GUIDE YVL E.6

BUILDINGS AND STRUCTURES OF A NUCLEAR FACILITY

Definitions

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 and 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 are binding on the licence holder, while preserving the licence holder's right to propose an alternative procedure or solution to that provided for in the regulations. If the licence holder can convincingly demonstrate that the proposed procedure or solution will implement safety standards in accordance with this Act, the Radiation and Nuclear Safety Authority may approve the procedure or solution.*

With regard to new nuclear facilities, this Guide shall apply as of 1 July 2020 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. This Guide replaces Guide YVL E.6 (15.11.2013).

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1 Introduction

101. In Finland, the authority that oversees the safety of the use of nuclear energy is the Radiation and Nuclear Safety Authority (STUK). Safety regulation by STUK covers the control of the service life of the buildings and structures of nuclear facilities insofar as they have a bearing on the facilities' nuclear and radiation safety. **[**2013-11-15 **]**

102. By virtue of Section 63(1)(3) of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority (STUK) is authorised to require that structures and components intended as parts of the nuclear facility be manufactured in a manner approved by the Radiation and Nuclear Safety Authority. STUK is authorised to oblige the licensee or licence applicant to arrange for STUK to have the opportunity to sufficiently control the manufacture of the nuclear fuel and structures and components related to it. **[**2020-06-19 **]**

103. According to the Section 6 of the Nuclear Energy Act (990/1987) [1], the use of nuclear energy must be safe; it shall not cause injury to people, damage to the environment or property. The safety of a nuclear facility is a result of the design, manufacture, construction, operation, and maintenance of the facility, its systems, and structures in a manner that is compliant with the safety and quality requirements. **[**2020-06-19 **]**

104. The Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (Y/1/2018) [2] presents the general requirements for the safety of nuclear facilities. The requirements for the safety of the plant's structures are presented in Sections 4–17 of the Regulation (STUK Y/1/2018), and the requirements for its construction and operation are presented in Sections 18–24. **[**2020-06-19 **]**

105. The Radiation and Nuclear Safety Authority Regulation on the Safety of Disposal of Nuclear Waste (STUK Y/4/2018) [4] presents the general requirements for the safety of nuclear facilities. The requirements for the design of a nuclear facility are presented in Sections 4–9 of the Regulation, and the requirements for its construction and operation are presented in Sections 22–29 of the Regulation. **[**2020-06-19 **]**

106. This Guide sets forth requirements and instructions for the design and execution of safety-classified concrete, steel and composite structures of nuclear facilities, and for the inspections performed during operation. In addition, this Guide sets forth requirements for coatings and fire safety products for concrete, steel and composite structures. **[**2020-06-19 **]**

107. In addition to the requirements set forth in this Guide, the design and manufacture of safety-classified buildings and steel, concrete and composite structures shall also adhere to the laws, regulations, building codes and guidelines in force in Finland. These include the Land Use

and Building Act (132/1999) [6] and Decree (895/1999) [7], and the regulations and guidelines issued by virtue of the said Act and Decree. **[**2013-11-15 **]**

108. The construction regulations, building codes and guidelines in force in Finland shall be followed in the design and execution of structures in class EYT (non-nuclear safety). **[**2013-11-15 **]**

109. A Decree by the Ministry of the Environment may issue more detailed construction requirements concerning structural strength, stability, and fire safety. The Ministry of the Environment maintains the Finnish Building Code, into which the building regulations, orders and Ministry guidelines that have been issued by virtue of the Land Use and Building Act and Decree have been compiled. In each municipality the building supervision authorities supervise that the decrees, regulations and orders given by the Ministry of the Environment are followed in all construction activities. **[**2013-11-15 **]**

110. The structures, materials and tests performed on them shall meet the valid requirements of the Finnish building legislation, regulations and building codes. **[**2013-11-15 **]**

111. If the Finnish construction regulations, codes and standards are insufficient, foreign regulations, guidelines and standards from the field may be applied. It shall then be ensured, however, that the regulations, codes and standards together form an applicable entity. **[**2020-06-19 **]**

112. Within the EU, construction products are to be brought onto the market as laid down in the Construction Products Regulation 305/2011 [5]. If a construction product is not within the scope of the harmonised product standard, and the manufacturer has not acquired a European Technical Assessment for the product, the construction product may be approved applying the approval procedures described in the Act on the Approval of Certain Construction Products (954/2012) [8] and the decrees and guides issued under it. **[**2020-06-19 **]**

2 Scope of application

201. In accordance with this Guide, STUK supervises the design, manufacture and use of the safety-classified buildings and steel, concrete and composite structures of nuclear facilities that are important to nuclear and radiation safety. STUK's regulation has no bearing on any regulatory measures required under the Land Use and Building Act (132/1999) [6] and Decree (895/1999) [7], unless authorities agree otherwise. **[**2020-06-19 **]**

202. The Guide shall apply to nuclear facilities, unless it is expressly stated that a requirement only applies to nuclear power plants. **[**2013-11-15 **]**

203. Pursuant to Guide YVL B.2 "Classification of systems, structures and components of a nuclear facility", a nuclear facility's structures, systems and components shall be assigned to safety classes 1, 2 and 3, and to class EYT (non-nuclear safety) on the basis of their safety significance. The systems, structures and components of nuclear facilities shall be assigned to three categories, S1, S2A and S2B, based on the seismic resistance requirements imposed on them. The requirements to be followed in the design, manufacturing, operation and supervision of structures shall be determined on the basis of their safety classification and seismic classification. **[**2020-06-19 **]**

204. The steel parts of composite structures are governed by the requirements for steel structures laid down in this Guide; correspondingly, their concrete components are governed by the requirements for concrete structures listed in this Guide. If the composite structures or steel structures form assemblies that also include system components, such as piping or valves, the appropriate E series YVL Guides shall be applied to the approval of the system components. **[**2013-11-15 **]**

205. Steel modular structures shall be processed as either composite structures or steel structures, depending on the design method of the load-bearing structures. **[**2013-11-15 **]**

206. If metallic materials other than steel are used in metal structures or composite structures, the guidelines for steel structures or composite structures laid down in this Guide shall be applied in their design, manufacture and approval. The guidelines for steel structures laid down in this Guide shall be applied to the design, manufacture and approval of those structures in safety classes 2 and 3 that are not made of concrete or steel. **[**2013-11-15 **]**

207. The requirements set forth in the Guide shall apply to the licensee and, where applicable, the licence applicant, plant suppliers and equipment suppliers, manufacturers of steel structures, and those performing construction work at a nuclear facility: building contractors and subcontractors. **[**2013-11-15 **]**

208. The structural requirements set forth in this Guide also involve the requirements presented in the Guides below; these shall be taken into consideration in the design and execution of structures of a nuclear facility:

a. Guide YVL A.1, “Regulatory oversight of safety in the use of nuclear energy”, sets forth requirements concerning the safety principles for the design and control of nuclear facilities.

b. Guide YVL A.3, “Leadership and management for safety”, sets forth the detailed requirements concerning the management system and quality management. These requirements also apply to the design, execution and in-service supervision of steel, concrete and composite structures. Insofar as a Guide mentioned above does not cover the specific features of the quality control of steel, concrete or composite structures, more detailed quality control instructions are provided in this Guide.

c. Guide YVL A.4, “Organisation and personnel of a nuclear facility”, sets forth the requirements concerning the organisation, personnel, competence and leadership required for the use of nuclear energy. The Guide also defines the competence requirements and approval procedures for the tasks that require separate approval from STUK.

d. Guide YVL A.5, “Construction and commissioning of a nuclear facility”, sets forth requirements for the management and control of the construction project of a nuclear facility during the various phases of construction.

e. Guide YVL A.7, “Probabilistic risk assessment and risk management of a nuclear power plant”, sets forth requirements for probabilistic fire risk assessments.

f. Guide YVL A.8, “Ageing management of a nuclear facility”, sets forth the requirements for the licensee’s design, operation and maintenance activities concerning ageing management in the systems, structures and equipment of a nuclear power plant.

g. Guide YVL A.11, “Security of a nuclear facility”, sets forth the requirements concerning the physical protection at nuclear facilities and their design. The Guide also provides the design requirements for the dimensioning of structures to withstand design basis threats, such as aircraft crashes and explosions.

h. Guide YVL B.1, “Safety design of a nuclear power plant”, sets forth requirements for the safety planning of a nuclear power plant and the design of safety-classified systems. This Guide YVL E.6 provides more detailed requirements and guidelines for the design of buildings and structures.

i. Guide YVL B.2, “Classification of systems, structures and components of a nuclear facility”, presents the safety classifications and seismic classifications and the principles for following them. When classifying structures for safety, it shall also be ensured that functional entities of structures are classified into the same safety class.

j. Guide YVL B.6, “Containment of a nuclear power plant”, provides the guidelines for the design and control of the containment.
k. Guide YVL B.7, “Provisions for internal and external hazards at a nuclear facility”, sets forth requirements for room and lay-out design at nuclear facilities, and design against internal and external threats.
l. Guide YVL B.8, “Fire protection at a nuclear facility”, sets forth the requirements and guidelines concerning fire protection at a nuclear power plant and presents the requirements for separating and load-bearing structures.
m. Guide YVL E.1, “Authorised inspection body and the licensee’s in-house inspection organisation”, sets forth the requirements concerning the authority, tasks, and reporting of inspection organisations. The Guide presents the procedure for approving an organisation as an authorised inspection body or the licensee’s in-house inspection organisation.
n. Guide YVL E.3, “Pressure vessels and piping of a nuclear facility”, sets forth the guidelines concerning pressure vessels and piping at a nuclear facility, and the materials and test specimens required for their manufacture and qualification. The licensee may, in a justified way, also apply Guide YVL E.3 to the manufacture and qualification of steel containers that only withstand hydrostatic pressure as presented in requirement 205 of Guide YVL E.3.
o. Guide YVL E.4, “Strength analyses of nuclear power plant pressure equipment”, sets forth requirements for the loads and strength analyses of a nuclear power plant’s primary circuit and other nuclear pressure equipment important to safety.
p. Guide YVL E.12, “Testing organisations for mechanical components and structures of a nuclear facility”, sets forth requirements for testing organisations.
q. Guide YVL E.13, “Ventilation and air-conditioning equipment of a nuclear facility”, sets forth requirements for similar equipment. **[**2020-06-19 **]**

3 Structural requirement specification

301. Before the design of structures is started, a structural requirement specification or another document containing the corresponding information including the requirements for design and quality shall be drawn up for concrete, steel, and composite structures in safety classes 2 and 3. Structure specific requirement specifications shall also be presented where necessary. The design requirements shall present the following:

a. The regulations, guidelines and standards applied, the limits of their scope of application with justifications, and the basis for the design of earthquake resistance, and applicable standards.

b. Initial data used for the design of structures: The initial data to be presented shall include the purpose of the structure as a part of a nuclear facility, a general description of the construction methods, and references to the layout plans.

c. The load combinations and, when the partial safety factor method is used, the combination and partial safety factors for loads, and the partial safety factors for the material properties.

d. Loads for which reference is made to regulations, guidelines and standards used and to the information provided by manufacturers, or to descriptions of loads transmitted to structures by components, pipings and radiation under operational and accident conditions. Loads (such as design pressure and design temperature, test pressure) shall be defined by taking into account the requirements of Guides YVL B.1, YVL B.6 and YVL B.7 and standard ASME III Div.2 [29].

e. Requirements for the properties of construction materials, justification of the requirements for the intended purpose of use and preliminary test programmes. The acceptance criteria shall be unambiguously defined.

f. The dimensioning and testing standards used for the structural fire safety design, and their acceptability.

g. The requirements for coatings and coating combinations used, and the test programmes for the coating combinations (see chapter 5.4). **[**2020-06-19 **]**

302. The licensee shall have documented structural requirement specifications for a nuclear facility's containment liner, equipment hatch and personnel and emergency airlocks or other similar documents that cover the design and inspection requirements for these components in each safety class. The requirements set forth in chapter 3 of Guide YVL E.3 "Pressure vessels and piping of a nuclear facility" shall be followed for these structural requirement specifications. **[**2020-06-19 **]**

303. As part of the structural requirement specification, the licensee shall draw up a general inspection plan presenting the inspections and control of manufacturing that are performed on the concrete structures, steel structures and composite structures of a nuclear facility and

separate structural parts thereof, such as the equipment hatch and personnel and emergency airlocks. The general inspection plan shall define the inspection and supervision stages in which STUK or an authorised inspection body, a third party, the licensee and other parties shall take part. The quality plan for the execution stage shall be drawn up on the basis of the general inspection plan (see chapter 7.7). **[**2020-06-19 **]**

4 Requirements concerning the contractors and the supervision of construction work and of the execution of structures

4.1 Construction supervision by the licensee

401. The licensee may purchase part of the construction developer functions from an external company through contracting. This does not, however, reduce the licensee's responsibilities as laid down in the Nuclear Energy Act, or the responsibilities of the party engaging in a building project as laid down in the Land Use and Building Act. **[**2013-11-15 **]**

402. If the licensee's organisation is not responsible for all of the construction functions, the licensee shall present a separate report describing how the licensee has arranged the supervision of construction activities. **[**2020-06-19 **]**

403. According to the Land Use and Building Act, the licensee shall, as a party engaging in a building project, ensure that the building is designed and constructed in accordance with the regulations and orders governing construction work and pursuant to the building permit granted. With a view to the complexity of the project, the licensee shall have available the necessary prerequisites and a sufficient amount of qualified personnel for the execution of the work. The holder of a construction licence, as referred to in Chapter 5 of the Nuclear Energy Act, shall be responsible for the nuclear facility being constructed to meet all safety requirements. **[**2013-11-15 **]**

404. The person in charge of the supervision of a nuclear facility's construction work at the site shall have the qualifications of a responsible site manager or senior supervisor in the difficult or exceptionally difficult difficulty class. In renovation construction and rebuilding cases that do not affect on the stability, leaktightness, fire compartmentation of the building frame or the durability of equipment assemblies, it is sufficient for the person in charge of the supervision of construction work at the site to have the qualifications of a site manager or supervisor corresponding to the execution class of the structures. **[**2020-06-19 **]**

405. The supervisor of construction work of structures and buildings in safety class 2 shall have at least the applicable qualifications of a site manager or supervisor in the exceptionally difficult difficulty class. **[**2020-06-19 **]**

406. The supervisor of construction work of structures and buildings in safety class 3 shall have at least the applicable qualifications of a site manager or supervisor in the difficult difficulty class. **[**2020-06-19 **]**

406a. In the repair and alteration work of structures and buildings in safety classes 2 and 3 which does not affect the stability, leaktightness, or fire compartmentation of the building frame, or the durability of the equipment assembly, the person in charge of the supervision of the work shall have at least the applicable qualifications of a site manager or supervisor in the difficulty class of similar structures in accordance with the National Building Code of Finland. **[**2020-06-19 **]**

407. Removed. **[**2020-06-19 **]**

408. The person responsible of the installation supervision of steel parts of steel and composite structures in safety classes 2 and 3 shall have the qualifications of a workshop manager of manufacturing steel structures of manufacturing class 2 or execution manager of steel structures of the difficult difficulty class. In repair and altering construction which does not affect the stability, leaktightness, or fire compartmentation of the building frame, or the durability of the equipment assemblies, it is sufficient for the person in charge of the supervision of installation to have the qualifications of a workshop manager of steel structures in the relevant manufacturing class or excecution manager in relevant difficulty class. **[**2020-06-19 **]**

4.2 Construction work execution organisation

409. The building contractor shall have in place a management system that has been certified in accordance with an applicable standard, such as SFS-EN ISO 9001 [36], or otherwise independently evaluated. Furthermore, the management system of the building contractor executing construction work in safety class 2 shall meet the requirements of Guide YVL A.3, and the management system shall be independently evaluated. **[**2013-11-15 **]**

410. The building contractor shall have in place systematic and documented methods for the assessment, selection and supervision of its subcontractors. The building contractor shall evaluate the effectiveness of the subcontractor's management system and ascertain that the subcontractor has the prerequisites for delivering products or services that satisfy all requirements. The same regulations and obligations shall apply to both the building contractor and the subcontractors involved in the construction. The building contractor shall be responsible for the operations of the subcontractor. **[**2013-11-15 **]**

411. The building contractor shall employ professional, experienced personnel, and appropriately qualified procedures, tools and equipment required in its operations. **[**2013-11-15 **]**

412. The building contractor shall employ persons who are responsible for site management and quality control: these persons shall have qualifications at least equal to those responsible for the supervision implemented by the licensee (see requirement 404). **[**2020-06-19 **]**

413. Site and excecution managers and supervisors of construction work that are employed by the building contractor shall have at least the same qualifications as those responsible for the licensee's construction supervision. **[**2020-06-19 **]**

414. The person responsible for the production of concrete shall have sufficient knowledge of proportioning of concrete and the properties of concrete, and sufficient practical experience. The person responsible for the production of concrete shall have the qualifications of a manager of concrete production. During the production of concrete, a process controller with sufficient knowledge of the process and properties of concrete shall be at the manufacture place of manufacture. The person in charge of the concrete laboratory shall have sufficient knowledge of concrete technology and the qualifications of a concrete laboratory technician. **[**2020-06-19 **]**

415. The manager of the manufacture of concrete elements at the factory shall have sufficient knowledge of the manufacturing of concrete and concrete elements, and sufficient practical experience. The manager of the manufacture of precast concrete products that are not CE marked shall have documented qualifications. The responsible excecution manager of prefabricated concrete structures shall have sufficient knowledge of the behaviour of the installed structures and structures under installation, work planning, installations and occupational safety as well as practical knowledge of managing excecution of prefabricated concrete structures. At least the applicable qualifications of a excecution manager in the difficult difficulty class is required. **[**2020-06-19 **]**

416. The manufacture of the concrete structures at the construction site shall be headed by a site manager of concrete work with qualifications in the difficult difficulty class. The site manager of concrete work shall be present during the important work phases, especially during concreting. If there are compelling reasons for the site manager of concrete work of difficult structures to leave the site temporarily during the concreting of those structures, the person must be substituted on the site by a site manager of concrete structures with qualifications in at least the conventional difficulty class. **[**2020-06-19 **]**

417. The reinforcement steel welding coordinator and welders shall have qualifications meeting the requirements of the standards applied (see Annex A). **[**2013-11-15 **]**

418. The qualification information for the persons listed in paras 412–417 shall be submitted to STUK together with the organisation description. **[**2020-06-19 **]**

419. The qualifications required in paras 412–417 may be demonstrated by means of training and work experience that has been acquired outside Finland. **[**2020-06-19 **]**

4.3 Execution organisation of steel and composite structures

420. The manufacturer of steel structures and composite structures shall have in place a management system that is certified in accordance with an applicable standard, such as SFS-EN ISO 9001 [36], or otherwise independently evaluated. Furthermore, the management system of the manufacturer of steel structures and composite structures in safety class 2 shall meet the requirements of Guide YVL A.3, and the management system shall be independently evaluated. The management system of a manufacturer employing special procedures shall also meet the applicable requirements of Guide YVL A.3 in safety class 3. **[**2020-06-19 **]**

421. The management system of a manufacturer performing welding in safety classes 2 and 3 shall meet the requirements of standards SFS EN1090-2 [16] and SFS-EN ISO 3834-2 [35]. The management system of a manufacturer performing heat treatment in connection with welding and closely related processes shall meet the requirements of standard SFS-EN ISO 17663 [37]. **[**2013-11-15 **]**

422. The manufacturer of steel structures and of steel parts of composite structures shall have in place systematic and documented methods for the assessment, selection and supervision of its subcontractors. The manufacturer shall evaluate the effectiveness of the subcontractor's management system and ascertain that the subcontractor has the prerequisites to deliver products or services that satisfy all requirements. The same regulations and obligations shall apply to both the proper manufacturer and the subcontractors involved in manufacture. The manufacturer shall be responsible for the operations of the subcontractor. **[**2020-06-19 **]**

423. The manufacturer of steel structures and of steel parts of composite structures shall employ professional, experienced personnel, and appropriately qualified procedures, tools and equipment required in its operations. **[**2020-06-19 **]**

424. The person in charge of the installation of structural assemblies of steel structures and composite structures shall have the qualifications of an excecution manager of steel structures at least for the difficult difficulty class. **[**2020-06-19 **]**

425. The manufacturer of steel structures and of the steel parts of composite structures shall have available a sufficient number of competent welding coordinators who plan, draw up and qualify the necessary welding and work procedures defined in the standard applied (for qualification requirements, see Annex B). **[**2020-06-19 **]**

426. The manufacturer of steel structures and of the steel parts of composite structures shall have in place qualified manufacturing procedures for the manufacture of the structure, or the preparedness to qualify the procedures before manufacture is started. **[**2020-06-19 **]**

427. The steel parts of steel structures and composite structures shall be manufactured under the supervision of a person with documented qualifications. The manager of the manufacturing process shall have the qualification of a workshop manager of steel structure manufacturing in class 1 for execution class EXC2 and in manufacturing class 2 for excecution classes EXC3 and EXC4. **[**2020-06-19 **]**

428. Persons making permanent weld joints on steel structures and the steel parts of composite structures shall have the welder qualifications defined in standard EN-ISO 9606-1. **[**2020-06-19 **]**

429. The qualifications of testing organisations shall be presented in a separate description. Guide YVL E.12 deals with the requirements, acceptance procedures and supervision of the operations of the testing organisations and personnel that carry out non-destructive and destructive testing. **[**2013-11-15 **]**

430. The testing organisations and personnel that perform destructive testing on steel structures and the steel components of composite structures in safety class 2 shall be approved by STUK under Guide YVL E.12. No approval from STUK is required for an NDT testing organisation of steel and composite structures in safety class 3, but the organisation shall be accredited. The accreditation certificate of an NDT testing organisation shall be delivered together with the manufacturer’s organisation description. **[**2013-11-15 **]**

431. The description concerning the manufacturer of the steel parts of steel structures and composite structures including the subcontractors shall present the qualifications of the person responsible for installation supervision according to requirement 424 and the qualifications of the person responsible for manufacturing supervision according to requirement 427. **[**2020-06-19 **]**

5 Materials and products to be used in concrete and steel structures

5.1 Construction materials and products

501. The construction materials and products shall meet all Finnish requirements. If the Finnish regulations, codes and standards are insufficient, foreign regulations, guidelines and standards from the field may be applied. It shall then be ensured, however, that the regulations, codes and standards used form an applicable entity. **[**2020-06-19 **]**

502. The acceptability of construction materials and products shall be demonstrated as follows:
a. The properties of construction materials and products are demonstrated with the CE marking. If the construction product is not within the field of application of a harmonised product standard, or if the manufacturer does not hold a European Technical Assessment (ETA) for the product, the properties may be demonstrated by means of a type approval or verification certificate under the Act on the Approval of Certain Construction Products (954/2012) [8]. A Declaration of Performance (DoP) or an ETA is required for CE marked products. Declarations of Performance, European Technical Assessments, type approval decisions and verification certificates that demonstrate acceptability shall be submitted to STUK for information.
b. The acceptability of products that are CE marked or that have an ETA, type approval or verification certificate shall be verified at the construction site if there is reason to assume that a product is not in conformity with the certificate.
c. In case installation of the product is not covered by the approval certificate, an installation procedure shall be drawn up that covers the quality control of the installation.
d. The qualification of coatings used in the inner containment shall be demonstrated in the manner presented in chapter 5.4. **[**2020-06-19 **]**

5.2 Materials and products for concrete structures

503. Regarding the specification, properties, manufacture and conformity of concrete, the standard SFS-EN 206 [17] and its national application standard SFS-7022 [18] shall be applied. More detailed instructions concerning nuclear facilities are presented in Annex A to this Guide. **[**2020-06-19 **]**

504. The following materials, constituents, supplies and methods shall have a valid type approval or verification certificate granted by a body approved by the Ministry of the Environment, unless they have a CE-marking or a European Technical Assessment:
a. Concrete admixtures
b. Special mortars and concretes

c. Prestressing tendons
d. Prestressing systems
e. Load-transferring metal parts and lifting anchors
f. Joint sealing composites and strips for concrete facades
g. Reinforcement steels, mesh reinforcements and concrete reinforcements
h. Special couplers for reinforcing steel bars
i. Special anchors for reinforcing steel bars
j. Bearings used in support joints. **[**2020-06-19 **]**

505. The acceptability of special mortars and concretes shall be demonstrated as follows:
a. Special mortars and concretes refer to ready-mixed mortars and concretes that are intended for load-bearing structures or structures requiring weather resistance, and that are delivered to the construction site as dry bagged products. Special mortars and concretes also include sealing and repair mortars that are required to be weather-resistant.
b. If the special mortars and concretes are not CE marked, a verification certificate from a body approved by the Ministry of the Environment is required. **[**2013-11-15 **]**

506. The following requirements shall apply to reinforcement steels, mesh reinforcements and concrete reinforcements:
a. The reinforcement elements shall be manufactured using reinforcement steels and weld joints the characteristics of which match the values used in the design of the structures. The ductility class of reinforcement steels in nuclear facilities shall be at least class B.
b. The essential technical requirements of reinforcement steels are presented in the Decree of the Ministry of the Environment (125/2016) [48].
c. The acceptability of reinforcement steels and mesh reinforcements is demonstrated with a type approval in accordance with the Decree of the Ministry of the Environment (126/2016) [49].
d. The manufacture of concrete reinforcements shall be verified by an organisation approved by the Ministry of the Environment in accordance with the assessment criteria of the verification certificate of the Ministry of the Environment. **[**2020-06-19 **]**

507. The acceptability of the prestressing tendon and the prestressing system shall be demonstrated as follows:
a. Sufficient preliminary descriptions shall exist of the properties of a prestressing system and of matters relating to its execution, such as allowable bends, anchors and splices. These descriptions shall be in the form of a European Technical Assessment. If no European Technical Assessment exists for the prestressing system, the properties may be demonstrated with a verification certificate issued by a body approved by the Ministry of the Environment.

b. The prestressing system shall follow the European Technical Approval Guideline (ETAG 013 [25]).
c. The acceptability of the prestressing tendons shall be demonstrated with a type approval granted by a body approved by the Ministry of the Environment, unless the prestressing tendons have a CE-marking in accordance with standard EN 10138. The type approval shall comply with the requirements of the Ministry of the Environment decrees. **[**2020-06-19 **]**

5.3 Materials and products for steel structures and composite structures

508. Steel structures and the steel parts of composite structures shall employ materials, supplies, products or systems that satisfy the requirements of standards SFS-EN 1993 [13] and SFS-EN 1090-2 [16] and the valid CE marking, type approvals, European Technical Assessments or verification certificates. **[**2020-06-19 **]**

509. The materials shall be unambiguously defined using the additional attributes (options) specified in standards SFS-EN 1993 and SFS-EN 1090-2. The additional attributes selected shall be presented in the execution specification and, whenever necessary, in drawings. **[**2013-11-15 **]**

510. The material for the steel containment, concrete containment liner, and the penetrations, equipment hatches and personnel and emergency airlocks of the containment shall be selected so as to fulfill the requirements of the applied standard (ASME III Div. 2 [29], ASME III Div. 1 NE [30], KTA 3401 [32-34]). **[**2020-06-19 **]**

511. Steel structures may be attached to concrete structures using load-transferring steel parts installed in the cast concrete, or by using post-installed anchors in line with Annex A. Separate guidelines shall be drafted for the installation and inspection of post-installed anchors to be appended to the construction plan. The qualifications of the installers shall also be defined. A report of the use, installation and quality inspection of any other types of steel parts or anchors shall be provided as an attachment to the construction plan. **[**2013-11-15 **]**

512. The properties of structural parts in composite structures that create the composite effect, such as the characteristics of shear studs and composite plate profiles, shall be demonstrated with a CE marking. If no harmonised product standards or European Technical Assessments (ETA) exist for the product, its characteristics may be demonstrated by means of a type approval or verification certificate from a body authorised by the Ministry of the Environment. **[**2013-11-15 **]**

513. For the structural parts creating the composite effect in composite structures, the containment liner, and pool lining plates, sufficient statistical test results concerning the strength

and deformation characteristics shall be submitted to STUK for approval, unless these characteristics are evident from the product's Declaration of Performance, European Technical Assessment, type approval or verification certificate. **[**2013-11-15 **]**

5.4 Coatings and fire protection products for concrete structures, steel structures and composite structures

514. Under accident conditions, the coatings of the containment's internal structures will be subjected to loads which essentially deviate from those encountered during normal operation. The coatings used shall be such that they will not have an unfavourable effect on accident management. It shall be demonstrated, therefore, that coatings will not come off to an extent which could block flow paths and endanger core cooling or removal of residual heat. Furthermore, it shall be demonstrated that under accident conditions chemical changes, if any, in the coating material do not create new risks. Neither shall the coatings cause electrical disturbances on contact surfaces of electrical equipment.

a. The design data shall present the requirements for the coatings inside the containment in terms of radiation tolerance, decontaminability, chemical resistance, durability under operating conditions, durability under accident conditions, fire resistance properties, and in-service inspection principles.

b. The design data shall also present the methods used to ensure the meeting of requirements set for coating materials, coating treatment combinations and the application of coatings.

c. Only coatings which have passed tests demonstrating the fulfillment of these requirements are allowable in structures inside the containment.

d. The tests shall be repeated in case a different coating material is used for repairs and/or recoating, or in case coating consistency has essentially changed compared with the original. Individual components with a negligible coated surface may be an exception from this rule.

e. Corresponding reports shall be presented of the containment's external coatings for which requirements relating to decontaminability or radiation tolerance are set.

f. The summary of justification shall present the fulfillment of the design requirements: e.g. how the testing parameters, such as radiation dose rates, set in the standards applied correspond to the assumptions concerning accident conditions. **[**2020-06-19 **]**

515. A plan shall be drawn up covering the quality control of the application of paint and coatings. The plan shall describe the quality control measures taken by the various parties and the recording of the results. The coating plan shall describe the means by which the fulfilment of the requirements set for coating materials and surface finishing systems and work is verified. **[**2020-06-19 **]**

515a. An external testing organisation shall be used in the demonstration of compliance with the design data of coating materials. **[**2020-06-19 **]**

515b. The testing methods for durability against radiation of coatings shall comply with the requirement level of ASTM D4082 [53], ASTM D5139 [54] and ISO 4628 [55]. **[**2020-06-19 **]**

515c. The testing methods for the durability against decontamination of coatings shall comply with the requirement level of ISO 8690 [56]. **[**2020-06-19 **]**

515d. The testing methods for the chemical resistance of coatings shall comply with the requirement level of ASTM D5139 [54], ISO 2812-2 [57] and ISO 4628 [55]. **[**2020-06-19 **]**

515e. The testing methods for the in-service adhesive strength of coatings requiring durability against radiation and decontamination shall comply with the requirement level of ISO 4624 [58]. The adhesion of the coatings shall comply with the requirements according to the requirement specification, however, in such a way that the adhesive strength in concrete structures shall be at least 2.5 MPa on floors and 1.5 MPa on walls, pillars, beams and ceilings. In steel structures, the adhesive strength shall be at least 5 MPa in tensile tests and at least 3 MPa against cohesion failure. **[**2020-06-19 **]**

515f. The testing methods for the in-service wear resistance of coatings requiring radiation and the ability to withstand decontamination shall comply with the requirement level of ISO-7784-2 [59]. The average decrease of mass shall be limited in accordance with the corresponding requirement specification; however, it shall not exceed 175 mg/1,000 repeats. **[**2020-06-19 **]**

515g. The testing methods for the required resistance under postulated accident and severe accident conditions of coatings requiring radiation and ability to withstand decontamination shall comply with the requirement level of ASTM D3911 [60] and ISO 4628 [55]. The coatings shall comply with the radiation, steam temperature, steam blast pressure and duration requirements in accordance with the requirement specification. **[**2020-06-19 **]**

515h. The intumescent painting of steel structures outside the containment shall adhere to guideline B7 “Steel structures” of the National Building Code of Finland [9], unless something else is required in the voluntary product approval (ETA approval or verification certificate). **[**2020-06-19 **]**

516. The work plans for steel structures shall present excecution drawings, an installation plan and a fire protection plan in accordance with guideline “Steel structures” of the National Building Code of Finland. The fire protection products shall have either a European Technical Approval (ETA) or a verification certificate granted by a body approved by the Ministry of the

Environment. The product requirements are presented in either the ETAG guidelines [24–25] or the assessment criteria of the verification certificates of the Ministry of the Environment.

[2020-06-19 **]**

6 Design

6.1 Design and execution process and organisations

601. The licensee's management system shall have procedures for assessing and selecting a nuclear facility's structural designers, building contractors, and manufacturers of structures. Management system requirements are set forth in Guide YVL A.3. **[**2013-11-15 **]**

602. Organization description reports concerning the design and execution processes and quality assurance of buildings and structures, descriptions of the organisation shall be sent to STUK for approval. The reports shall describe how quality assurance related to the design and execution of structures has been arranged in the organisations of the licence applicant, plant supplier, structural designer and building contractor. The reports shall demonstrate how the correctness and correct application of the initial data is ensured, and how the design practices, functions of all parties and quality management are verified. Chapter 3 of Guide YVL B.1 presents the general requirements related to the design of nuclear power plants and its verification. **[**2013-11-15 **]**

603. The licensee shall have a sufficiently resourced, competent organisation in place to ensure the conformity of the nuclear facility during the design, execution and operation of the buildings and structures. The organisation description shall be submitted to STUK for approval. **[**2013-11-15 **]**

604. The organisation performing structural design shall have a management system in place, which has been certified in accordance with an applicable standard, such as SFS-EN ISO 9001 [36], or otherwise independently evaluated. The licensee shall apply the requirements of chapter 8 of Guide YVL E.4 in the evaluation and control of the organisation performing structural design as well as in the quality management of structural analyses. **[**2020-06-19 **]**

605. Where operation is concerned, the organisation shall employ a sufficient number of qualified personnel, and the lines of responsibility shall be clear. The organisation descriptions shall present the responsibilities and qualifications of the personnel. **[**2020-06-19 **]**

6.2 Qualifications of the structural designer

606. The qualification requirements for structural designers that depend on the difficulty class of the design task are presented in the Land Use and Building Act and the decrees and guidelines of the Ministry of the Environment issued by virtue of the Act. The design tasks belong to following difficulty classes: exceptionally difficult, difficult, conventional and minor design tasks. **[**2020-06-19 **]**

607. For each building or structure of a nuclear facility, a structural designer in charge shall be appointed; he or she shall have the qualifications of a structural designer for structures in the exceptionally difficult difficulty class. Depending on the load-bearing structure of the building, the required qualifications may be those for a structural designer of concrete or steel structures. The structural designer in charge shall approve the plans falling under his or her field of responsibility. **[**2020-06-19 **]**

608. The structural designer of safety class 2 concrete or steel structures shall have the qualifications of a structural designer of structures in the exceptionally difficult difficulty class and sufficient experience in the design of structures that are similar to those used in a nuclear facility. The designer of safety class 3 concrete or steel structures shall have at least the qualifications of a structural designer of structures in the difficult difficulty class. The designer of composite structures shall have the qualifications of a concrete or steel structure designer according to the difficulty class of the composite structure. **[**2020-06-19 **]**

608a. For building- or structure-specific repair and alteration design at the nuclear facility with no effect on the stability, leaktightness and fire compartmentation of the building frame and the durability of the equipment assembly,
a. a structural designer in charge shall be appointed; he or she shall have at least the qualifications of a structural designer in the competence class of similar structures in accordance with the National Building Code of Finland. Depending on the target of repair and alteration work in the building, the required qualifications may be those for a structural designer of concrete or steel structures. The structural designer in charge shall approve the plans falling under his or her field of responsibility.
b. The structural designer of concrete, steel or composite structures in safety classes 2 and 3 shall have at least the qualifications of a structural designer in the competence class of similar structures in accordance with the National Building Code of Finland. **[**2020-06-19 **]**

609. In addition to the exceptionally difficult difficulty class concrete structure designer qualifications, the designer of prestressed concrete structures shall have sufficient experience

in the design of prestressed structures similar to those used in a nuclear facility. **[**2020-06-19 **]**

610. The fulfillment of the training and experience requirements presented in requirements 606, 608, 608a and 609 may be demonstrated with a clarification submitted to STUK; studies and qualifications completed abroad are also acceptable. **[**2020-06-19 **]**

611. During the construction of structural frames of buildings in safety classes 2 and 3, a representative of the structural designer shall be present at the construction site or promptly available if required. The designer's representative shall have the same qualifications as the structural designer (paras. 608 and 609). **[**2013-11-15 **]**

6.3 Plan review and reviewer qualifications

612. The licensee shall review and approve the documents submitted to STUK for approval and information. In order to ensure the correctness and acceptability of the design, comparison analyses or mock-up tests shall be done when necessary. Regarding construction plans, the results from document inspections shall be enclosed with the summary of justifications submitted, see chapter 7.11. **[**2013-11-15 **]**

613. The person responsible for inspecting plans shall have the qualifications required in requirement 607 or item a of requirement 608a of a responsible structural designer. **[**2020-06-19 **]**

614. The persons inspecting plans shall have the qualifications required in requirement 608 or item b of requirement 608a of a structural designer; the inspector of plans for prestressed structures shall have the qualifications required in requirement 609. **[**2020-06-19 **]**

6.4 Design methods

615. Design shall be founded on generally accepted, experimentally verified standards and calculation methods. The version of the calculation software shall be verified in the calculation environment that is used. Significant design parameters that are not based on standards shall be verified by means of experiments. In the design of load-bearing and bracing structures, essential technical requirements are considered fulfilled when the structures are designed and implemented in accordance with the Eurocodes [10–14] and their national annexes that have been issued as decrees by the Ministry of the Environment. The standard SFS-EN 1998-1 [26] may be used in the handling of load combinations **[**2020-06-19 **]**

616. The design and analysis software for numerical methods, such as the finite element method (FEM), shall be ensured by using a validation method that is sufficient for the intended purpose. The results from the validation method shall be presented in the management system

documentation of the designing organisation (see para. 604 and Guide YVL E.4, chapter 8). **[**2020-06-19 **]**

617. When using demanding design methods and computer software, the individual performing the calculation shall have the necessary training and experience to use the calculation method or software in question. **[**2013-11-15 **]**

618. The results from numerical calculation methods shall be verified using simpler analyses. The realisation of the equilibrium and compatibility conditions in numerical calculations shall be verified. Equilibrium conditions shall be verified by comparing loads and support reactions. The results shall be inspected for satisfying boundary conditions and how realistic the structural deformations are. **[**2013-11-15 **]**

6.5 General design requirements

619. When selecting the structural types and materials for the concrete and steel structures, the operating and environmental conditions of the structure as well as requirements and restrictions resulting from manufacturing and testing shall be considered. **[**2013-11-15 **]**

620. The life cycle of the nuclear facility shall be taken into consideration when designing the service life of buildings and structures. The structure shall be designed and implemented in a manner that allows it to maintain sufficient operability throughout the planned service life of the structure. The structures that have a shorter service life than the planned service life of the facility shall be replaceable. Essential operability requirements are presented in chapter 4 of Guide YVL A.8. **[**2013-11-15 **]**

621. To reach the planned service life, the exposure classes shall be defined according to environmental conditions.
a. Based on the exposure class, the requirements for concrete and concrete structures shall be defined in compliance with guideline “Concrete structures” of the National Building Code of Finland [9]. More detailed service life dimensioning of a concrete structure may be performed according to Concrete Code BY 65 [39].
b. The exposure classes of steel assemblies shall be defined according to the standard SFS-EN ISO 12944 [40]. The exposure class is used to define the requirements, such as the quality of steel to be used, the protection method and any inspection and maintenance measures required by the protection method (see guideline “Steel structures” of the National Building Code of Finland [9]). **[**2020-06-19 **]**

622. Structures shall be designed and dimensioned in a manner that provides them with sufficient reliability against failure. During service, the structure shall also be sufficiently

resistant to the appearance of deformations, cracks, vibrations, settling or creep, losses of leaktightness or other effects that may be detrimental to the intended purpose and use of the structure. **[**2020-06-19 **]**

623. In addition to strength analysis, stability, deformation, fatigue, creep, relaxation and progressive collapse of the structure shall be assessed, if necessary, to verify its durability and reliability under operational and accident conditions. **[**2013-11-15 **]**

624. During exposure to fire, the capacity (R) of the load-bearing structure, and the integrity (E) and insulation capacity (I) of the separating structure, shall remain at a sufficient level for the time period required. Guide YVL B.8 presents the fire resistance requirements for buildings and their load-bearing and separating structures. The design and testing of fire resistance shall be based on methods that are pursuant to the EN or ISO standards. When using other methods, their validity shall be demonstrated. **[**2020-06-19 **]**

625. Based on the consequences of a possible failure, the buildings are divided into three consequence classes: CC3, CC2, and CC1. The consequence classes and their use in design are presented in the Ministry of the Environment Decree (3/16) [50] concerning the national choices of standard SFS-EN 1990 and the guideline “Basis of structural design for load-bearing structures” of the National Building Code of Finland. **[**2020-06-19 **]**

626. Buildings and structures in safety class 2 belong to consequence class CC3, and the competence class of the structure design task is exceptionally demanding (see chapter 8). **[**2020-06-19 **]**

627. Buildings and structures in safety class 3 belong to consequence class CC3. Their design of load-bearing and bracing structures in safety class 3 shall take place at least as a structure of the difficult difficulty class. Consequence class CC2 may be approved for structures not affecting the stability, leaktightness, or fire compartmentation of the building, or the durability of equipment assemblies; in this case, the design of these structures shall, at a minimum, take place in the conventional difficulty class. **[**2020-06-19 **]**

628. The assumptions of the structural analyses and the structural systems, structures and boundary conditions shall be coherent with the behaviour of loads and structures. This shall apply to the operation of the load-bearing and bracing structures, structural continuity characteristics and vibration characteristics. **[**2013-11-15 **]**

629. Structural systems shall be designed to be sufficiently ductile and uniform in strength. If the brittle failure mechanism is dimensioning by nature, the margin of safety shall be justified. **[**2013-11-15 **]**

630. The structural requirement specification shall present how the cracking of concrete structures and its effects are taken into account in the design of the structures, and what measures are taken to limit cracking. For example, watertightness is one criterion for the limiting of cracking. Another essential reason to limit cracking is the management of the service life against corrosion. **[**2020-06-19 **]**

6.6 Dynamic analysis of structures

631. The seismic design of structures and components assigned to seismic category S1, as defined in Guide YVL B.2, shall consider loads caused by a design basis earthquake. To determine the loads affecting the structures and components, dynamic analyses shall be used to derive the floor response spectra or acceleration-time diagrams of those building levels that house the structures and components in question using the ground response spectrum as initial data. **[**2013-11-15 **]**

632. The eigenmodes of vibration, accelerations and displacements of the structure shall be defined by means of structural analyses that consider inertial forces (dynamic structural analyses). Standards SFS-EN 1998-1 [26], ASCE 4-16 [27] and ASCE 43-05 [28] provide instructions on handling earthquakes and other simultaneous load combinations. Guide YVL B.7 provides more detailed instructions on performing dynamic analyses and earthquake analyses. Guide YVL A.11 presents the design requirements for designing structures to withstand certain dynamic design basis threats, such as aircraft crashes. **[**2020-06-19 **]**

633. The vibration resistance objectives, structural damping and assumptions of the energy dissipation shall be in balance. The chosen damping ratio values shall be justified, taking into consideration the utilisation rate of the structural capacity and the cracking of the concrete and composite structure. **[**2013-11-15 **]**

6.7 Containment

634. The leak-tightness of a concrete containment building shall be ensured by using a steel liner. The dimensioning of the liner and penetrations of the concrete containment’s protective shell shall follow standard ASME III Div. 2 [29]. The design, manufacture and quality control of steel structures for equipment hatches and personnel airlocks in concrete containment shall follow the guidelines of ASME III Div.1 Subsection NE [30]. The requirements set for pressure vessels in Guide YVL E.3 shall be applied to the design, manufacture and quality control of the pressure resisting shell’s penetrations, equipment hatches and personnel airlocks. A strength analysis report shall be drawn up according to Guide YVL E.4. **[**2013-11-15 **]**

635. The design, manufacture and quality control of a steel containment and its penetrations, equipment hatches and personnel airlocks shall comply with the following standards (a) or the design by analysis method (b):
a. Guidelines of ASME III Div.1 Subsection NE, Class MC Components [30]. Alternatively, standard SFS-EN 13445-3 may be used for penetrations and airlocks. The requirements set for pressure vessels in Guide YVL E.3 shall be applied to the design, manufacture and quality control of the steel containment. A strength analysis report pursuant to Guide YVL E.4 shall be drawn up for the steel containment.
b. When using the design by analysis method, the minimum wall thickness of the steel containment casing shall, however, be at least the minimum wall thickness determined by means of the calculation formula. **[**2020-06-19 **]**

636. The licensee may present alternative standards to ASME III for the design of the containment and its penetrations, hatches and airlocks that meet the design requirements set forth in Guides YVL B.1 and YVL B.6. One of the prerequisites for approval is that the standard in question (for example, SFS-EN 13445-3, KTA3401.1, KTA3401.2 and KTA3401.3) has been utilised in earlier construction of similar nuclear power plants. **[**2013-11-15 **]**

637. The concrete containment may be designed in accordance with standard SFS-EN 1992 [12] and the national choices provided in the guideline “Concrete structures” of the National Building Code of Finland [9]. The reliability of concrete structures of the containment in the ultimate limit state shall be at least as high as when designed according to standard ASME III Div. 2.
a. In the structural requirement specification of the containment, the licensee shall present the loads and load combinations, with their partial safety factors and combination factors, used in the design. The partial safety factors and possible acceptance criteria and limits for stresses and elongations shall also be presented.
b. When load combinations are calculated, care shall be taken not to overestimate loads reducing maximum stress.
c. The loads and load combinations shall take into account the general design criteria given in Guides YVL B.1 and YVL B.6.
d. The partial safety factors for load combinations and loads as well as partial safety factors for material properties shall be presented for the loads during construction, operation and accident conditions (earthquake, external and internal events, postulated and severe accident).
e. The leak-tightness and other operability characteristics for the structures shall be demonstrated by using service limit state dimensioning, and structural strength shall be

demonstrated by means of ultimate limit state design or design according to the method of allowable stresses. **[**2020-06-19 **]**

638. As set forth in Guide YVL A.7, containment leaking mechanisms and failure shall be analysed in conjunction with a Level 2 probabilistic risk assessment (PRA). Therefore, probabilistic assessments shall also be made to assess the structural reliability of the containment. When assessing containment reliability, use shall be made of the probability distributions of loads, material properties and calculation methods. The reliability levels of material properties shall be based on quality control documentation from the construction period. **[**2020-06-19 **]**

6.8 Leaktightness and leak monitoring of pools containing radioactive substances

639. The concrete structures, liner structure and leak collection systems of pools that contain radioactive substances shall be designed and implemented in a manner that enables the reliable cooling of the pools and prevents severe damage to spent fuel as set forth in requirement 424 of Guide YVL B.1. **[**2020-06-19 **]**

640. The concrete structures of pools and tunnels that are filled with water or solutions containing radioactive substances shall be designed to be watertight by using materials meeting all water-tightness requirements and reinforcement that limits the cracking of concrete. **[**2020-06-19 **]**

641. The water-tightness of pools containing radioactive substances shall be ensured by using a stainless steel liner. Weld seams in the pools shall be equipped with a leak drainage system that can identify liner leaks and the area of the leak. The design shall take account of the requirement that the weld seams of the liner shall be testable using non-destructive methods (NDT). **[**2020-06-19 **]**

642. The liner structure of pools containing radioactive substances shall remain watertight in all design conditions. The design conditions shall be presented in the structural requirement specification, and they shall be based on a generally accepted standard, such as KTA 2502. **[**2013-11-15 **]**

6.9 Verification of the design solution

643. Where necessary, design solutions shall be verified using independent comparative analyses and mock-up tests. **[**2013-11-15 **]**

644. The dimensioning of the containment's pressure resistant shell against accident conditions (earthquake, external and internal events, postulated and severe accident) shall be verified using comprehensive analyses by an independent third party. The verification shall be performed by means of global and local non-linear analyses. Guide YVL B.6 sets forth requirements concerning the durability of the containment under transients and accident conditions. **[**2013-11-15 **]**

645. If necessary, the durability and tightness of the structures shall be verified using test loads, pressure tests, water filling etc. Guide YVL B.6 sets forth the essential requirements concerning the experimental verification of the operation of the containment. **[**2013-11-15 **]**

7 Construction plan

701. The construction plan for safety class 2 and 3 or seismic category S1 and S2A steel structures and the design documents of concrete structures shall include the following documents, and as a rule they shall be specific to each building or type of structure:

a. Organisation description
b. The regulations, codes and standards applied
c. Design bases
d. Structural calculations
e. Structural drawings
f. Execution specification
g. Quality control plan
h. Installation construction plan
i. In-service structural inspection plan
j. Plan for containment pressure and leakage tests
k. The licensee's summary of justification.

The content of the construction plan shall comply with the requirements presented in the regulations and guidelines of the National Building Code of Finland. **[**2020-06-19 **]**

702. The installation construction plan shall be submitted for approval under Annex C to STUK or an authorised inspection body. **[**2013-11-15 **]**

703. Additionally, the construction plans for steel structures shall include the following documents:

a. Manufacturing plan for structures in consequence classes CC3 and CC2
b. Manufacturing plan for structures subjected to fatigue loads. **[**2020-06-19 **]**

7.1 Organisation description

704. The organisation description shall describe how the quality assurance of the design and execution of structures has been arranged in the organisations of the various involved parties. The setting up of quality assurance in other organisations whose activities have a bearing on the quality of structures shall also be accounted for. The quality assurance function shall be sufficiently independent of design and execution. **[**2013-11-15 **]**

705. The organisation description shall include a description of the management system of the building contractor or steel structure manufacturer and assessments of the said system, including a report on the following:

a. Management system certification
b. The assessment, selection, familiarisation and supervision processes of subcontractors
c. References of similar deliveries
d. Qualifications of the forepersons and employees (for requirements, see chapter 4.2).
[2020-06-19 **]**

706. In addition to the above, the following requirements shall apply to the manufacturers of steel structures.
a. If the manufacturer of the steel structure or the manufacturer's important subcontractor is a manufacturer approved by STUK, the construction plan shall include references to STUK's decisions of approval and the periods of validity of these decisions.
b. Regarding testing organisations, a reference shall be made to STUK's decisions on approval of the testing organisation, including the periods of validity.
c. If the testing organisation has been approved based on accreditation, a reference to the accreditation shall be added to the construction plan. **[**2020-06-19 **]**

7.2 Applicable regulations, guidelines and standards

707. The official regulations, guidelines and standards applied shall be presented. Any deviations from the design requirements of the structural requirement specification approved by STUK shall be justified. **[**2013-11-15 **]**

7.3 Design bases

708. At least the following initial data utilised in the design of structures shall be given:
a. Layout drawings
b. A building's purpose as part of the nuclear facility
c. A structure's purpose as part of the building
d. Loads and load combinations
e. Materials, construction supplies and construction products used
f. A general description of construction methods
g. Classification of coatings of structure surfaces
h. In-service inspection principles. **[**2020-06-19 **]**

709. The justifications for the loads and load combinations selected shall be presented by referring to the applied standard and to the design requirements of the structural requirement specification approved by STUK. **[**2013-11-15 **]**

710. The acceptability of the concrete types and the constituents of the concrete shall be demonstrated by means of a report, and the properties of the fresh concrete shall be ensured by means of preliminary test results (see Annex A). **[**2013-11-15 **]**

711. A report shall be presented describing the properties and demonstrating the applicability of reinforcement steels, prestressing tendons and prestressing systems for their intended purpose. **[**2013-11-15 **]**

712. In the material report and drawings, the following shall be presented for the different parts of the steel structure:
a. Standard marking and type of material and welding consumables used in accordance with the applicable standard
b. Method of manufacture, delivery status and type of material certificate of the material as laid down in standard SFS EN 10204 [41] (for requirements, see Annexes B and D)
c. Grounds for the choice of construction material made, where necessary. **[**2020-06-19 **]**

713. The design information shall present the coatings and fire protection of the structures and the requirements and classification defined for them. The requirements for coatings and fire protection are presented in chapter 5.4. **[**2020-06-19 **]**

7.4 Structural calculations and analyses

714. The structural calculation shall describe how the dimensioning presented has been derived from the structural system, structures, boundary conditions, load combinations and material properties. The document shall be detailed enough that the reliability of the analysis method used and the fulfilment of the design requirements can be assessed based on it. The document shall allow for the replication of the essential parts of the calculation. The structural calculation shall assess at least the following points:
a. The analyses concerning the stability, deformation, fatigue, creep, relaxation and progressive collapse of the structure during implementation and complete structure shall be presented when necessary.
b. The results of non-linear analyses shall also be presented for the behaviour of the containment and its structures under accident conditions.
c. Loads and load combinations, boundary conditions, assumptions and simplifications, calculation methods, illustrated results, the acceptability of results and conclusions shall be presented for the structural calculations included in the construction plan.
d. Validation results shall be presented for the computer software used for structural calculations as laid down in the requirements of requirement 616.

e. The structural models for the static functionality and bracing of the structural system shall be presented. When the finite element method is used, the input data, the element mesh chosen, information of element types, boundary conditions, assumptions made and an interpretation of the results shall be presented in a summary report. Furthermore, the independence of the solution from the element mesh density shall be demonstrated when necessary.
f. The realisation and verification of the equilibrium and compatibility conditions shall be presented in the outputs (see requirement 618).
g. The outputs shall present the force quantities, stresses and deformations caused by the dimensioning load combinations of the structures. The outputs shall allow for the assessment of the effects of different design parameters and loads on the behaviour of the structure.
h. The ultimate limit state and service limit state analyses, applicable accident analyses, and the structural fire design shall be presented.
i. The references to source literature and the applied details of the source literature shall be presented.
j. The source literature shall be presented to the inspector of the construction plan upon request.
k. The calculated deformations of structures subjected to test loads during the various phases of test loading shall be presented.
l. The structural calculations shall be clearly presented and the necessary references to other documents, source literature and drawings shall be made. **[**2020-06-19 **]**

7.5 Drawings

715. The drawings shall describe the structure, structural parts and details such that the size, geometry, manufacture, and installation of the structure and their allowable tolerances are given in sufficient detail. The drawings shall be explicit and clear.
a. The drawings shall present necessary further instructions concerning execution of the work, quality control and the requirements set for structures during construction.
b. In addition to the information required by the regulations and guidelines of the Finnish Building Code, the drawings shall present the safety classes and seismic classes of the structures and their boundaries if the drawings present structures of multiple classifications.
[2020-06-19 **]**

7.6 Execution specification

716. An execution specification shall be drawn up for the load-bearing and bracing structures. The execution specification shall be drawn up for steel structures according to standard SFS-EN 1090-2, and for concrete structures according to standard SFS-EN 13670, as well as their national application standards SFS 5975 [21] and SFS 5976 [44]. The execution specifications for composite structures shall apply both of the above standards. **[**2013-11-15 **]**

717. The execution specification shall set forth the requirements and instructions for the execution of a structure. The requirements concerning execution are based on the execution classes. The execution specification shall be detailed enough so that, with the help of it and structural drawings, structures can be constructed to meet all requirements. The execution classes for safety-classified structures are presented in chapters 8.1 and 8.3, which set forth the requirements for execution. **[**2013-11-15 **]**

7.7 Quality plan

718. An execution quality plan is always required for the execution of construction work at nuclear facilities. The quality plan is a building project quality control document that includes a description of the constructor's ability to fulfill the imposed requirements, a description of the organisation including responsibilities, the principles and responsibilities of quality control, and a plan concerning quality control (quality control plan) and quality control records (see the Ministry of the Environment's decree on load-bearing structures [42]). **[**2020-06-19 **]**

719. The quality control plan shall present the items subject to quality control, and the quality control measures, inspections and tests to be performed. Corresponding instructions shall be prepared for each quality control procedure or inspection, including the recording of quality control results. The instructions shall present, among other matters, the item inspected, the inspection method, scope and requirements, and the performer of the procedure, the drawing up of records, and reporting. References to standards may be used to present detailed information. **[**2020-06-19 **]**

720. For concrete structures, the quality control plan shall include the readiness inspection for concreting as one phase; for steel structures, it shall include a construction inspection. **[**2013-11-15 **]**

721. The responsible organisation/persons and the date of execution shall also be given of measures and inspections conducted under the quality control plan. **[**2013-11-15 **]**

722. The quality control plan for structures may be divided into an inspection plan and inspection procedures, which describe in detail the methods, reporting and supervision. **[**2013-11-15 **]**

723. The licensee shall draw up a statement on the acceptability and suitability of mock-up and procedure tests of the various manufacturing procedures performed and their related supervision activities. **[**2013-11-15 **]**

724. Annex A presents more detailed requirements concerning the quality control plan and inspection plan of concrete structures. **[**2020-06-19 **]**

725. Annex B presents more detailed requirements concerning the inspection plan of steel structures. **[**2013-11-15 **]**

7.8 Installation construction plan

726. The licensee shall draw up a construction plan for the installation of safety-classified steel structures, steel parts of composite structures, and concrete elements. It may be submitted separately or included in the manufacturing construction plan. Where applicable, the plan shall meet the requirements for the manufacturing construction plan. **[**2020-06-19 **]**

727. The installation construction plan shall be submitted for approval to STUK or an authorised inspection body according to Annex C. **[**2013-11-15 **]**

728. The installation construction plan (installation plan) for concrete elements and precast concrete products shall include the information and stability analyses presented in standards SFS-EN 13670 [20] and BY65 Concrete Code [39]. **[**2020-06-19 **]**

729. The installation construction plan (installation plan) for steel structures and steel assemblies of composite structures shall be drawn up according to the guidelines of the National Building Code of Finland concerning steel structures and composite structures. **[**2020-06-19 **]**

7.9 In-service structural inspection plan

730. The in-service structural inspection plan shall present the inspections to be conducted on structures at specified intervals during plant operation, the methods of performing of the inspections, and the criteria for assessment and recording of the inspection results. The plan for the in-service inspection of reactor containment concrete structures shall include the following information:

a. Inspection of displacements, strains and leak-tightness of structures at specified intervals and

in conjunction with leakage and pressure tests.
b. Inspection of the condition of post-tensioned containment tendons and anchors at specified intervals.
c. Inspection of structures essential for the containment's function by test loading or other reliable methods, if necessary. **[**2020-06-19 **]**

731. The containment shall feature measurement instrumentation that allows for the acquisition of sufficient information on the displacements and strains of the containment building's base slab and pressure resistant shell, as well as temperature and humidity, during the leak-tightness and pressure tests. The prestressing force in the tendons of a post-tensioned pressure resistant shell shall be measurable for at least some of the tendons. **[**2013-11-15 **]**

7.10 Plan for containment pressure and leakage tests

732. The plan for the pressure and leakage tests of the reactor containment shall present unambiguous acceptance criteria for at least the items below:
a. Containment displacements and strains under different pressure levels
b. Recovery of displacements and strains
c. Cracks and their mapping
d. Temperatures, leakage volumes. **[**2020-06-19 **]**

733. Guidelines that are useful for the preparation of the plan are presented in standard ASME III Div.2 [29] and USNRC Regulatory Guide 1.90 [31]. The plan for containment pressure and leakage tests may also be part of the in-service inspection plan. **[**2013-11-15 **]**

7.11 Summary of justifications

734. The licensee shall draw up a summary of justification presenting how the structure meets the requirements set for it, and how the licensee has established its conformity to requirements. The summary of justification shall also present the changes made to the approved documents, any non-conformances that occurred during manufacture, and their impact on the suitability and acceptability of the structure. **[**2013-11-15 **]**

735. If the construction plan does not entirely meet the requirements of the YVL Guides, the safety analysis report (SAR) or STUK's decisions, the summary of justification shall present deviations from the requirements and how the safety level required by the YVL Guides can be achieved in this case. **[**2013-11-15 **]**

8 Execution

8.1 Execution of concrete structures

801. The execution of concrete structures shall follow the requirements set forth in this Guide and standard SFS-EN 13670 and its national application standard SFS 5975. **[**2013-11-15 **]**

802. The quality assurance of load-bearing welds and fixing joints of reinforcement steels of structures in safety classes 2 and 3 shall be made in accordance with standard SFS-EN 13670 and its national application standard SFS 5975, pursuant to the requirements of execution class 3. The welding procedure specifications for load-bearing welding joints of reinforcement shall be submitted to STUK for approval together with the design documentation of the concrete structures. **[**2013-11-15 **]**

803. Detailed requirements for the execution of concrete structures are presented in Annex A of this Guide. **[**2013-11-15 **]**

804. The definition, properties, manufacturing and conformity of concrete shall follow standard SFS-EN 206 and its national application standard SFS 7022, which details the preservation guidelines and allowed cement types. **[**2020-06-19 **]**

805. The safety class for concrete structures shall be presented in the plans. Concrete structures in safety class 2 and 3 shall be manufactured as execution class 3 structures under standard SFS-EN 13670. Structures made of high strength concrete and prestressed structures belong to execution class 3. Concrete with a strength class higher than C50/60 is considered high strength concrete. **[**2020-06-19 **]**

806. The exposure classes of the concrete structures shall be defined according to standard SFS-EN 206 and the prevailing environmental conditions. The exposure class is used to define the requirements, such as the steel quality to be used, the nominal concrete cover and any requirements concerning concrete and the execution in accordance with the guidelines “Concrete structures” of the National Building Code of Finland. **[**2020-06-19 **]**

8.2 Precast concrete products and concrete elements

807. The requirements of this Guide shall be applied to the design, manufacture and supervision of concrete elements cast at the construction site and CE marked, European product standards compliant precast concrete products. **[**2013-11-15 **]**

808. Concrete element construction shall follow the requirements of standard SFS-EN 13670 and its national application standard SFS 5975 and the guidelines of the National Building Code of Finland for concrete structures. These requirements shall also apply to concrete elements manufactured at the construction site and the factory-fabricated concrete elements that are not manufactured under a European product standard. The requirements shall also apply to the installation of precast concrete products and elements. **[**2020-06-19 **]**

809. The manufacture of precast concrete products shall follow the requirements of this Guide, those laid down in the standard SFS-EN 13369 [45] and the harmonised product standards leading to the CE marking of precast concrete products. **[**2020-06-19 **]**

810. The following information on factories that manufacture safety-classified concrete elements or precast concrete products shall be submitted to STUK for approval:
a. Organisation description
b. The regulations, codes and standards applied
c. Quality control plan. **[**2020-06-19 **]**

811. Quality control documentation shall be submitted for approval concerning the scope of inspection of concrete elements and precast concrete products; it shall define the inspection scope per each element type. **[**2013-11-15 **]**

812. Before casting the precast element, the manufacturer of the concrete element or product shall perform an inspection to verify conformity to the construction plan. After an approving inspection by the manufacturer, the licensee’s representative shall perform a concreting readiness inspection on safety class 3 concrete elements or precast concrete products, inspecting the first element or precast concrete product and at least 10% of the total number of concrete elements or precast concrete products of the lot. The concreting readiness inspection of concrete elements or precast concrete products in safety class 2 shall be performed by STUK. **[**2020-06-19 **]**

8.3 Execution of steel structures and composite structures

813. The licensee shall describe the detailed requirements and procedures concerning the qualification of the manufacturing procedures of steel structures and the steel parts of composite structures in its management system and related instructions, taking into account standard SFS-EN 1090-1 [15]. The instructions shall take into consideration the manufacturing of the structures and installation performed at the construction site; therefore, the requirements apply to the equipment suppliers and their subcontractors, the welding contractors and the licensee's manufacturing activities. **[**2020-06-19 **]**

814. The execution of steel structures and the steel parts of composite structures shall follow the requirements set forth in this Guide, standard SFS-EN 1090-2 and its national application standard SFS 5976 and the guidelines of the National Building Code of Finland for steel and composite structures. **[**2020-06-19 **]**

815. Detailed requirements for the execution of steel structures and the steel parts of composite structures are presented in Annex B. **[**2013-11-15 **]**

816. Steel structures in safety class 2 and 3 shall be manufactured at least as execution class EXC3 structures under standard SFS-EN 1090-2. Structures in safety class SC3 with not affecting the stability or fire compartmentation of the building frame, or the durability of equipment assemblies can be manufactured as execution class EXC2 structures. **[**2020-06-19 **]**

817. Composite structures in safety classes 2 and 3 do not have a specific execution class; the execution class of a concrete and steel composite structure is defined separately for the concrete and steel under requirements 805 and 816 and standards SFS-EN 1090-2 and SFS-EN-13670. **[**2020-06-19 **]**

9 Inspections of civil structures

9.1 Readiness inspections for concreting, injection and prestressing work

901. The manufacturing of concrete structures and composite structures in safety classes 2 and 3 shall be done according to STUK-approved design documents of structures and plans for individual work phases or work assignments. **[**2013-11-15 **]**

902. The installation of formwork and reinforcement for concrete structures in safety classes 2 and 3 may begin once the design documents have been submitted to STUK and the licensee has authorised that this work may be started. **[**2013-11-15 **]**

903. The installation of reinforcement for composite structures in safety classes 2 and 3 may begin once STUK or an authorised inspection body has performed the installation inspection of the steel parts of the composite structure. **[**2013-11-15 **]**

904. Before concreting can be started, the design documents of a concrete or composite structure in safety class 2 or 3 shall be approved by STUK. **[**2020-06-19 **]**

905. The concreting, injection or prestressing of structures in safety class 2 may be started after STUK has approved the design documents and the detailed work plans, and inspected the concreting readiness on the site. **[**2013-11-15 **]**

906. The concreting work plan for a structure in safety class 2 shall be submitted to STUK for approval no later than two weeks before concreting is planned to be started. However, if the concreting process in question is very extensive or demanding, the plan shall be submitted no later than four weeks before concreting is planned to be commenced. **[**2020-06-19 **]**

907. For prestressing and injection work for structures in safety class 2, detailed plans concerning work performance and quality control shall be submitted to STUK no later than four weeks before the work in question is started. **[**2020-06-19 **]**

908. The prerequisite for the readiness inspection to be performed by STUK on concrete and composite structures in safety class 2 is that the licensee has inspected and approved the quality control documents concerning the concrete structure or concreting part of the composite structure, and has for its part determined that there is sufficient readiness to start work. **[**2013-11-15 **]**

909. The licensee shall request a concreting readiness inspection for structures in safety class 2 from STUK about one week before the planned inspection date. The protocol from the licensee’s readiness inspection shall be submitted to STUK for information before the readiness

inspection carried out by STUK. **[**2020-06-19 **]**

910. The concreting and injection of concrete structures or composite structures in safety class 3 may be started after STUK or an authorised inspection body has approved the design documents pertaining to the structures. The licensee shall inspect and approve the quality control protocols concerning the concrete structure, concreting part of the composite structure, or injection work, and determine that sufficient readiness exists for starting the work. **[**2013-11-15 **]**

911. In its decision, STUK or an authorised inspection body will separately list those structures in safety class 3 whose concreting or injection may be started only after an inspector from STUK or an inspection organisation has approved the detailed work plans and ascertained on the site that there is sufficient readiness to start work. **[**2020-06-19 **]**

912. The application of coatings on safety class 2 and 3 concrete structures may be started after STUK has approved the documents concerning them, and once all of the structural inspections and reviews that are required before the coating work are complete. **[**2020-06-19 **]**

9.2 Construction inspection and installation construction inspection of steel structures and the steel assemblies of composite structures

913. The construction inspection of a steel structure or the steel parts of a composite structure consists of the following:

a. An inspection of the execution of the construction plan

b. An inspection of the manufacturing records

c. A visual inspection of the structure

d. A functional test and/or leak-tightness test, when applicable. **[**2013-11-15 **]**

914. The licensee shall request STUK or an authorised inspection body to conduct a construction inspection approximately two weeks before the planned inspection date. **[**2013-11-15 **]**

915. In the construction inspection, welds of structures in safety classes 2 and 3 shall be inspected before the application of coating on a steel structure or composite structure. **[**2020-06-19 **]**

916. The construction inspection is usually performed on the completed steel structure (parts to be embedded in concrete, for example) or on steel parts of steel or composite structures on the manufacturer’s premises before delivery or installation. If the construction inspection is conducted at the plant site, the licensee shall, during the acceptance inspection, ensure that the

requirements for conducting a construction inspection have been fulfilled. **[**2020-06-19 **]**

917. The licensee, plant and equipment supplier and manufacturer shall ensure that staff with the necessary expertise is available during the construction inspection. **[**2013-11-15 **]**

918. The licensee shall agree on the relevant construction inspection dates with the manufacturer, plant supplier or importer. **[**2013-11-15 **]**

919. When agreeing on a date for the construction inspection, attention shall be given to the approval procedures related to the various manufacturing phases and any necessary partial construction inspections in accordance with the construction plan. The manufacturer shall ensure that construction inspections and partial inspections are conducted during the work phase for which they were planned. **[**2013-11-15 **]**

920. A prerequisite for the construction inspection conducted by STUK or an authorised inspection body is that the construction plan for the item to be inspected has been approved in accordance with decisions on the scope of inspection responsibillities either by STUK or an authorised inspection body. **[**2013-11-15 **]**

921. A construction inspection shall not be performed on serially manufactured standard structures, if their properties have been demonstrated by means of a CE marking, a European Technical Assessment, a type approval or a verification certificate. **[**2013-11-15 **]**

922. The construction inspection shall be performed if the CE marked, ETA approved or type approved product is a safety class 2 or 3 steel structure or component, the construction plans of which have been approved by STUK or an authorised inspection body. **[**2013-11-15 **]**

923. The licensee shall ensure that all plans concerning the manufacture of the steel or composite structures as well as the approvals and conditions pertaining to them are taken into account in the construction inspection. **[**2013-11-15 **]**

924. The licensee, manufacturer and plant supplier shall assess and approve the manufacturing records of the equipment or structure prior to submitting it to STUK or an authorised inspection body. **[**2013-11-15 **]**

925. The licensee, manufacturer and plant supplier shall ensure beforehand, by conducting their own inspections, that the requirements for starting the construction inspection are met and that the steel structures or their parts to be inspected can be inspected and approved in the construction inspection. **[**2013-11-15 **]**

926. The licensee shall request STUK or an authorised inspection body to conduct an installation construction inspection of steel structures or the steel parts of composite structures

about two weeks before the planned date. The installation construction inspection and partial inspections shall ensure the acceptability of the installation of the steel structure or the steel parts of a composite structure, and records of the installation quality inspection. **[**2013-11-15 **]**

9.3 Execution audits

927. The licensee shall supervise the implementation of quality assurance in various organisations to the extent deemed necessary and in accordance with Guide YVL A.3. Audits are particularly important if deviations from approved documents and plans have been observed. **[**2013-11-15 **]**

928. Independently of the licensee's follow-up inspections, STUK carries out inspections at various sites before the commencement of and during construction work in a scope it considers necessary; these visits are made, in particular, to the production plants which supply materials listed below: steel factories (reinforcement steels and prestressing tendons), plants manufacturing components for prestressing systems, plants manufacturing anchor plates, concrete batching plants and concrete element factories. **[**2013-11-15 **]**

9.4 Reporting on inspections and testing

929. Reporting aims to provide STUK with the prerequisites for the monitoring the progress of the work and the control actions taken, and for the rapid assessment of test results. **[**2013-11-15 **]**

930. The licensee shall draw up a plan concerning reporting to STUK and the inspection organisations before the construction work for the plant is started, and submit it to STUK for approval. In the plan, the licensee shall present a proposal for the key schedules and testing results related to the construction of structural elements to be submitted for information. **[**2013-11-15 **]**

931. The reporting plan shall include at least general schedules, monthly schedules and weekly schedules and results of concreting work. Work schedules for the next two weeks shall be submitted on a weekly basis.

a. Weekly schedules for the inspections of steel structures and steel parts of composite structures.

b. Summaries of the key results related to concreting work: test results for cement, results from tests at the construction site and batching plants, grading strengths for structures in safety classes 2 and 3 by each concreted part, rolling average and grading strengths for nine test specimens from the construction site results, test results for reinforcement steel and

prestressing tendons, and other necessary results. **[**2020-06-19 **]**

932. The results concerning concreting work in safety classes 2 and 3 shall be submitted to STUK for information every month. **[**2013-11-15 **]**

933. STUK shall be notified without delay, and a deviation report drawn up when necessary, if any part of the concrete test results deviates from the acceptable range of fluctuation. The same shall apply if any unexpected matters which may affect the acceptability of the structures arise at the construction site. **[**2013-11-15 **]**

934. Upon completion of a nuclear facility's concrete structures, a concrete work report shall be drawn up for all concrete structures (safety class 2, 3 and EYT (non-nuclear)), which shall be submitted to STUK for information before any buildings are commissioned. The concrete work report shall contain at least the following information:
a. Contractor's work arrangements, quality assurance and control, quality control of materials, quality control of the execution work.
b. Concreted structures, acceptability of hardened concrete, acceptance tests for concrete at the batching plant, acceptance tests for concrete at the construction site, special concreting, post-concreting.
c. Prestressing work.
d. Non-conformancies and how they are addressed.
e. Summary of how the design criteria for concrete structures have been met. **[**2020-06-19 **]**

9.5 Commissioning inspections and test programmes

935. Buildings and structures in safety classes 2 and 3 may be commissioned after they have been accepted by STUK or an authorised inspection body in a commissioning inspection. STUK does not perform commissioning inspections on buildings and structures in class EYT. **[**2013-11-15 **]**

936. The licensee shall present to STUK the procedures whereby it approves the completed buildings and structures in safety classes 2, 3 and EYT for commissioning. **[**2013-11-15 **]**

937. The licensee shall perform the commissioning inspections on buildings and structures. After this, the licensee may present a written request for a commissioning inspection to STUK, and it shall be submitted to STUK no later than two weeks before the time of the inspection. **[**2013-11-15 **]**

938. Pursuant to Guide YVL B.6, a pressure test shall be performed on the containment before commissioning the plant to ensure the structural durability of the containment. The test

programme of the containment pressure tests and leak-tightness tests shall be prepared and delivered to STUK for approval in accordance with Guide YVL A.5. The containment commissioning inspection shall be conducted in two phases:
a. the readiness of the containment for the pressure test, and any non-conformancies from the state required for commissioning,
b. the results from the pressure test, and the readiness of the containment for commissioning. **[**2020-06-19 **]**

939. The commissioning inspections of the containment material and personnel airlocks shall be performed in two phases, following chapters 11.3 “The first phase of the commissioning inspection” and 11.4 “The second phase of the commissioning inspection” of Guide YVL E.3. **[**2020-06-19 **]**

940. The commissioning programmes for the equipment hatch and personnel airlocks shall be prepared and delivered to STUK for approval in accordance with Guide YVL A.5. The approval status will be inspected by STUK during the first phase of the commissioning inspection. **[**2013-11-15 **]**

941. The commissioning inspections of the facility’s buildings and structures shall have been acceptably performed before the facility or parts thereof are taken into use. **[**2013-11-15 **]**

942. The commissioning inspections may be performed in stages, so that the buildings and structures that must be operable before fuel is introduced into the facility are inspected first. Once the loading of nuclear fuel begins, STUK’s commissioning inspection shall have been acceptably completed on all safety related buildings and structures. **[**2013-11-15 **]**

9.6 In-service inspections

943. During the operation of a nuclear facility, the licensee shall conduct in-service inspections of buildings and structures according to a specific programme. The inspection programme shall take account of the requirements for in-service inspections established in the design data. The in-service inspection programme shall be submitted to STUK for approval before the commercial operation of the facility is started. **[**2020-06-19 **]**

944. Detailed inspection procedures may be sent to STUK for information at a later date, however no later than one month prior to the first planned inspection date. **[**2020-06-19 **]**

9.7 Repairs and modifications

945. Pursuant to Guide YVL B.1, conceptual design plans and system specific pre-inspection documents shall be submitted to STUK for approval for all safety class 1, 2 and 3 systems prior to the commencement of the detailed design of parts and structures. The content of a system's conceptual design plan shall correspond to that of the preliminary safety analysis report. Additionally, the conceptual design plan shall contain a report on the quality management principles, including design reviews and the qualification of the design organisation. **[**2020-06-19 **]**

946. This Guide shall be applied, to the extent appropriate, when repairing or altering concrete, steel and composite structures or performing complementary building for them during the operation of nuclear facilities. Repair and alteration plans for safety class 2 and 3 concrete, steel and composite structures shall be approved by STUK or an authorised inspection body before work is started. **[**2020-06-19 **]**

10 Documents to be submitted to STUK

10.1 Phases of a nuclear facility's regulatory control

1001. The regulatory control of a nuclear facility contains five phases: the decision-in-principle phase, the construction licence phase, the construction phase, the operating licence phase, and in-service condition monitoring. This chapter presents the documents to be submitted to STUK in the phases listed above, and the key requirements on their content. **[**2013-11-15 **]**

1002. Referenced literature not easily available, or copies thereof, relating to the documents shall be submitted to STUK with the documents in question. **[**2013-11-15 **]**

10.2 Documents to be submitted during the decision-in-principle phase

1003. During the decision-in-principle phase, documents shall be submitted whereby the prerequisites for achieving the standards required by Finnish regulations and guidelines in terms of construction technology and structures can be ascertained. The documents to be submitted are presented in Chapter 5.1 of Annex A to Guide YVL A.1. **[**2020-06-19 **]**

10.3 Documents to be submitted at the construction licence phase

1004. Chapter 5.2 of Annex A to Guide YVL A.1 presents the requirements for the documents to be submitted during the construction licence phase. For construction technology, the preliminary safety analysis report, the topical reports supplementing it, the classification document, and the preliminary plans for construction quality assurance (see para 602) shall be submitted. A topical report shall be submitted concerning, in particular, the provisions made for earthquakes and aircraft crashes. The descriptions concerning the organisation and the design process quality assurance presented in chapters 6.1 and 6.2 shall be presented. **[**2020-06-19 **]**

1005. The following shall also be presented for structures in safety classes 2 and 3:
a. System description of the buildings and the functions of their structures as part of a nuclear facility.
b. Preliminary structural requirement specifications for steel, concrete and composite structures, including the regulations, guidelines and standards applied and their areas of application pursuant to chapter 3.
c. Structure and building specific general requirement specifications and general inspection plans.
d. Test results that are important in terms of design, such as the effects of molten core material on concrete structures.

e. Preliminary materials report.

f. Preliminary dimensioning, applicable calculation models and computer software.

g. Criteria for the in-service structural supervision of the containment.

h. Principles of leak monitoring and structural supervision of the fuel pools. **[**2020-06-19 **]**

10.4 Design documents to be submitted during construction

1006. The delivery plan for the design documents shall be submitted to STUK for information. In the delivery plan, the licensee shall present a proposal for the documents to be delivered and their delivery times. **[**2020-06-19 **]**

1007. The construction plans of concrete structures and of the concrete parts of composite structures in safety classes 2 and 3 shall be submitted to STUK or an authorised inspection organisation (Annex C) for approval two months before concreting is started on the structures or structural parts in question. The structural requirement specification with the design requirements shall have been approved by STUK before the construction plans are delivered. **[**2013-11-15 **]**

1008. The manufacture of steel structures and the steel parts of composite structures in safety class 2 may be started once STUK has approved the construction plans. This requirement shall also apply to the parts or components of composite structures in safety class 2 or 3, in the design of which other E series equipment Guides (known as system modular structures, requirement 204) are used. **[**2013-11-15 **]**

1009. The construction plans of steel structures and the steel parts of composite structures in safety class 3 shall be submitted to STUK or an inspection organisation for approval before manufacture may begin. The structural requirement specification of the steel and composite structures with their design requirements shall have been approved by STUK before the construction plans are delivered. The construction inspections shall be performed in line with the design documents approved by STUK. **[**2013-11-15 **]**

1010. The design documents of structures and buildings in class EYT shall be presented to STUK upon request whenever they are relevant in terms of radiation and nuclear safety. **[**2013-11-15 **]**

1011. The final in-service structural supervision plan shall be submitted to STUK for approval before the reactor is loaded. The plan shall include the design of in-service inspections and the periodic inspections included in the plan. **[**2020-06-19 **]**

1012. If deviations from approved documents are detected during manufacture, a non-conformance report shall be drawn up in which at least the following information is presented:
a. The nuclear safety significance of the non-conformance, with justifications.
b. Description of the location, who discovered the non-conformance, who created the report, who processed the matter.
c. Description of the non-conformance, proposal/plan for corrective action.
d. Inspection/approval markings of the report, distribution of the non-conformance report.
e. Inspection markings of actions necessitated by the non-conformance report.
f. Final approval markings of the non-conformance report. **[**2013-11-15 **]**

1013. If the non-conformancies discovered during manufacture affect the properties of the structure, the summary of justification delivered together with the construction plans (see chapter 7.11) shall be updated and delivered to STUK for approval before the commissioning inspection of the structure in question. **[**2020-06-19 **]**

10.5 Documents to be submitted during the operating licence phase

1014. The final safety analysis report will be processed in conjunction with the operating licence application. Chapter 8 and Annexes A and B discuss other control procedures relating to buildings and structures. **[**2013-11-15 **]**

1015. The as-built documentation shall be submitted to STUK for information. The documents to be submitted are defined in more detail in the delivery plan for the design documents. **[**2013-11-15 **]**

10.6 Modifications to structural systems of an operating nuclear facility

1016. The submission of documents related to alterations to the structural systems of an operating nuclear facility shall, where applicable, follow the same principles as those presented above for a nuclear facility under construction. **[**2020-06-19 **]**

11 Regulatory oversight by the Radiation and Nuclear Safety Authority

11.1 Division of inspection responsibilities

1101. STUK inspects and approves the plans for concrete, steel and composite structures in safety classes 2 and 3, and performs concreting readiness inspections and construction inspections for steel structures and the steel parts of composite structures at key locations. **[**2013-11-15 **]**

1102. Annex C presents the division of inspection responsibilities between STUK and an authorised inspection body. The division of inspection responsibilities can be supplemented by issuing separate decisions concerning buildings and structures that STUK will inspect (such as structures for physical protection, fuel pools, and pressure tests). **[**2013-11-15 **]**

1103. The inspection organisation shall be authorised and approved in accordance with Guide YVL E.1, and it shall have the necessary prerequisites for the inspection. **[**2020-06-19 **]**

11.2 Structural requirement specification

1104. STUK shall approve in its decision the structural requirement specifications set by the licensee for the concrete, steel and composite structures or the corresponding information in connection with other design documents. **[**2020-06-19 **]**

1105. The fulfillment of the set requirements shall be verified in connection with document reviews and construction inspections, and as part of the construction and operation inspection programmes. **[**2013-11-15 **]**

1106. The specifications based on the licensee’s requirements and drafted by the plant and equipment suppliers shall be sent to STUK for approval. **[**2013-11-15 **]**

11.3 Approval of inspection and testing organisations

1107. The requirements and approval procedure for inspection organisations are presented in Guide YVL E.1, and the requirements and approval procedure for testing organisations is presented in Guide YVL E.12. **[**2013-11-15 **]**

11.4 Regulation of design organisations

1108. The oversight of design organisations is covered in Guides YVL B.1 and YVL E.4. **[**2013-11-15 **]**

1109. STUK approves the organisation description of the design organisation and inspects the qualifications of the structural designers according to the requirements set forth in chapter 6.2. **[**2013-11-15 **]**

11.5 Construction plans and design documents

1110. STUK or an authorised inspection body shall process the construction plan for steel structures and the steel parts of composite structures and the design documents of concrete structures, which include the documents laid down in chapters 7 and 10 of this Guide. **[**2013-11-15 **]**

1111. The first phase of the construction plan and design document review is the assessment of the licensee's summary of justification. If the licensee's own review is deemed insufficient, it shall be supplemented by the licensee. **[**2013-11-15 **]**

1112. The result of processing the construction plan shall be presented in a decision by STUK or an authorised inspection body. Minor updates to approved plans may be processed as received for information. **[**2013-11-15 **]**

1113. STUK or an authorised inspection body shall issue permission to start the manufacture on the basis of construction plans and design documents pursuant to chapter 10.4, and inspections pursuant to chapter 11. **[**2013-11-15 **]**

11.6 Control of manufacturing and construction inspection

1114. STUK or an authorised inspection body monitors the manufacture of safety-classified steel structures in connection with partial construction inspections or during separate visits. The supervision inspection may also be agreed to be included in the monitoring audits carried out during manufacturing. **[**2013-11-15 **]**

1115. STUK approves the construction supervision organisation description and inspects the qualifications of the supervisors according to the requirements set forth in chapter 4.1 of the present Guide. **[**2013-11-15 **]**

1116. STUK supervises the manufacture of safety class 2 concrete structures by means of readiness inspections for concreting, grouting, injection or prestressing work. STUK supervises

the manufacture of safety class 3 concrete structures at locations it separately specifies. Based on approved construction plans, it is decided how concreting, grouting, injection or prestressing work is supervised while the work proceeds. **[**2020-06-19 **]**

1117. Supervision observations shall be recorded in the construction inspection protocol and/or inspection memoranda of steel structures. Observations made during the supervision of concrete structures shall be recorded in readiness protocols. If any essential defects are discovered, the inspector may discontinue manufacturing. **[**2013-11-15 **]**

1118. The construction inspection by STUK or an authorised inspection body of a steel structure or steel part of a composite structure shall comprise verification of the structure's conformity to requirements against the construction plan, review of the manufacturing or installation records documentation, a construction inspection, checking the results of strength verification tests as well as a review of the necessary pressure and functional tests. **[**2020-06-19 **]**

1119. A concreting readiness inspection of a concrete structure or a composite structure performed by STUK consists of the verification of the conformity of the reinforcement and formwork against the construction plan, the review of the installation records of embedded steel parts, tendon system components and formwork, and the inspection of the readiness for concreting at the site of casting. **[**2020-06-19 **]**

1120. The inspector shall draw up a protocol of the construction inspection, partial construction inspection or readiness inspection, specifying the item inspected, the inspections made and their results. Any shortcomings detected shall be entered as remarks in an annex to the inspection protocol. **[**2020-06-19 **]**

1121. The construction inspection or readiness inspection shall be deemed complete and the inspection protocol shall be signed when the structure inspected has undergone all the inspections and testing required in the construction plan or inspection plan, and when the remarks documented during the construction inspections have been corrected by the licensee. **[**2013-11-15 **]**

1122. An approved construction inspection is a prerequisite for transporting the steel part to the site of installation. If necessary, the construction inspection may also be performed at the plant site. **[**2013-11-15 **]**

1123. An approved readiness inspection is a prerequisite for starting concreting, grouting, injection or prestressing work in safety class 2 or, when separately indicated, in safety class 3 (see chapter 9.1). **[**2013-11-15 **]**

11.7 Installation control and construction inspection

1124. The control of installation, and the installation construction inspection, shall be performed in an analogous manner to the control of manufacturing and the construction inspection. **[**2013-11-15 **]**

1125. An approved installation construction inspection of a steel structure is a prerequisite for the commissioning inspection. **[**2013-11-15 **]**

1126. An approved installation construction inspection of the steel part of a composite structure is a prerequisite for the concreting readiness inspection of a composite structure, or it may be an partial inspection related to the concreting readiness inspection of a composite structure. **[**2013-11-15 **]**

11.8 Commissioning inspection

1127. During the commissioning inspection of structures, STUK shall inspect the following:
a. The structures and buildings have been constructed according to the design documents approved by STUK or an authorised inspection body, and the required concreting readiness inspections, construction inspections of steel structures, and installation construction inspections have been performed (document review and visual inspection).
b. Non-conformancies have been processed in an acceptable manner.
c. The quality control records of concrete structures and the concrete parts of composite structures have been approved by the licensee, STUK or an authorised inspection body.
d. The licensee has performed the commissioning inspections. **[**2020-06-19 **]**

1128. The commissioning inspection of structures may be conducted in two phases for buildings and structures on which functional tests are performed. In this case, the first phase of the commissioning inspection of a structure by STUK or an authorised inspection body shall verify the approval status of documents, completion of installation and fulfilment of the safety regulations required by functional tests. **[**2020-06-19 **]**

1129. In the second phase of the commissioning inspection, the functional tests to ensure readiness for operation shall be carried out. The functional tests shall be conducted in accordance with an approved commissioning testing programme. **[**2013-11-15 **]**

1130. Based on approved pre-operational testing, the structure shall be granted an operating licence in a commissioning inspection protocol. The operating licence may also be granted for a fixed period. If pre-operational testing is not required, the operating licence may be granted during the first stage of the commissioning inspection. **[**2013-11-15 **]**

11.9 Use, condition monitoring, maintenance, in-service inspections

1131. STUK supervises the use, condition monitoring and maintenance of steel, concrete and composite structures of a nuclear power plant during the inspections that are part of its in-service inspection programme and during other inspections it performs. **[**2013-11-15 **]**

1132. The reviews of maintenance and repair work plans, work construction inspection and readiness inspections follow the same process as this Guide presents for the approval of the original work. **[**2020-06-19 **]**

1133. STUK oversees the licensee's in-service inspections at its discretion and, in addition to this, also conducts in-service inspections of safety class 2 and 3 buildings and structures according to its own programme. **[**2013-11-15 **]**

11.10 Modifications

1134. Inspections and monitoring of alterations are carried out in nearly the same manner as those of the original structure. Repair and alteration plans of safety class 2 and 3 concrete, steel and composite structures shall be processed at the licensee's request, and at the level required by the scope and impact of the alteration. Upon completion of work, STUK or an authorised inspection body conducts a combined construction and commissioning inspection. **[**2020-06-19 **]**

1135. The licensee shall request an inspection from STUK or an authorised inspection body approximately two weeks before the intended date. The manufacturer, the plant supplier (in plant deliveries), a third party, and the licensee shall establish in advance using their own inspections that the conditions for the requested inspections exist. **[**2013-11-15 **]**

1136. STUK may grant inspection rights to an authorised inspection body it has approved in accordance with Guide YVL E.1. Annex C to this Guide defines the principles for the division of inspection responsibilities between STUK and authorised inspection bodies; these principles may be supplemented by issuing separate decisions. **[**2020-06-19 **]**

1137. STUK or an authorised inspection body shall draw up an inspection record specifying the item inspected and the inspections made. The protocol shall record any shortcomings that the licensee is to address by a set deadline. **[**2013-11-15 **]**

12 ANNEX A Detailed instructions for the execution of concrete structures

12.1 Quality control of the manufacture of concrete structures

A101. The requirements and instructions set forth in standard SFS-EN 206 [17], its national application standard SFS-7022 [18], and the Concrete Code BY65 apply to the quality control of fresh concrete and hardened concrete. **[**2020-06-19 **]**

A102. Quality control measures and inspections of concrete structures are required at least for the items listed below:

a. batching plant and laboratory
b. concrete constituents
c. fresh concrete (proportioning)
d. hardening and hardened concrete
e. reinforcement steels
f. reinforcement steel couplers and anchorages
g. prestressing systems
h. load-transferring metal parts and lifting anchors
i. special mortars and concretes
j. application of paints and coatings
k. CE marked products, products in accordance with verification certificates, and type approved products **[**2020-06-19 **]**

A103. Batching plant and laboratory:

The manufacturing and testing of concrete shall be verified and subject to inspection by an organisation approved by the Ministry of the Environment. Concerning the batching plant and laboratory, a report presenting the following shall be prepared and sent to STUK for information:

a. quality manual of the batching plant
b. job descriptions and professional training of batching plant staff
c. general drawings of the batching plant and laboratory
d. batching plant equipment
e. storage of concrete constituents
f. inspections of equipment and measuring instruments
g. description of concrete fabrication
h. making of concrete in the cold season
i. concrete laboratory and its equipment

j. inspections of the batching plant and laboratory
k. reserve batching plant. **[**2020-06-19 **]**

A104. Concrete constituents:
a. Cement shall be CE-marked under standard SFS-EN 197-1 [19]. The allowed types of cement are listed in national application standard SFS-7022 [18] for standard SFS-EN 206 [17]. The qualification of the mineral additions shall be established in accordance with Concrete Code BY 65. However, samples shall always be taken of cement if there is any reason to doubt its acceptability. This shall also apply to mineral additions, such as ground blast furnace slag, if they are used as binding agents in the concrete. The tests shall be conducted at an approved testing laboratory. If the additions are not CE-marked, the results of their quality inspections shall be submitted to STUK for information.
b. Aggregate: Aggregate pursuant to standard SFS EN 12620 and its national application standard SFS 7003 shall be used in the mixing of concrete. The aggregate shall be CE marked and inspected. If the aggregate is not CE marked, the concrete mixing company shall ensure, under the supervision of a body approved by the Ministry of the Environment, that the manufacturer's quality control testing required by the above standards has been completed. The use of recovered or recycled aggregate in the structures of nuclear facilities is not allowed.
c. Additions: additions are fine inorganic materials used to improve certain characteristics of concrete. Additions are divided into type I and type II additions. Additions shall be CE labelled. The applicability of additions shall be demonstrated in accordance with Concrete Code BY 65.
d. Water: Potable water can be used for manufacturing concrete without a separate analysis. If the water used for manufacturing is not taken from the water supply network, it shall be tested for concentration of chlorides, sulphates, and humus before construction is started. The water shall be subjected to tests during the construction phase if there is any reason to doubt its acceptability. Standard SFS-EN 1008 presents the general applicability of water. The use of recycled water generated in the manufacturing of concrete is not acceptable in safety-classified concrete structures of nuclear facilities.
e. Admixtures: The use of concrete admixtures shall adhere to standard SFS-EN 934-2. A verification certificate from an organisation approved by the Ministry of the Environment shall be available for admixtures without a CE marking. The verification certificates of admixtures shall be submitted to STUK for information with the submission of the preliminary test programme for concrete.
f. Fibres are used, for example, to improve the tensile, bending and shear strength and impact resistance of concrete. The general applicability of fibres shall be demonstrated in accordance with Concrete Code BY 65. **[**2020-06-19 **]**

A105. Properties of fresh concrete:

a. At the batching plant: The properties of fresh concrete shall be determined according to Concrete Code BY 65.

b.At the site: The consistency of fresh concrete shall always be determined in connection with the making of test specimens. Other properties of fresh concrete shall be monitored, where necessary. **[**2020-06-19 **]**

A106. Preliminary testing of concrete:

a. Preliminary tests shall be undertaken to determine the correct composition of fresh concrete and to test the fulfilment of the properties laid down in plans, such as compressive strength, resistance to water penetration, gas permeability, pumpability, frost-resistance, and shrinkage/creep.

b. The preliminary test programme shall be sent to STUK for information before testing is started. Test results shall be sent to STUK for information before concreting work is started. In the tests, the same concrete constituents shall be used as in the actual concreting. The preliminary tests shall determine the limit values for concrete composition; these values define a range for variation in the concrete constituents, admixtures, and other composition in actual work. Preliminary tests shall be repeated if essential changes take place in the constituents, admixture or composition of concrete, or in other conditions in the area covered by the preliminary tests. **[**2020-06-19 **]**

A107. Concrete acceptance tests during construction at the batching plant:

a. Certified manufacturing at a batching plant: Concrete acceptance tests shall be performed under the guidelines of Concrete Code BY 65 and the instructions from the Ministry of the Environment and a body approved by it.

b. Certified manufacturing of concrete elements: Concrete acceptance tests shall be performed under the guidelines of Concrete Code BY 65 and the instructions from a body approved by the Ministry of the Environment. **[**2020-06-19 **]**

A108. Concrete acceptance tests during construction on the site or at the element factory regarding concrete structures in safety class 2:

a. For determining the compressive strength of the concrete, at least one test specimen shall be made for each beginning 25 cubic metres of concrete and for each strength class; however, at least three test specimens shall be made for each concreting section (small concreting sections will be assessed on a case-by-case basis). Some test specimens may be tested before or after the actual quality assessment age.

b. For determining the depth of penetration of water, at least three test specimens shall be

made for each beginning 250 cubic metres of concrete if water penetration resistance requirement has been set for the concrete.
c. For controlling tensile and bond strength, gas permeability and other properties of the concrete, a separate written plan shall be drafted, where necessary.
d. Core samples shall be taken of the finished structure or reliable tests performed by NDT methods to determine the compressive strength and any other properties of the concrete in accordance with a separately approved programme. Tests shall be repeated a sufficient number of times so that they or the standard test specimens give a reliable idea of the properties of the concrete used for the structural element in question. **[**2013-11-15 **]**

A109. Concrete acceptance tests during construction on the site or at the element factory regarding concrete structures in safety class 3:
a. For determining compressive strength, at least one test specimen shall be taken for each beginning 50 cubic metres and for each strength class.
b. If a water penetration resistance requirement has been set for the concrete, at least one test specimen shall be made for each beginning 250 cubic metres of the concrete to determine conformity with this requirement.
c. For controlling tensile and bond strength, permeability to gas and other properties of the concrete, a separate written plan shall be drafted, where necessary. **[**2013-11-15 **]**

A110. Grading strength shall be calculated under the guidelines of Concrete Code BY 65. If the test specimens are intended to be tested before or after the actual quality evaluation date, extra test specimens shall be made for these tests. **[**2020-06-19 **]**

A111. The quality control of reinforcement steels shall meet the requirements of Decree of the Ministry of the Environment on the Type Approval of Weldable Reinforcement Steels and Mesh Reinforcements (126/2016) [49]. Furthermore, the following measures shall be included in the quality control plan:
a. Three specimens identical in size shall be taken of each batch of reinforcement steel used for safety class 2 concrete structures; the test specimens shall undergo both tensile and bending tests.
b. Specimens shall be taken of reinforcement steels used for safety class 3 structures if there is any reason to doubt their acceptability.
c. The tensile and bending tests of reinforcement steels shall be conducted at an approved testing laboratory.
d. The results of the reinforcement steel tests shall be available before the structures from the reinforcement steels of which the samples have been taken are concreted. **[**2020-06-19 **]**

A112. Special mechanical splices of reinforcement steel bars:

a. Reinforcement steel bars may be spliced by means of special mechanical couplers whose characteristics can be found in a verification certificate issued by a body approved by the Ministry of the Environment. Special mechanical couplers of reinforcement steel bars are considered acceptable if the quality control of the manufacturer is subject to supervision by a body approved by the Ministry of the Environment.

b. The quality control of special mechanical couplers of reinforcement steel bars shall meet the requirements of standards ISO 15835-1 and ISO 15835-2 with the specifications presented in the assessment criteria of the verification certificates of the Ministry of the Environment. The fatigue characteristics of special couplers (class F) shall be demonstrated by tests. Furthermore, the following measures shall be included in the quality control plan:

i. For the verification of the validity of couplers used for safety class 2 concrete structures, one sample for each beginning 200 couplers shall undergo a tensile test.

ii. Tensile tests of couplers shall be carried out at an approved testing laboratory.

c. For special couplers used in class S1 buildings and aircraft crash structures, class S1 tests in accordance with standard ISO 15835-1 (2009) shall be carried out.

d. The results of the reinforcement steel special coupler tests shall be available before concreting the structures for which the couplers have been used. **[**2020-06-19 **]**

A113. Reinforcement steel welded joints made at the construction site:

a. The welds and welding quality control performed at the construction site on reinforcement steels for structures in safety classes 2 and 3 shall adhere to the requirements for execution class 3 laid down in standards SFS-EN 13670 [20] and SFS 5975 [21].

b. Execution class 3 requires that load-bearing welded joints shall be inspected under standard SFS-EN ISO 17660-1 [22] and that non load-bearing tack weld joints shall be inspected under standard SFS-EN ISO 17660-2 [23].

c. The qualification requirements for welders and welding coordinators of reinforcement steels are presented in standards SFS-EN ISO 17660-1 and SFS-EN ISO 17660-2. **[**2020-06-19 **]**

A114. Prestressing systems:

The quality control of prestressing tendons shall meet the technical requirements of tendons according to the Ministry of the Environment. Furthermore, the following measures shall be included in the quality control plan:

a. Lists specifying the prestressing steel grades, nominal diameters and volumes as well as batch numbers and factory material testing results of various prestressing tendon delivery lots shall be presented.

b. For prestressing tendons used for safety class 2 structures, one specimen shall be taken from every beginning fifty tonnes/batch/nominal diameter for both tensile testing and deflected tensile testing; however, at least three specimens shall be taken of each batch for tensile testing and deflected tensile testing.
c. Prestressing tendons used for safety class 2 structures shall be subjected to a stress corrosion cracking resistance test programme, if necessary.
d. Specimens shall always be taken of prestressing tendons intended for use in safety class 3 structures if there is any reason to doubt their acceptability.
e. The tensile tests, deflected tensile tests, relaxation tests, and stress corrosion cracking tests shall be performed at an approved testing organisation.
f. The results of prestressing tendon tensile test and deflected tensile tests shall be available before prestressing work is started on the tendons manufactured of the batch under examination.
g. The results of the 1,000-hour relaxation test for tendons shall be available before the grouting of prestressing tendons manufactured from the batch under examination is started.
[2020-06-19 **]**

A115. Work related to the prestressing system and the installation and prestressing of tendons. For the installation of the prestressing system and for the prestressing and grouting of tendons, a separate quality control plan shall be drawn up presenting the following items:
a. Corrosion protection of components of the prestressing system during transport, and during storage at the factory and at the construction site
b. Installation of prestressing system components (ducts, tendons and anchorages)
c. Condition monitoring of prestressing system components during various work phases
d. Prestressing
e. Grouting
The quality control plan shall comply with Concrete Code BY65 and the requirements presented in the European Technical Approval Guideline (ETAG 013). **[**2020-06-19 **]**

A116. For load-transferring metal parts and lifting anchors, the primary standard is SFS-EN 1992-4:
a. The acceptability of continuously manufactured metal components transferring loads in concrete structures (anchor plates, anchor bolts) and lifting anchors shall be established with the CE marking. If there are no harmonised product standards or European Assessment Document for the product, its characteristics can be demonstrated by means of type approval, a verification certificate, or by means of calculations and experiments performed at accepted testing organisations.

b. The characteristics of non-continuously manufactured metal components transferring loads shall be established either by means of calculations based on the design principles of the materials, or tests. The instructions issued for the design and supervision of steel structures shall be followed in the manufacture of these metal components.
c. Post-installed anchor plates:
i. The acceptability of the post-installed anchor plate used shall be established according to the requirements for load-transferring steel parts stated above.
ii. Post-installed anchors must not be used without a justified reason to fasten steel structures, equipment and piping in safety class 1.
iii. A separate procedure shall be prepared for the installation and installation quality control of post-installed anchors and plates; the procedure shall also determine the qualifications of the staff installing the post-installed anchors and plates.
iv. Anchors used for fixing structures in seismic categories S1 and S2A shall be seismic class C2 anchors in accordance with European Assessment Document EAD 330232 and technical report TR049.
d. A description shall be drawn up on the use and installation of other fastenings, such as grouted bolts and chemical anchors, covering the acceptability demonstration and other quality control measures concerning the fastenings in question and their installation. **[**2020-06-19 **]**

A117. Special mortars and concretes
a. The quality control of special mortars and concretes shall conform to the requirements of the harmonised product standard or the Ministry of the Environment decrees and directions laid down in the National Building Code of Finland. The characteristics of special mortars and concretes may be demonstrated with a CE marking or a verification certificate issued by a body approved by the Ministry of the Environment.
b. There shall be a quality control plan for injection work carried out on crack repairs in concrete and for grouting work to protect post-tensioned tendons against corrosion; the plan shall satisfy the requirements of the National Building Code of Finland or Guidelines for the European Technical Approval (ETAG). Furthermore, the following requirements shall be included in the quality control plan for grout used filling the prestressing tendon ducts:
i. For compressive strength tests, at least three 7-day and three 28-day specimens/per work shift per item shall be made; however, at least one 7-day and one 28-day specimen shall be fabricated per each beginning cubic metre of grout.
ii. 7-day and 28-day specimens shall be made of one batch of grout manufactured.
iii. Specimens for the determination of grout bleeding and volume change shall always be made

at the same time as the compressive strength specimens.
iv. The consistency of grout shall always be determined during the fabrication of the compressive strength test specimens.
c. Before the grouting work phase is started, preliminary tests on the grout shall be conducted to verify compliance with the requirements. **[**2020-06-19 **]**

12.2 Detailed requirements for concreting and other work plans

A201. A concreting work plan shall be drawn up for every concreting section to provide additional information on details regarding the manufacture and quality control of structures. **[**2013-11-15 **]**

A202. Description of the concrete manufacturer shall be submitted together with the concreting work plan. **[**2013-11-15 **]**

A203. The concreting work plan consists of a description for the concreting section and work, and a quality plan for the concreting section.
a. The concreting work plan shall be drawn up by the contractor, and it shall be reviewed by the construction developer and licensee, who will then add to it their own quality control plans, if necessary.
b. In the concreting work plan, it is not necessary to repeat items which have been brought up in the design documentation, unless this is necessary to emphasise some measure related to quality control or work performance. A common concreting work plan may be drawn up for small concreting sections for which similar concreting methods are used. **[**2013-11-15 **]**

A204. The description of the concreting plan and work shall present sufficiently detailed information on the following, among other things:
a. work schedule, consumption of concrete, work supervision, number of personnel, work shifts, preparation for malfunctions, measures required by tests
b. formwork and its support structures (if necessary, dimensioning of formwork)
c. reinforcement
d. division into concreting sections
e. reservations
f. prestressing tendons, ducts and anchors
g. preparatory work at the site
h. basic information about concrete, concrete admixtures and their dispensing
i. description of concreting work, concreting equipment, concreting method, concrete transfers, compaction, concreting speed, construction joints
j. temperature measurements of fresh concrete during hardening

k. after-care of concrete surfaces, monitoring of strength and other characteristics, date of formwork and support structure removal
l. measures related to winter work, heat treatment and special methods. **[**2020-06-19 **]**

A205. The quality plan for a concreting section shall contain a detailed description of all the inspection and quality control measures related to the manufacture of the section. The inspection and quality control items relating to the manufacture of a concreting section are as follows:
a. Requirements which the concreting of a section places on other structures
b. Preliminary testing related to the concreting
c. Tests to be conducted on concrete constituents
d. Tests to be conducted on fresh concrete
e. Concrete test specimen plan
f. Tests to be conducted on hardened concrete
g. Tests to be conducted on reinforcement steels and prestressing tendons and their splices
h. Concrete transportation equipment
i. Concrete target temperatures
j. Provisions made for excavation and other vibrations
k. Monitoring of the strength development of hardened concrete
l. Action plan in case concreting work is discontinued
m. Dimensions of structure
n. Curing of concrete
o. Inspection of the concreting section after the disassembly of formwork. **[**2013-11-15 **]**

A206. Detailed plans concerning work performance and quality control shall be prepared for other work, such as prestressing and grouting. When drawing up the work plans, procedures A204-A205 issued for concreting work, Concrete Code BY65 and the instructions concerning prestressing and grouting given in guideline ETAG 013 shall be applied. **[**2020-06-19 **]**

12.3 Mock-up tests of concrete structures

A301. A mock-up test shall be completed for the manufacture of complex structures. A plan shall be drawn up in advance for the mock-up test, the performance of the test shall be documented, and the final report shall establish the usability of the materials and methods when manufacturing the actual structures. **[**2020-06-19 **]**

A302. In at least the following cases, mock-up tests are required to demonstrate the validity of a work method:

a. The work method, such as a demanding injection or grouting work, is used for the first time.

b. It is difficult to ascertain the results and validity of accomplished work.

c. Accomplished work is difficult to repair. **[**2020-06-19 **]**

A303. Plans and justifications for the mock-up tests shall be presented for the purpose of assessing the test results. **[**2013-11-15 **]**

A304. The mock-up tests may also be needed to demonstrate the qualifications of the staff. **[**2013-11-15 **]**

13 ANNEX B Detailed instructions for the execution of steel structures and steel parts of composite structures

13.1 Quality control of steel component manufacturing

B101. A nuclear facility's safety class 2 and 3 steel structures shall be manufactured according to an approved construction plan. **[**2020-06-19 **]**

B102. The approved manufacturing construction plan, procedures and standards shall be available at the place of manufacture. **[**2013-11-15 **]**

B103. The manufacturer shall oversee all demanding work phases. Inspection and testing phases specified in the SFS-EN ISO 3834-2 [35] standard shall be applied in welding supervision. **[**2020-06-19 **]**

B104. Personnel engaged in the heat treatment of a steel structure shall have the proper training and instructions for the task. Requirements for heat treatment equipment and the performance of heat treatment have been presented in standard SFS-EN ISO 17663 [37], among others. **[**2020-06-19 **]**

B105. If the construction plan states that a steel structure shall be heat treated after welding, post-heat treatment repair welding requires a repair plan approved by STUK or an inspection organisation approved by STUK. **[**2013-11-15 **]**

B106. When manufacturing has been completed, the manufacturer shall inspect the equipment or structure's surface quality and cleanliness in accordance with the construction plan, as well as ensure that product quality is preserved during storage and transport. Records on the control of manufacturing conducted by various parties shall be kept, describing the manufacturing, inspection or test phase supervised. **[**2013-11-15 **]**

B107. The manufacturer shall use non-conformity reports to determine the cause of any errors and non-conformities discovered during manufacturing, assess their significance, and issue corrective actions as well as a plan on how to prevent the non-conformity from recurring. **[**2013-11-15 **]**

B108. Non-conformities shall be approved in accordance with the procurement agreement and the manufacturer's management system. If a non-conformity remains in a product, approval for this shall be justified in the non-conformity report. **[**2013-11-15 **]**

13.2 Manufacturing procedures

B201. Manufacturing shall be based on manufacturing procedures approved under the management system. **[**2013-11-15 **]**

B202. In safety class 2, the manufacturing procedures shall be submitted to STUK for approval. In safety class 3, the manufacturing procedures shall be submitted where applicable. **[**2013-11-15 **]**

B203. The manufacturing procedures and persons involved in manufacturing shall be qualified in accordance with the procedures described in the management system. **[**2013-11-15 **]**

B204. With regard to welding, the welding procedure specifications qualified by welding procedure tests in accordance with standard SFS-EN ISO 15614-1 [46] or corresponding procedures may be considered acceptable as far as the most demanding load-bearing welded joints are concerned. **[**2020-06-19 **]**

B205. The welders and welding operators shall have been qualified. The documents that are required for demonstrating the quality requirements are presented in standard SFS-EN ISO 3834-5 [51]. Welder qualification is demonstrated in accordance with SFS-EN ISO 9606-1 [38]; welding operator qualification is demonstrated in accordance with SFS-EN ISO 14732 [52]. **[**2020-06-19 **]**

B206. The manufacturer shall have available a sufficient number of personnel to coordinate welding. Persons who are in charge of quality operations shall have sufficient authority to perform all the necessary actions. The tasks and responsibility limits of such persons shall be clearly defined. The qualification of the welding coordinator shall be demonstrated under standard SFS-EN ISO 14731 [47]. Standard SFS EN ISO 1090-2 presents the welding coordinator’s level of technical knowledge by execution class. **[**2020-06-19 **]**

13.3 Quality control of steel assemblies

13.3.1 Inspection plan

B301. The inspection plan for steel structures shall present the methods for inspecting and testing base materials, welding filler materials, welded joints and completed structures during the various manufacturing phases. The plan shall be drawn up such that it shows the following:
a. Part or weld-specific identification data and references to steel structure drawings;
b. Markings in accordance with the standard applied in the manufacturing of materials and welding filler materials as well as the necessary references to material specifications;

c. Weld-specific references to the welding procedures and, where necessary, to the procedure and production tests conducted to qualify these procedures;
d. The detailed tests and inspections to be conducted on a steel structure as well as its components and welds; and a reference to the testing or inspection procedures **[**2013-11-15 **]**

B302. If inspections and tests of a part or welded joint are carried out during more than one manufacturing phase, whether repeated in part or in full, they shall be presented as separate inspections (such as a description of the weld root, or ultrasonic testing of a weld prior to and after heat treatment). **[**2013-11-15 **]**

B303. If procedure or pre-production tests are needed to qualify the manufacturing procedures, a separate inspection plan shall be presented for them, the contents of which are determined by the above principles. Furthermore, a separate plan is needed if properties of the materials or welded joints are altered during manufacture such that the information provided in the materials report is no longer valid. **[**2013-11-15 **]**

B304. The following shall be evident from the inspections and tests marked in the inspection plan of procedure and pre-production tests: on whose premises they take place and who (manufacturer, subcontractor, approved testing or inspection organisation, installer) carries them out. The inspection plan shall present the reports to be drawn up and the supervision of inspection and testing. **[**2020-06-19 **]**

B305. The licensee shall list the testing procedures that apply to the material tests of steel structures. In addition, the testing procedures that apply to the manufacturing and installation of steel structures shall be identified. The instructions shall include the method, scope, acceptance criteria and reporting of the inspection or testing. As to details, a reference to applicable standards can be made. **[**2013-11-15 **]**

B306. The procedures shall cover the destructive testing of materials with relevant material certificate and control requirements, the methods of manufacture, non-destructive testing as well as the testing (such as leakage and functional tests) and inspection of the final product. **[**2013-11-15 **]**

13.3.2 Material certificates

B307. The information required from material certificates is defined in the material certificate, material, and welding consumable standards. If necessary, the licensee shall supplement the requirements in other documents. **[**2013-11-15 **]**

B308. The material certificate or other document shall include a confirmation from the manufacturer of the material or welding consumable that the delivered products are compliant with the requirements of the order and the product specification to which reference is made. **[**2013-11-15 **]**

B309. The material certificate of a material or a welding filler material shall clearly indicate the certificate type under standard SFS-EN 10204 [41] or a corresponding standard. **[**2020-06-19 **]**

B310. The material certificate requirements set for construction materials and welding consumables are presented in Annex D. **[**2013-11-15 **]**

13.4 Procedure tests pre-production tests and production tests

B401. Procedures with essential parameters shall be drawn up for demanding work processes such as welding, forming and heat treatment, which affect material strength and properties. Other manufacturing procedures shall also have the necessary procedures to ensure the quality of work. **[**2013-11-15 **]**

B402. Manufacturer-specific welding procedures, heat treatment procedures and hot and cold-forming procedures to be used in manufacturing and installation shall be qualified by means of procedure tests before beginning any manufacturing work. The procedure test shall demonstrate that the material properties approved as the basis for design are retained during manufacture and that the manufacturer is qualified to use the manufacturing procedure. **[**2013-11-15 **]**

B403. The procedure test for steel and composite structures in safety class 2 shall be conducted under the supervision of an authorised third party. The procedure tests for structures in safety class 3 may be supervised in accordance with standard EN 1090-2. Procedure tests carried out for each place of manufacture shall remain valid indefinitely insofar as the manufacturing based on them takes place within the range of essential parameters defined in the applicable standard. **[**2013-11-15 **]**

B404. When an item is significant in terms of nuclear safety or when the procedure test does not reflect the actual working conditions, a review shall be made of the suitability of the manufacturing procedures with pre-production tests carried out prior to the commencement of

manufacture or production tests as part of manufacture. **[**2013-11-15 **]**

B405. A pre-production test shall refer to a test performed in advance by the persons participating in the manufacture, taking into account the limitations set by the working environment. A production test refers to a test specimen manufactured using actual manufacturing parameters that allows for testing its metallurgic and strength properties using destructive methods. **[**2013-11-15 **]**

14 ANNEX C Division of inspection responsibilities

Building structures and structural fire protection (YVL E.6 and B.8)	**Safety Class** [1]		
	1	**2**	**3**
Licensing, planning, and other advance approvals			
Description of the planning process and quality assurance of buildings and structures	-	STUK	STUK
Approval of the responsible structural designers of the buildings (E.6), the designer responsible for fire protection planning (B.8), and the design organisation	-	STUK	STUK
Manufacturer approval (part of construction plan)	-	STUK	AIO [2]
Approval of inspection organisation	-	STUK	STUK
Approval of testing organisation	-	STUK	STUK
Structural and fire technical requirement specifications and quality control guidelines under YVL B.8 and YVL E.6, delivery plan of design documents	-	STUK	STUK
Approval of system planning	-	STUK	STUK
Approval of product approval documentation (CE marking, ETA approval, type approval or verification certificate)	-	STUK	AIO [2]
Approval of coatings that tolerate radiation and accident conditions and coatings that can be decontaminated (E.6)	-	STUK	STUK
Approval of aircraft crash analyses (A.11), earthquake analyses (B.7), fire analyses, fire compartment and exit route drawings (B.8), and structural containment analyses (E.6)	-	STUK	STUK
Approval of construction plan	-	STUK	AIO [2]
Manufacturing and construction inspection			
Approval of licensee's supervision organisation	-	STUK	STUK
Plans for concreting, injection, and prestressing work	-	STUK	AIO [2]
Readiness inspections and on-site supervision for concreting, injection and prestressing work	-	STUK	AIO [2]
Construction inspection, pressure test, leakage test and factory tests for steel structures and composite structures	-	STUK	AIO [2]

1) Class EYT to be defined separately.

2) AIO = Authorised inspection body. See para. 1102. **[**2020-06-19 **]**

Building structures and structural fire protection (YVL E.6 and B.8)	**Safety Class** [1]		
	1	**2**	**3**
Installation and commissioning			
Installation construction plan	-	STUK	AIO [2]
Installation construction inspection	-	STUK	AIO [2]
Commissioning testing plan	-	STUK	STUK
Commissioning inspections, concrete structures, steel structures and composite structures and buildings (E.6), and fire protection systems and arrangements for the commissioning of the building (B.8)	-	STUK	STUK/AIO [2]
In-service supervision and inspections			
Repair and alteration plans, building structures (E.6) and structural fire protection (B.8)	-	STUK	AIO [2]
Inspections of repairs and alterations	-	STUK	AIO [2]
Ageing management (A.8)	-	STUK	STUK
Plan for in-service inspection (ISI) (E.6)	-	STUK	STUK
Performance of in-service inspections, such as containment pressure and leakage tests	-	LH [4]	LH [4]
Results of in-service inspections, such as containment pressure and leakage tests [3]	-	STUK	STUK

1) Class EYT to be defined separately.
2) AIO = Authorised inspection body. See para. 1102.
3) Pressure tests and leakage tests and combinations thereof will be performed in accordance with a plan approved by STUK.
4) LH = license holder. **[**2020-06-19 **]**

15 ANNEX D Material certificate requirements for materials and welding filler materials, SFS-EN 10204

Component	Safety Class	
	2	3
Structural steels	3.1 1)	3.1
Stainless steels	3.1 1)	3.1
Welding consumables	3.1	2.2
Structural bolting assemblies	2.2	2.2
Self-tapping and self-drilling screws and blind rivets	2.1	2.1
Studs for arc studs welding	3.1	3.1

1) Certificate 3.2i is required for the carbon steels and stainless steels of the containment's material and personnel airlocks.

A material certificate of a higher level shall be approved in all cases.

[2020-06-19 **]**

16 References

1. Nuclear Energy Act (990/1987). [2013-11-15]

2. Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (Y/1/2018). [2020-06-19]

3. Nuclear Energy Decree (161/1988). [2013-11-15]

4. Radiation and Nuclear Safety Authority Regulation on the Safety of Disposal of Nuclear Waste (Y/4/2018). [2020-06-19]

5. Regulation (EU) No 305/2011 of the European Parliament and of the Council. [2013-11-15]

6. Land Use and Building Act (132/1999). [2013-11-15]

7. Land Use and Building Decree (895/1999). [2013-11-15]

8. Act on the Approval of Certain Construction Products (954/2012). [2020-06-19]

9. The National Building Code of Finland (RakMK), Ministry of the Environment. [2013-11-15]

10. SFS-EN 1990: Basis of structural design (all parts). [2020-06-19]

11. SFS-EN 1991: Actions on structures (all parts). [2020-06-19]

12. SFS-EN 1992: Design of concrete structures (all parts). [2020-06-19]

13. SFS-EN 1993: Design of steel structures (all parts). [2020-06-19]

14. SFS-EN 1994: Design of composite steel and concrete structures (all parts). [2020-06-19]

15. SFS-EN ISO 1090-1 + A1, Execution of steel structures and aluminium structures. Part 1: Requirements for conformity assessment of structural components. [2020-06-19]

16. SFS-EN ISO 1090-2 + A1, Execution of steel structures and aluminium structures. Part 2: Technical requirements for steel structures. [2020-06-19]

17. SFS-EN 206:2014 + A1, 2016, Concrete. Specification, performance, manufacturing and conformity . [2020-06-19]

18. SFS 7022 Concrete. Application of standard SFS-EN 206 in Finland. [2020-06-19]

19. SFS-EN 197-1. Cement. Part 1: Composition, specifications and conformity criteria for common cements. [2013-11-15]

20. SFS-EN 13670 Execution of concrete structures. [2020-06-19]

21. SFS 5975 Execution of concrete structures. Application of standard SFS-EN 13670 in Finland. [2013-11-15]

22. SFS-EN ISO 17660-1 Welding. Welding of reinforcement steel. Part 1: Load-bearing welded joints. [2013-11-15]

23. SFS-EN ISO 17660-2 Welding. Welding of reinforcement steel. Part 2: Non load-bearing welded joints. [2013-11-15]

24. ETAG 001, Guideline for European Technical Approval of Metal Anchors for Use in Concrete. EOTA [2013-11-15]

25. ETAG 013, Guideline for European Technical Approval of Post-Tensioning Kits for Prestressing of Structures. EOTA [2013-11-15]

26. SFS-EN 1998-1: Design of structures for earthquake resistance. Part 1: General rules, seismic actions and rules for buildings. [2020-06-19]

27. ASCE 4-16 Seismic Analysis of Safety-Related Nuclear Structures. [2020-06-19]

28. ASCE 43-05 Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities. [2013-11-15]

29. ASME Boiler and Pressure Vessel Code Section III Division 2, Code for Concrete Reactor Vessels and Containments. [2020-06-19]

30. ASME Boiler and Pressure Vessel Code Section III Division 1, Subsection NE, Class MC Components. [2020-06-19]

31. USNRC Regulatory Guide 1.90, Inservice inspection of prestressed concrete containment structures with grouted tendons. [2013-11-15]

32. KTA 3401.1 Reaktorsicherheitsbehälter aus Stahl, Teil 1 (Steel Containment Vessels, Part 1) Werkstoffe und Erzeugnisformen (Materials). [2013-11-15]

33. KTA 3401.2 Reaktorsicherheitsbehälter aus Stahl, Teil 2: (Steel Containment Vessels, Part 2:) Auslegung, Konstruktion und Berechnung (Analysis and Design). [2013-11-15]

34. KTA 3401.3 Reaktorsicherheitsbehälter aus Stahl, Teil 3 : (Steel Containment Vessels, Part 3:) Herstellung (Manufacture). [2013-11-15]

35. SFS-EN ISO 3834-2 Quality requirements for fusion welding of metallic materials. Part 2: Comprehensive quality requirements. [2020-06-19]

36. SFS-EN ISO 9001, Quality management systems. Requirements. [2013-11-15]

37. SFS-EN ISO 17663 Welding. Quality requirements for heat treatment in connection with welding and allied processes. [2013-11-15]

38. SFS-EN ISO 9606-1 Qualification test of welders. Fusion welding. Part 1: Steels. [2020-06-19]

39. BY65, Concrete Code 2016, Concrete Association of Finland. [2020-06-19]

40. SFS-EN ISO 12944-1:2017 Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Part 1: General introduction. [2020-06-19]

41. SFS-EN 10204 Metallic materials. Types of inspection documents. [2020-06-19]

42. Ministry of the Environment's Decree on load-bearing structures (477/2014). [2020-06-19]

43. Removed. [2020-06-19]

44. SFS 5976 Execution of steel structures and aluminium structures. Application of standard SFS-EN 1090-2 in Finland. [2020-06-19]

45. SFS-EN 13369:2018 Common rules for precast concrete products. [2020-06-19]

46. SFS-EN ISO 15614-1 Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys. [2020-06-19]

47. SFS-EN ISO 14731 Welding coordination. Tasks and responsibilities. [2020-06-19]

48. Decree of the Ministry of the Environment on the Essential Technical Requirements of Weldable Reinforcement Steels and Mesh Reinforcements (125/2016). [2020-06-19]

49. Decree of the Ministry of the Environment on the Type Approval of Weldable Reinforcement Steels and Mesh Reinforcements (126/2016). [2020-06-19]

50. Ministry of the Environment Decree concerning national choices for the basis of structural design, when applying standard SFS-EN 1990 (3/16). [2020-06-19]

51. SFS-EN ISO 3834-5: Quality requirements for fusion welding of metallic materials — Part 5: Documents with which it is necessary to conform to claim conformity to the quality requirements of ISO 3834-2, ISO 3834-3 or ISO 3834-4. [2020-06-19]

52. SFS-EN ISO 14732: Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials. [2020-06-19]

53. ASTM D4082-10: Standard Test Method for Effects of Gamma Radiation on Coatings for Use in Nuclear Power Plants. [2020-06-19]

54. ASTM D5139-12: Standard Specification for Sample Preparation for Qualification Testing of Coatings to be Used in Nuclear Power Plants. [2020-06-19]

55. ISO 4628-2:2016: Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 2: Assessment of degree of blistering. **[**2020-06-19 **]**

56. ISO 8690:1988: Decontamination of radioactively contaminated surfaces — Method for testing and assessing the ease of decontamination. **[**2020-06-19 **]**

57. ISO 2812-2:2007: Paints and varnishes — Determination of resistance to liquids — Part 2: Water immersion method. **[**2020-06-19 **]**

58. ISO 4624:2016: Paints and varnishes — Pull-off test for adhesion. **[**2020-06-19 **]**

59. ISO 7784-2:2016: Paints and varnishes — Determination of resistance to abrasion — Part 2: Method with abrasive rubber wheels and rotating test specimen. **[**2020-06-19 **]**

60. ASTM D3911-16: Standard Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions. **[**2020-06-19 **]**

17 Removed (A.4 References)

1. Removed. **[**2020-06-19 **]**

2. Removed. **[**2020-06-19 **]**

3. Removed. **[**2020-06-19 **]**

4. Removed. **[**2020-06-19 **]**

18 Removed (B.5 References)

1. Removed. **[**2020-06-19 **]**

2. Removed. **[**2020-06-19 **]**

3. Moved to reference number 46. **[**2020-06-19 **]**

4. Removed. **[**2020-06-19 **]**

5. Removed. **[**2020-06-19 **]**

6. Moved to reference number 47. **[**2020-06-19 **]**

7. Removed. **[**2020-06-19 **]**

Definitions

Installation construction plan (buildings and structures)

Installation construction plan shall (for buildings and structures), refer to a construction plan describing how a steel structure, steel component of a composite structure, or a concrete element or a precast concrete product, including supports, connects to other structures.

Authorised inspection body (AIO)

Authorised inspection body shall refer to an independent inspection organisation approved by the Radiation and Nuclear Safety Authority under Section 60 a of the Nuclear Energy Act to carry out inspections of the pressure equipment, steel and concrete structures and mechanical components of nuclear facilities in the capacity of an agency performing public administrative duties. (Nuclear Energy Decree 161/1988, in Finnish). Authorised inspection body and authorised inspection organisation have same meaning in YVL Guides.

Concrete

Concrete shall refer to material that has been fabricated by mixing cement, coarse and fine aggregate and water, and potentially admixtures and additives, and the properties of material develop as the cement hardens (hydrates) with the help of water.

Concrete element

Concrete element shall refer to a concrete structure that has been cast and cured outside of its final location (either factory-built or fabricated at the construction site).

Fresh concrete

Fresh concrete shall refer to fully mixed concrete that is still in a state where it may be compacted using a method of choice.

Concrete cover

Concrete cover shall refer to the thickness of the concrete layer protecting the reinforcement.

Concrete structure

Concrete structure shall refer to concrete, reinforced concrete and prestressed concrete structures.

Reinforcement steel

Reinforcement steel shall refer to steel used for non-prestressed reinforcement of a concrete structure.

Precast concrete product

Precast concrete product shall refer to a concrete element manufactured under an applicable European product standard.

CE marking

CE marking shall refer to the only label that indicates that a building product complies with the declared performance levels and the applicable requirements of the European Union's harmonised legislation.

Non-linear structural analysis

Non-linear structural analysis shall refer to solving a partial differential equation group using the finite element method (FEM), for example. The non-linearity of a structure may be geometrical by nature, due to the behaviour of the material, or related to the boundary conditions. A geometrical non-linearity

Special process

Special processes shall refer to manufacturing processes, the results of which cannot be directly verified by means of a product inspection or testing after manufacture; instead, any shortcomings in the process may only appear later while the product is in use. Special processes include, for instance welding, forming and heat treatment.

Eurocodes

Eurocodes shall refer to the pan-European design standards for load-bearing structures published by the European Committee for Standardization.

European Technical Assessment (ETA)

European Technical Assessment (ETA) shall refer to an approval that may be granted for building products for which no harmonised product standard exists. ETA is a voluntary technical approval resulting in CE marking.

Prestressing system

Prestressing system shall refer to the complex formed by the prestressing tendons used, the installation, prestressing, locking, and protection of the prestressing tendons , and the related equipment and work methods.

Prestressing tendon

Prestressing tendon shall refer to the base material used for reinforcement of concrete structures subject to prestressing.

Prestressed concrete structure

Prestressed concrete structure shall refer to a reinforced concrete structure with reinforcement that is partially or fully prestressed.

Floor response spectrum

The floor response spectrum describes the maximum vibrations of single-degree-of-freedom oscillators with various natural frequencies and a particular damping ratio positioned in a certain area of a building. The calculation of the floor response spectrum involves an analysis, based on the dynamic behaviour of the frame structure, of the transfer of the vibration from an earthquake or other external source to the part of the building under examination where it strains systems, structures, and components. Depending on the design basis, the floor response spectrum is an acceleration, velocity or displacement spectrum or an energy response spectrum in accordance with their combination.

Aggregate

Aggregate shall refer to granular mineral constituent material of concrete, which forms concrete when joined together by cement paste.

Test specimen

Test specimen shall refer to a piece manufactured for testing from a concrete, steel or reinforcement sample.

High strength concrete

High strength concrete shall refer to concrete that has a compression strength class higher than C50/60 pursuant to standard EN 1992-1-1.

Utilisation rate

Utilisation rate shall refer to the ratio between the design load of the structure and the capacity of the structure.

Service life

Service life shall refer to the period of time beginning from the commissioning of the SSC fulfilling its operability requirements and ending when the degraded operability is not restored to the required level anymore.

Service limit state dimensioning

Service limit state dimensioning shall refer to dimensioning at a limit state where a structure no longer meets the requirements set as conditions for its usability (such as maximum crack width or displacement).

Commissioning inspection

Commissioning inspection shall refer to an inspection that ensures the operability of safety class 2 and 3 concrete structures, steel and concrete structures, prestressed concrete structures, or steel and composite structures and buildings and that is performed before the nuclear operation of the facility begins.

Composite structure

Composite structure shall refer to a structural entity formed by a concrete and steel structure where the interoperation of the concrete and the steel components have a substantial role in relation to the load-bearing capacity, leak-tightness and fire protection properties of the structural entity. A composite structure consists of load-bearing structural components where the slip between steel and concrete and the disconnection of the components remains limited. Typical composite structures include composite columns, walls, beams and slabs.

Licensee

Licensee shall refer to the holder of a licence entitling to the use of nuclear energy. (Nuclear Energy Act 990/1987)

Modular structure

Modular structure shall refer to an assembly consisting of several structural components and equipment parts. Components of the structure may include steel components, piping and piping supports, valves, cable trays, steel platforms and reinforcement steel. As the load-bearing structure of a modular structure act usually the steel components delivered to the construction site as pre-fabricated parts, or a composite structure consisting of these steel components and concrete.

Ultimate limit state design

Ultimate limit state design shall refer to design at a limit state where the structure is considered to lose its load-bearing capacity in part or entirely.

Summary of justifications

Summary of justifications shall refer to a document that presents how the structure meets the requirements set for it, and how the licensee has established its conformity to requirements. The summary of justifications shall also present the changes made to the approved documents, any non-conformances that occurred during manufacture, and their impact on the suitability and acceptability of the structure.

Damping ratio

Damping ratio shall refer to the ratio of the actual damping coefficient (the ratio of the viscous damping force to velocity) for a single-degree-of-freedom oscillator to the critical damping

coefficient (the maximum value of the damping coefficient at which periodically attenuating oscillation is possible). The damping ratio is usually expressed as a percentage.

Inspection organisation

Inspection organisation shall refer to an organisation that performs inspections to examine a product, process, service or installation, or the design thereof, and to verify their conformity to requirements. (SFS-EN ISO/IEC 17020:2012)

Steel structure

Steel structure shall refer to structural steel components that are delivered as construction products. Typical steel structures of nuclear facilities include: load-bearing structures of buildings, load-bearing steel structures of the concrete reactor containment, vessels subject to hydrostatic pressure, piping break supports, missile protectors, storage racks for fresh and spent fuel, gates and linings of spent fuel pools, crane rail supports, doors and hatches, steel platforms and spent fuel handling equipment and crane rails.

Testing organisation

Testing organisation shall refer to an organisation performing testing activities requiring special competence. (Nuclear Energy Act 990/1987)

Execution (construction)

Execution of construction shall refer to all functions required for the physical creation of a building, including the acquisitions made for the site, the manufacture, transport, storage and installation of building materials and products, and inspection activities and documentation.

Execution specification (construction)

Execution specification shall refer to a presentation of the information and requirements that are necessary for the execution of steel structures, including the necessary information and requirements concerning steel structural products and steel structure components. Execution specification for a concrete structure shall refer to a classified collection of requirements set for execution, which may apply to the entire construction work or a single component.

Execution class (construction)

Execution class shall refer to a classified collection of requirements set for execution, which may apply to the entire construction work, a single assembly or a detail of a single assembly (SFS-EN 1090-2, SFS-EN 13670).

System/structure/component important to safety

System/structure/component important to safety shall refer to systems, structures or components in safety classes 1, 2 and 3 and systems in class EYT/STUK.

Type approval (building products)

Type approval for building products shall refer to a voluntary approval procedure for building products in use in Finland that are legislated in the Decree on the Type Approval of Certain Construction Products. Type approval shows that a building product meets its required essential technical requirements with respect to the purpose of use stated by the manufacturer. A manufacturer who so wishes may apply for type approval for a building product subjected to the Decree on the Type Approval. Type approval is granted by a type organisation authorized by the Ministry of the Environment. Type approval requires certification of the production control. The type approval is mandatory for the building inspection authorities, which means that a type approved building product can be used in a construction work.

Manufacturing (building products)

Manufacturing shall, in the context of Guide YVL E.6, refer to all the measures that are required to produce and deliver a steel assembly. Depending on the case, this may include procurement, pre-fabrication and assembly, welding, mechanical attachment, transport, surface treatment, inspection, and documentation. Manufacturing shall refer to the manufacture of a steel assembly, building product, building part or building element when it takes place elsewhere than at the site of construction.

Verification certificate

Verification certificate shall refer to a certificate verifying that the characteristics of a building product are in line with the Land Use and Building Act (132/1999) or the provisions issued by virtue of the Act for the intended purpose of use defined by the manufacturer. The verification certificate is granted by a body approved by the Ministry of the Environment (Act on the Approval of Certain Construction Products [954/2012]).

Harmonised product standard

Harmonised product standard shall refer to a product standard drawn up by the European Committee for Standardization (CEN) that results in CE marking and of which an announcement has been published in the Official Journal of the European Union. For each product group, it defines the properties that are determined for the products, the manufacture quality control requirements, and the information to be reported in the CE marking.