or components in safety class 3 for which a type approval pursuant to section 5.10 is not required, an assessment of the system platform software shall be performed under an applicable standard on the basis of the reliability objective set for the system or component.

**617**. The evaluation report defined in para. 616 shall present the observations made in the inspection, the need for any corrective actions, and a justified decision on the acceptability of the software for the intended purpose of use.

**618**. An analysis of the capability of the design process and conformity to standards of the design process of the system platform software and application software shall form a part of the demonstration of reliability of a software-based system or component in safety class 2 or 3.

**619**. An analysis of the qualifications of the personnel participating in design and testing shall form a part of the demonstration of reliability of a software-based system or component in safety class 2 or 3.

**620**. As a part of the demonstration of the reliability of a software-based system or equipment in safety class 2 or 3, an analysis of the standards used and their applicability shall be made.

### 6.3 Software design procedures and processes

**621**. A life cycle model under an applicable standard shall be defined for the manufacture of software in safety class 2 or 3.

**622**. The methods used in the design, testing and quality assurance of software in safety classes 2 and 3 shall be defined.

**623**. Any conditions and limitations presented in the type approval of the system platform (para. 615) or the assessment of the system platform (para. 616) shall be taken into account in the design and implementation of application software in safety class 2 or 3.

**624**. The design, manufacture and testing processes of a nuclear facility's software in safety class 2 shall be independently assessed after each phase in a manner that allows for ensuring the correct transfer of the set requirements to the final product that will be taken into use.

### 6.4 Software tools

**625**. The operating experience feedback from tools used in the design, implementation and testing of software of systems and equipment in safety class 2 shall be collected and documented in a comprehensive and systematic manner.

**626**. The software tools of systems and equipment in safety class 2 shall be covered by comprehensive configuration management.

**627**. The design and implementation of software of safety class 3 systems and equipment shall utilise software tools whose configuration management, maintenance and fault data collection are appropriately documented.

**628**. The configuration management, maintenance and modification design of tools used for configuration and object code generation in safety classes 2 and 3 shall be implemented using procedures which consider the safety significance of the system or component.

**629**. The impact of a potential tool-induced error on safety shall be accounted for when specifying the qualification procedures of software tools in safety class 2.

**630**. In the case of a software tool error, the procedures used to ensure the safe functioning of systems installed at the facility shall be documented.

### 6.5 Cybersecurity and isolation of data transfer

**631**. The design, operation and maintenance of electrical and I&C systems and components shall take into account cybersecurity matters in accordance with the licensee's information security procedures.

**632**. Unauthorised access to rooms and to any software of equipment important to the facility's safety and disturbance-free operation shall be prevented by sufficient physical protection, technical and administrative security measures. Requirements related to security arrangements at a nuclear facility are provided in Guide YVL A.11 and requirements for information security are provided in Guide YVL A.12.

**633**. The installation of unauthorised parts of software during design, manufacture, commissioning, periodic testing and maintenance shall be reliably prevented.

**634**. Accesses to the software of electrical and I&C systems and components, and any modifications made thereto during such accesses, shall be traceable.

**635**. No physical possibility shall exist for the establishment of a data transfer connection to the software-based systems important to the safety of a nuclear facility from outside the system inwards.

**636**. A software-based arrangement of unidirectional data transfer shall not be considered a sufficient means of protection to meet the requirement laid down of para. 635.

**637**. As regards para. 635, the software-based systems that are essential to the safety of the nuclear facility shall be identified and specified in the licensee's information security procedures.

**638**. Information security requirements are discussed in more detail in Guides YVL A.12, B.1 and A.3.

### 6.6 Existing software

**639**. Existing software is subject to the same requirements as software to be developed.

**640**. Any deficiencies in the documentation and implementation of the design process of existing software may be substituted for by means of analyses and testing, while taking into account the requirements set by the safety class and safety significance.

**641**. Software structure and functions shall be analysed, and the functions to be excluded from use documented, for the suitability analysis of existing software.

**642**. The documentation of the existing software and system shall enable the configuration management and modification planning of the system or software.

### 6.7 Software testing

**643**. A testing plan shall exist for all software.

**644**. The software testing plan shall be aligned with the testing plans of the component and system.

**645**. The test plan and procedures used for a system or component belonging to safety class 2 or 3 shall be sufficient, taking into account the safety significance and reliability target of the system or component.

**646**. The software shall also be tested in the equipment to be installed at the facility.

**647**. The final testing of a system or component belonging to safety class 2 or 3 shall cover all functions with their timings, including, as far as practically possible, the self-diagnostic functions.

**648**. The testing of the software shall include static and dynamic tests.

**649**. The software test cases shall also include transient situations used in transient and accident analyses.

**650**. The coverage of the tests of safety classes 2 and 3 software shall be analysed against the requirements at the different phases of testing.

**651**. Justification shall be provided for the selection and number of the final tests of software in safety classes 2 and 3.

## 7 Receiving, installation and commissioning

### 7.1 General requirements for receiving, installation and commissioning

**701**. Procedures used during the receiving, installation and commissioning of electrical and I&C systems and equipment presented in the licensee's quality management system shall describe the duties of the organisations responsible for a specific function, the division of work, the areas of responsibility, and the procedures used for documentation, and the scope of inspections to be performed.

### 7.2 Receiving inspection

**702**. A licensee's receiving inspection shall be performed on the safety-classified electrical and I&C equipment, cables and, if any, their software.

**703**. During the receiving inspections defined in para. 702, the licensee shall ensure that the component, its assembly, software and configuration correspond to the design.

**704**. During the receiving inspections of components and software, the licensee shall ensure that the result documentation from the quality management of the component or software meets the acceptance criteria.

**705**. During the receiving inspections of components, the licensee shall ascertain that the component has not suffered any damage during transport.

**706**. Inspections and tests relating to the receiving inspection shall be performed acceptably.

**707**. The receiving inspection shall be documented.

### 7.3 Installation

**708**. An installation schedule shall be defined for installations.

**709**. The scope, actions, responsibilities and records of the installation and coupling inspections and functional tests to be done after the installation shall be defined.

**710**. The licensee shall perform an installation inspection on the safety-classified electrical or I&C equipment and cables installed.

**711**. During the installation inspection, the licensee shall ensure that the installation is appropriate and that it has been performed according to approved plans and the guidelines and principles concerning a nuclear facility.

### 7.4 Commissioning

**712**. The licensee shall successfully perform a commissioning inspection on the installed or modified safety-classified electrical or I&C systems, equipment or cables before they are commissioned.

**713**. If necessary, the commissioning inspection may be divided into two parts. The first part may review the documentation created before commissioning testing, and determine that the system, component or cable installed is ready for commissioning testing operation. The second part reviews the result documentation from commissioning testing. This way the inspection load in larger projects may be divided across several phases, which improves the manageability of the installation and commissioning testing phase.

**714**. During the commissioning inspections, the licensee shall verify that the component or system installed complies with the approved plans, and that this has been ascertained by means of sufficient inspections and tests.

**715**. The licensee's commissioning inspection shall verify that any defects and faults discovered during previous phases have been corrected.

**716**. The licensee's commissioning inspection shall ensure that any changes made in the commissioning phase have been implemented according to the procedures specified for the system's configuration management.

**717**. The licensee's commissioning inspection shall ensure that the parameters of a software-based component or system have been set and recorded according to the configuration management system.

**718**. The licensee's commissioning inspection shall inspect the realisation of the licensee's quality management.

**719**. The licensee's commissioning inspection shall verify that the electrical or I&C system, components, cables and installations fulfil the environmental and operating condition requirements set by their location of use.

**720**. The licensee's commissioning inspection shall inspect that the installation inspections and functional tests have been performed acceptably. The commissioning testing result documentation and the protocols related to commissioning shall be reviewed, and they shall not contain shortcomings that prevent commissioning.

**721**. The licensee's commissioning inspection shall inspect the readiness of the instructions regarding the system.

**722**. The licensee's commissioning inspection shall ensure that any remarks made by STUK during earlier regulatory measures have been appropriately taken care of.

**723**. The licensee's commissioning inspection shall verify that no obstacles exist that would prevent commissioning.

**724**. If any minor non-conformances from a STUK-approved suitability analysis or pre-inspection documents are discovered during the licensee's

commissioning inspection, they shall be brought to the attention of STUK's inspector.

**725**. A deviation report shall be prepared of any significant deviations observed during the licensee's commissioning inspection, and it shall be submitted to STUK for approval.

**726**. The commissioning inspections of safety-classified electrical and I&C systems and equipment may only be performed by a STUK-approved organisational unit and inspector that is independent of design and installation and belongs to licensee's organisation.

**727**. The following shall be appended to the licensee's application for the performers of commissioning inspections:

- an organisation description showing the organisational position of the unit and individuals performing the inspections and the independence of the inspections activities.
- a description of those performing the inspections, detailing their education, work experience and competence as well as for what inspections the approval is sought
- a description of the procedures used in and the essential instructions pertaining to the inspections
- further clarifications, if necessary.

**728**. The inspectors shall have sufficient professional competence and experience as well as appropriately qualified equipment, tools and methods needed to perform the inspections.

**729**. A STUK-granted authorisation to perform commissioning inspections is valid for a maximum of five years at a time. When needed, an application for a renewal of the authorisation shall be submitted to STUK no later than 3 months prior to the expiration of the previous authorisation.

# 8 Ageing management

**801**. The general ageing management requirements are discussed in Guide YVL A.8. This Guide only sets forth requirements for the ageing management of cables inside the containment.

**802**. To monitor their ageing, the various types of cable of safety-classified electrical and I&C equipment inside the containment shall undergo mechanical and electrical inspections every five years at least.

**803**. A plan shall be prepared for the monitoring of the ageing of the cables inside the containment.

**804**. The licensee shall regularly evaluate the adequacy of the plan described in para. 803, taking into consideration, for example, the results of cable inspections, operating experience feedback and any significant changes in the environmental conditions of the cables.

**805**. The results of the ageing monitoring of the cables inside the containment shall be reported at least every five years together with the ageing follow-up report required by Guide YVL A.8.

# 9 Documents to be submitted to STUK

## 9.1 Quality management

**901**. The licensee shall submit a system-specific quality plan of electrical and I&C equipment to STUK for information together with the system documentation (see YVL B.1).

**902**. If the system-level documentation is not prepared, as in the case of a spare parts procurement, the licensee shall submit a component-specific quality plan to STUK for information together with the preliminary suitability analysis.

## 9.2 Qualification plan

**903**. The licensee shall submit a system-specific qualification plan of electrical and I&C equipment (para. 505) to STUK for information together with the system documentation.

**904**. If the system-level documentation is not prepared, as in the case of a spare parts procurement, the licensee shall submit a component-specific qualification plan to STUK for information together with the preliminary suitability analysis.

### 9.3 Suitability analyses

**905**. The preliminary and final suitability analyses concerning electrical and I&C equipment and cables in safety class 2 and essential accident instrumentation (see Definitions, chapter 11) in safety class 3 shall be submitted to STUK for approval.

**906**. The preliminary and final suitability analysis may be combined into a single document if the analysis concerns a replacement spare part.

**907**. The preliminary and final suitability analyses of electrical and I&C equipment and cables in safety class 3, apart from those listed in para. 905, shall be submitted to STUK for information with the following contents:

- the licensee's conclusion of the equipment's suitability for its location of use according to para. 340 from the preliminary suitability analysis
- the licensee's conclusions and analyses of the equipment's suitability and its conformance to the requirements according to paras 348 and 349 from the final suitability analysis.

**908**. The following documents shall be submitted to STUK for information with the preliminary suitability analysis:

- requirement specification for the component or cable specific for the intended location of use (see section 3.2)
- in safety class 2, an evaluation report from the review of the requirement specification of the electrical and I&C equipment and cable, see para. 325
- verification of the suitability of the component or cable, see para. 341
- description of the component, see para. 342
- description of the manufacturer, see para. 343
- quality plan, if required, see para. 902
- qualification plan, if required, see para. 904
- information and plans concerning type approvals and tests as well as the standards, organisations and accreditations used in them.

**909**. The preliminary suitability analyses shall be submitted to STUK well in advance before the component factory testing.

**910**. The preliminary suitability analyses submitted to STUK for approval shall have been approved by STUK before the factory tests are started.

**911**. The following documents shall be submitted to STUK for information with the final suitability analysis:

- qualification results, see para. 350
- independent review of the acceptability of the qualification measures, if required, see para. 351
- any measures related to the follow-up of the storage life, service life and ageing of equipment and materials, see para. 354
- a summary of the results of quality management during manufacturing, if needed, see para. 355
- a summary of the results of factory tests, if needed, see para. 356
- any deviations from the information presented in the preliminary suitability analysis of the component or cable, see para. 357
- a review of the effectiveness of quality management during design and manufacture, if needed, see para. 358
- a software evaluation, if needed, see chapter 6.

**912**. The final suitability analysis shall be submitted to STUK well in advance before the performance of the licensee's commissioning inspections or, in the case of spare part changes, before the installation of the component at the facility.

**913**. The licensee's commissioning inspection cannot be closed before STUK has made a decision concerning the final suitability analysis submitted for approval.

**914**. In case of a spare part change, the installation of the component at the facility may not be started before STUK has made a decision concerning the suitability analysis submitted for approval.

### 9.4 Control of manufacturing and factory tests

**915**. A factory test plan shall be submitted to STUK for information of those factory tests which STUK confirms it will follow.

**916**. For the purpose of potential inspections on the manufacturers' and suppliers' premises, the testing schedules of the safety-classified electrical and I&C systems, components and cables (performance and functional tests) shall be submitted to STUK for information in good time.

**917**. During factory inspection visits, STUK shall be provided with the opportunity to check, for example, the manufacturers' design and manufacturing processes, management systems, the documents on quality management produced during manufacturing and those referred to in the qualification plan.

## 9.5 Installation phase

**918**. For the purposes of installation supervision, if STUK so requests, the installation schedule of safety class 2 and 3 electrical and I&C systems, components and cables subject to pre-inspection shall be sent to STUK for information prior to the commencement of the installation.

**919**. During installation supervision, the licensee shall show STUK the plans and instructions used in the licensee's installation inspection as well as the inspections' result documentation.

## 9.6 Commissioning phase

**920**. The commissioning testing programmes of safety class 2 and 3 electrical and I&C systems shall be submitted to STUK for approval well before the commencement of testing.

**921**. The commissioning testing programmes of safety class 2 and 3 electrical and I&C systems shall have been approved by STUK before the commencement of testing.

**922**. The schedules for the commissioning testing of safety class 2 and 3 electrical and I&C systems shall be submitted to STUK for information well before the commencement of testing.

**923**. The result reports from the commissioning testing of safety class 2 and 3 electrical and I&C systems shall be submitted to STUK for approval without delay. More detailed requirements concerning commissioning testing are given in Guide YVL A.5.

**924**. A report on the commissioning inspections performed and their results of all commissioning inspections performed by the licensee shall be submitted to STUK for information annually.

**925**. The performance of a system commissioning inspection performed by STUK (see section 10.4) shall be requested in writing well before the inspection date.

**926**. The system commissioning inspection performed by STUK (see section 10.4) shall be conducted prior to plant unit start-up or prior to system commissioning in case commissioning takes place during operation.

**927**. During the commissioning inspections performed by STUK (see section 10.4), the licensee shall present to STUK the results from the licensee's commissioning inspection and their related result documentation.

## 9.7 Operation phase

**928**. The periodic testing programmes of safety-classified electrical and I&C systems, components, and cables and those subject to the Operational Limits and Conditions, the procedures to be followed during testing, and condition monitoring instructions shall be submitted to STUK for information.

**929**. The licensee shall record the test results for the electrical and I&C systems, equipment, and cables during the operation phase.

## 9.8 Modifications during operation

**930**. Electrical and I&C system modifications in safety classes 2 and 3 may be started only after STUK has approved the system's pre-inspection documentation and when any requirements pertaining to the starting and supervision of work stated in the approval have been fulfilled.

**931**. The installation of electrical or I&C equipment subject to the requirement of para. 334 shall not be started before the preliminary and final suitability analyses have been submitted to STUK and any documentation submitted for approval has been approved by STUK.

**932**. The commissioning testing programmes of modified system parts and components shall be prepared such that the impact of the modifications is tested to a sufficient extent by means of commissioning testing programmes corresponding to the original commissioning testing programmes.

**933**. Prior to a system's commissioning, the licensee shall obtain approval for any changes that need to be made to the Operational Limits and Conditions.

**934**. The emergency, transient and operating procedures of a nuclear facility shall be updated to correspond to the modified electrical or I&C system or equipment prior to the system commissioning.

**935**. The maintenance instructions of the electrical or I&C system and its components shall be updated without delay in connection with the modification.

**936**. After the commissioning of a modified electrical or I&C system, any changes proposed to be made to the Final Safety Analysis Report shall be submitted to STUK for approval without delay.

## 9.9 Ageing monitoring

**937**. The follow-up report concerning the ageing of the cables inside the containment shall be submitted to STUK for information every five years together with the ageing follow-up report required under Guide YVL A.8.

## 9.10 Summary of documents to be submitted to STUK at different phases

| Phase | Document | Submission method | Submission to STUK and limitations |
|---|---|---|---|
| System design phase | Preliminary suitability analysis | For approval for SC2 and essential accident instrumentation, for information for SC3 | To be submitted before equipment factory tests. Factory tests may not be started before the document has been approved. |
| System design phase | Appendices to the preliminary suitability analysis (see para. 908) | For information for SC2 and SC3 | Before equipment factory tests |
| System design phase | Quality plan of the system and its components (as an appendix to the pre-inspection documentation of the system or together with the preliminary suitability analysis) | For information for SC2 and SC3 | Before equipment factory tests |
| System design phase | Qualification plan of the system and its components (as an appendix to the pre-inspection documentation of the system or together with the preliminary suitability analysis) | For information for SC2 and SC3 | Before equipment factory tests |
| Equipment manufacturing phase | Schedules and test plans for factory tests if necessary (see para. 915) | For information | Before equipment factory tests |
| Equipment manufacturing phase | Final suitability analysis of a spare part of a running facility | For approval for SC2 and essential accident instrumentation, for information for SC3 | To be submitted before installation of the equipment. Equipment installation may not be started before the document has been approved. |

| **Phase** | **Document** | **Submission method** | **Submission to STUK and limitations** |
|---|---|---|---|
| Equipment manufacturing phase | Appendices to the final suitability analysis of a spare part at a running facility | For information for SC2 and SC3 | Before equipment installation |
| Installation phase | Installation schedule for safety classes 2 and 3 upon request (see para. 918) | To STUK in writing | Before the installation is started |
| Commissioning phase | Electrical/I&C commissioning testing programmes for safety classes 2 and 3 | For approval | To be submitted before the tests are started. The documents shall be approved by STUK before commencing the tests. |
| Commissioning phase | Electrical/I&C commissioning testing schedules for safety classes 2 and 3 | To STUK in writing | Before the tests are started |
| Commissioning phase | Electrical/I&C commissioning testing results for safety classes 2 and 3 | For approval | To be submitted without delay after the tests |
| Commissioning phase | Final suitability analysis (not for a spare part of a running facility) | For approval for SC2 and essential accident instrumentation, for information for SC3 | To be submitted before the licensee's commissioning inspection. The licensee's commissioning inspection cannot be completed before STUK has approved the document. |
| Commissioning phase | Appendices to the final suitability analysis (not for a spare part of a running facility) | For information for SC2 and SC3 | Before the licensee's commissioning inspection |
| Commissioning phase | A deviation report of any significant deviations observed during the licensee's commissioning inspection | For approval | The licensee's commissioning inspection cannot be completed before STUK has approved the deviation. |
| Commissioning phase | Request for a possible commissioning inspection performed by STUK (see section 10.4) | To STUK in writing | To be submitted before the commissioning of the system. Commissioning cannot take place before STUK's inspection. |
| All phases | Application for the organisations and persons performing the licensee's commissioning inspections. | For approval | When changes are introduced to the organisation or personnel. Approval from STUK is required before activities may be started. |
| All phases | Annual report of the licensee's commissioning inspections (see para. 924) | For information | Annually |

# 10 Regulatory oversight by the Radiation and Nuclear Safety Authority

## 10.1 Oversight of quality management

**1001**. STUK assesses the quality management systems of the licensee and its subcontractors and how the licensee assesses the operation of its own and the subcontractors' quality management systems.

## 10.2 Oversight of manufacturing and factory tests

**1002**. STUK supervises, at its discretion, manufacture of the electrical and I&C systems, equipment and cables in safety classes 2 and 3 by means of inspection visits.

## 10.3 Oversight of installation

**1003**. At its discretion, STUK supervises the installation of safety class 2 and 3 electrical and I&C systems and equipment.

**1004**. During inspection visits, STUK oversees that the overall implementation corresponds to the approved pre-inspection documentation and that it meets the required quality level.

## 10.4 Oversight of commissioning

**1005**. During the inspections part of the inspection programme during operation and construction, STUK supervises the licensee's commissioning activities of electrical and I&C equipment and cables.

**1006**. STUK oversees commissioning testing and system tests at its discretion at the facility.

**1007**. At its discretion, STUK may perform its own commissioning inspection of electrical and I&C systems and equipment.

**1008**. During the pre-inspection of electrical and I&C systems, STUK specifies the systems whose commissioning inspections it will conduct.

## 10.5 Oversight during operation

**1009**. During the operation of a nuclear facility, STUK supervises the electrical and I&C systems, equipment and cables by evaluating the licensee's operations and the effectiveness of its procedures. The inspection focuses on the procedures whereby the licensee ensures the reliable and correct operation of systems and equipment. This supervision may be carried out, for example, by reviewing the licensee's guidelines, functional processes, reports, or the maintenance, repair and modification works of systems and individual components.

**1010**. The licensee's operations are monitored in regularly repeated inspections of the operation inspection programme, during annual outages, and in connection with large modifications.

**1011**. The acceptability of the requirements pertaining to the operability of safety-classified electrical and I&C systems, equipment and cables, as well as the scope of periodic tests are assessed by STUK during the review of the Operational Limits and Conditions of the nuclear facility.

## 10.6 Modifications during operation

**1012**. STUK applies the same principles to the supervision of modifications made during operation to the electrical and I&C systems and equipment of nuclear facilities as to the control of the design, procurement, installation and commissioning of new systems and equipment.

## 10.7 Ageing monitoring

**1013**. STUK supervises the implementation and results of the licensee's ageing monitoring programme of electrical and I&C systems, equipment and cables in addition to the licensee's ageing monitoring reports also in conjunction with the inspections part of the periodic inspection programme.

# Definitions

**Trickle charge voltage for a set of accumulators**

The trickle charge voltage for a set of accumulators shall refer to a voltage generated by a battery charger in order to maintain a charge level on a set of accumulators that exceeds the nominal voltage of the set of accumulators.

**Preliminary suitability analysis**

Preliminary suitability analysis shall be used by the licensee to verify that a component is suitable for its intended location of use on the basis of its rated values. The qualification of the component is also inspected and designed. After the preliminary suitability analysis the requirement specification of the component is verified, and the procurement of the component may be started, if necessary.

**Instrumentation and control (I&C) equipment**

Instrumentation and control (I&C) equipment shall refer to equipment controlling, adjusting or observing the operation of a nuclear facility or components thereof. Control may consist of automatic operation or relaying commands given by humans.

**Software to be developed**

Software to be developed during the present design work, such as software for a programmable logic application.

**Qualification**

Qualification shall refer to a process to demonstrate the ability to fulfil specified requirements (corresponds to the qualification process of the ISO 9000 standard).

**Validation**

Validation shall refer to confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled. (ISO 9000)

**Essential accident instrumentation**

Essential accident instrumentation shall refer to measurement indications and status indications needed to guide a nuclear facility into and maintaining it in a controlled state, whereby the implementation of safety functions is confirmed in the manner required by the accident and disturbance instructions. Furthermore, essential accident instrumentation includes the containment dose rate measurements and radioactivity or dose rate measurements of off-gas emissions that have been put in place to prepare for accidents. Essential accident instrumentation comprises all equipment in the communication chain from the sensor to the monitor.

**Location requirements**

Location requirements shall refer to the requirements set on a component by its location of use at a nuclear facility. The location of use at a facility and as part of the facility's other systems sets requirements on the device in terms of the tolerance of environmental conditions, functionality, performance, and tolerance of potential accident conditions.

**Component life cycle**

Component life cycle shall refer to the various stages of a component from design to production, operation, maintenance and decommissioning.

**Final suitability analysis**

Final suitability analysis shall refer to the licensee's assessment to demonstrate (validate) that a component meets its rated values. This can be achieved by means of type approval and testing, quality control procedures, and operating experience.

**Rated value**

Rated value shall refer to the information used by the component manufacturer as a starting point for the design of a component or an I&C system platform, such as the nominal current of a breaker or the duration of a processing sequence of programmable logic. The manufacturer usually indicates the rated values in the component's brochure or specification.

**Software-based**

Software-based shall refer to a function achieved by means of executing program code with a processor. The term should not be confused with the concept of programmable. For example, a software-based temperature transducer is in no way "programmable" after manufacture, but its operation is based on program code executed by a processor.

**Existing software**

Existing software shall refer to software that has been manufactured before the life cycle of the present project, such as the software for a serially manufactured pressure transducer or the system platform software of programmable logic.

**System platform software**

System platform software shall refer to component software that is not modified for different locations of use, such as the real-time operating system, network communication routines, or function libraries. Generally, users cannot access the system platform software.

**Serially manufactured component**

Serially manufactured component shall refer to a component that is not designed or manufactured for the location of use at the request of the client.

**Application software**

Application software shall refer to component software created for each location of use in order to achieve the desired functionality at the location of use. User can usually view or modify application software.

**Electrical equipment**

Electrical equipment shall refer to equipment used in the production, transmission and transformation of electrical power and the protection of the grid. Electrical equipment includes accumulators, transformers, distribution centres, power distribution network protective relays, motors, frequency converters and electromechanical components. If a nuclear facility uses distributed instrumentation and control systems, with I&C functions distributed between various pieces of electrical equipment, such as protective relays and frequency converters, the requirements of I&C equipment shall also be taken into account in handling these electrical equipment.

**Verification**

Verification shall refer to confirmation, through the provision of objective evidence, that set requirements have been fulfilled.

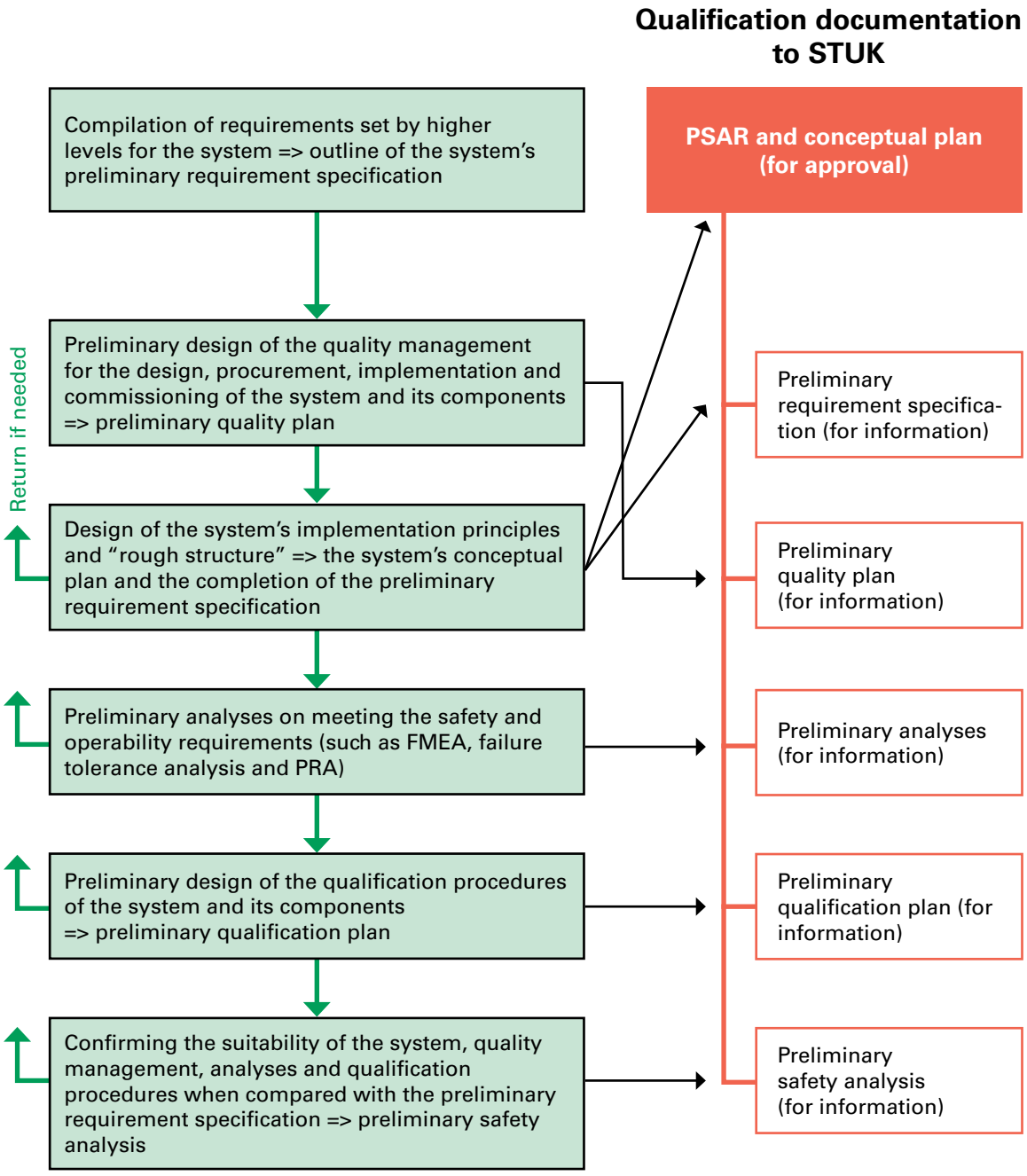
**Type approval**

Type approval shall refer to a nationally or internationally recognised procedure whereby the accredited certification body granting the approval verifies that the product and its implementation meet the applicable technical requirements.

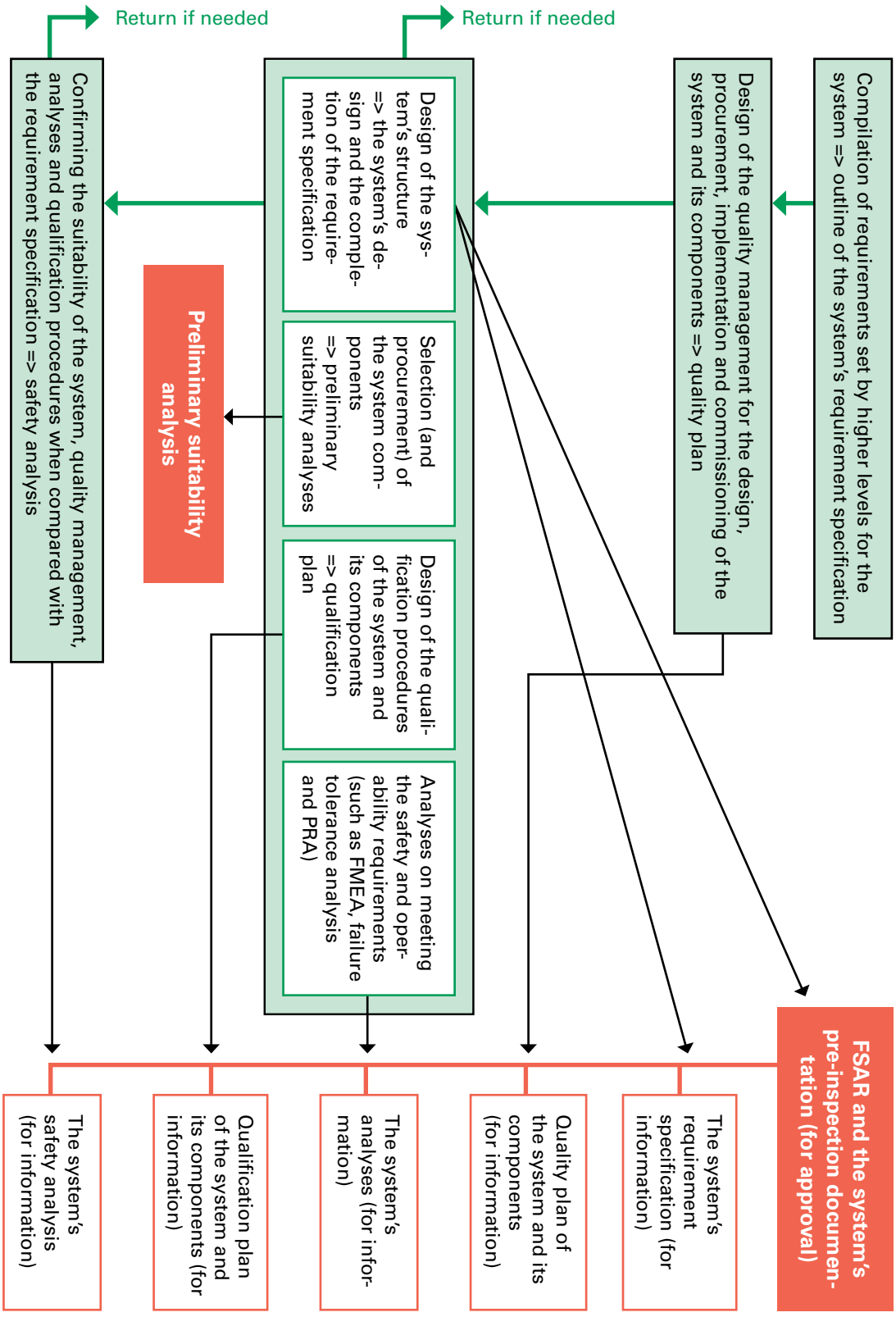
# References

1. Nuclear Energy Act (990/1987).
2. Government Decree on the Safety of Nuclear Power Plants (717/2013).
3. Quality management systems SFS-EN ISO 9000:2005.
4. Licensing of safety critical software for nuclear reactors, Common position of seven European nuclear regulators and authorised technical support organisations, Revision 2010.
5. Decision 768/2008/EC of the European Parliament and of the Council on a common framework for the marketing of products, and repealing Decision 93/465/EEC, 9 July 2008.
6. Conformity assessment. Requirements for bodies certifying products, processes and services. SFS-EN ISO/IEC 17065:2012.
7. Conformity assessment. Requirements for the operation of various types of bodies performing inspection. SFS-EN ISO/IEC 17020:2012
8. Competence of testing and calibration laboratories. General requirements. SFS-EN ISO/IEC 17025:2005.

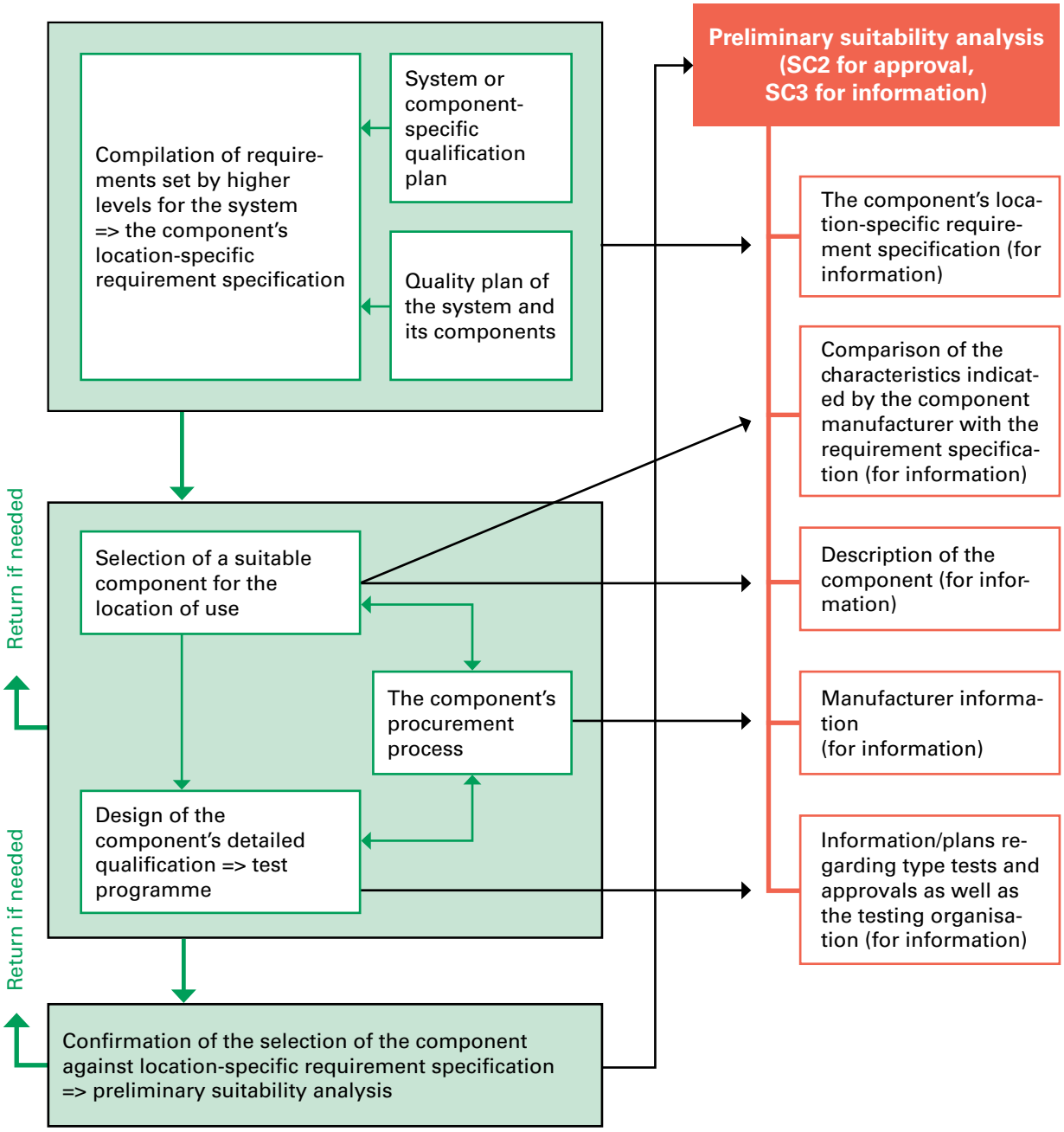
# APPENDIX A Example of how the design process relates to the preliminary safety report or conceptual plan



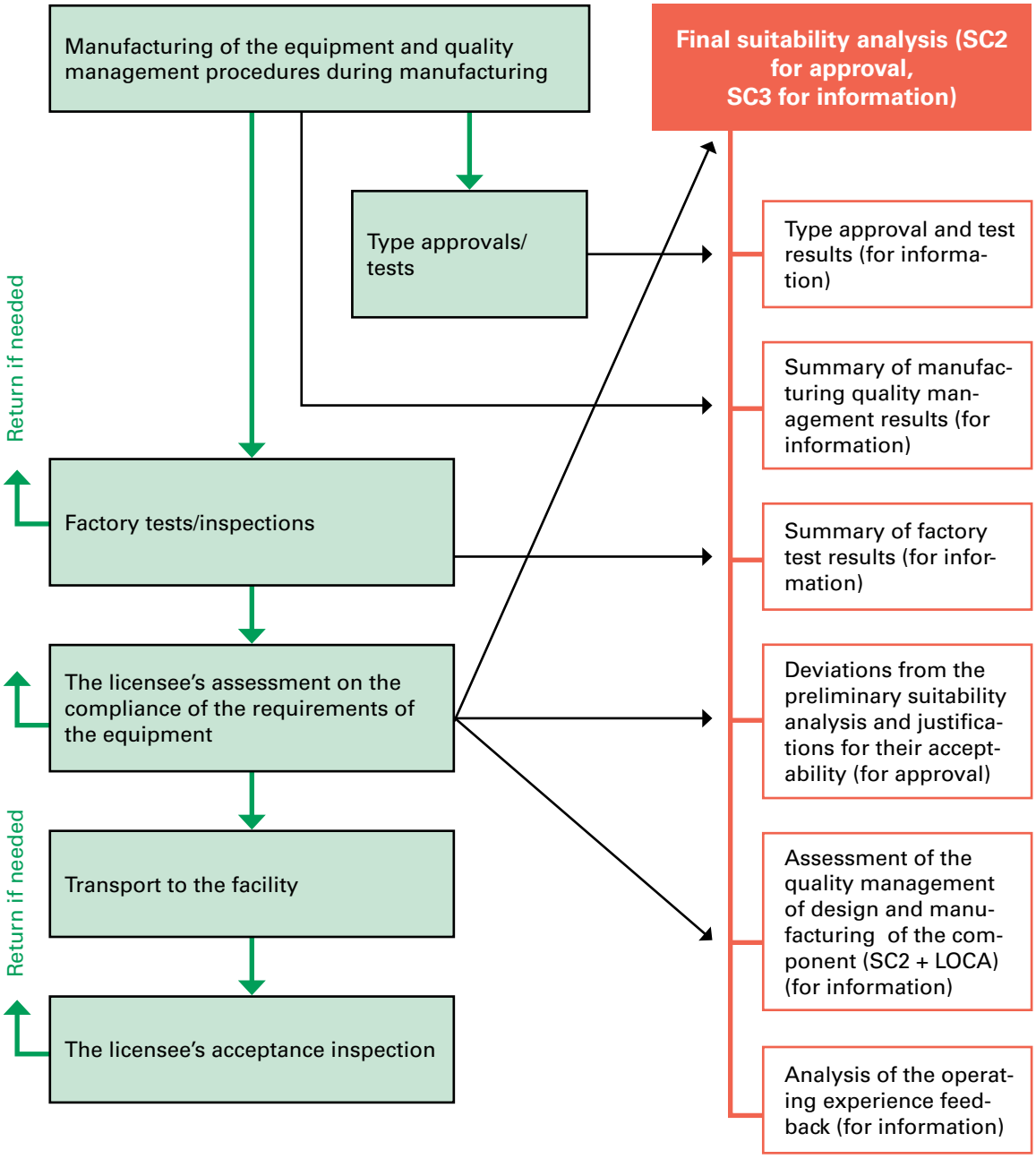
# APPENDIX B Example of how the design process relates to the final safety report or system pre-inspection documentation



# APPENDIX C Example of how the design process relates to the preliminary suitability analysis



# APPENDIX D Example of how the implementation process relates to the final suitability analysis



# APPENDIX E Example of how the implementation process taking place at the facility relates to STUK's control