

# GUIDE YVL E.9

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## PUMPS OF A NUCLEAR FACILITY

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## 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 3 February 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.9 (15.11.2013).

Translation. Original text in Finnish.

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## 1 Introduction

101. Pumps are used for the transfer of liquids for many applications at a nuclear facility. They are of essential importance for electricity generation and safety functions such as reactor cooling during accidents. It is important for the safety of a nuclear facility that the integrity and performance of pumps installed at the nuclear facility is assured until the end of their specified design service life in those postulated situations and conditions that may prevail in their service place. [2020-01-20 ]

102. This Guide presents requirements for the design, manufacturing, installation, commissioning, operation, condition monitoring and maintenance of pumps. The requirements shall be applied to both built-to-order and serially manufactured pumps; however, the requirements pertaining to procurement of a serially manufactured pump are presented separately in Chapter 14. The Guide also describes the oversight procedures applied by STUK and an authorised inspection organisation (AIO) to verify compliance with the presented requirements. [2020-01-20 ]

103. The following legislation sets the legal basis for this Guide:

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

Under Section 4(2) of Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (STUK Y/1/2018) [3], *requirements set for and the actions taken to ascertain the compliance with the requirements of the systems, structures and components implementing safety functions and connecting systems, structures and components shall be commensurate with the safety class of the item in question.*

Under Section 5(3) of Radiation and Nuclear Safety Authority Regulation on the Safety of Disposal of Nuclear Waste (STUK Y/4/2018) [4], *the requirements set for and the actions to ascertain the compliance with the requirements of the systems, structures and components implementing operational safety functions and connecting systems, structures and components shall be commensurate with the safety class of the item in question.* [2020-01-20 ]

## 2 Scope of application

201. This Guide applies to Safety Class 1, 2 and 3 pumps in nuclear facilities in all phases of their service life from procurement to operation. The Guide's requirements apply to licensees as well as those in the pump supply chain. [2020-01-20 ]

202. The systems design requirements on which pump design is based are given in the B Series of the YVL Guides. [2013-11-15 ]

203. The requirements for the electrical and I&C equipment for pumps are given in Guide YVL E.7 "Electrical and I&C equipment of a nuclear facility". The preliminary and final suitability assessments of the electrical and I&C equipment are processed according to the submittal method and schedule specified in Guide YVL E.7. The compatibility of the pump and electrical and I&C equipment shall, however, be demonstrated with an operability analysis to be appended to the pump's construction plan. [2020-01-20 ]

204. Strength analyses are addressed in Guide YVL E.4 "Strength analyses of nuclear power plant pressure equipment". [2013-11-15 ]

205. The requirements for the processes and functions of the licensee and suppliers' management system are given in Guide YVL A.3 "Leadership and management for safety". [2020-01-20 ]

206. STUK approves inspection organisations conducting inspections of nuclear facility pumps in accordance with Guide YVL E.1 "Authorised inspection body and the licensee's in-house inspection organisation". [2013-11-15 ]

207. STUK approves inspection organisations conducting tests of nuclear facility pumps in accordance with Guide YVL E.12 "Testing organisations for mechanical components and structures of a nuclear facility". [2013-11-15 ]

### 3 Licensee's general equipment requirement specification for pumps

301. The licensee shall have a general equipment requirement specification for the nuclear facility's pumps. The general equipment requirement specification shall include the general design and quality control requirements for Safety Classes 1, 2 and 3 pumps set by the licensee to be observed in procurement supplemented with the service place-specific requirements. In addition to the pump's safety class, the requirements can also be proportioned part-specifically, in which case the requirement level depends on the significance of the part to the fulfilment of the pump's design bases. [2020-01-20 ]

302. With regard to the design requirements of the pumps, the general equipment requirement specification shall present safety class-specifically:

- a data sheet for the design bases and values to be specified for the pumps
- applicable standards and other requirements based on which the pumps are designed and dimensioned
- structural material requirements
- inspectability and maintainability requirements
- all other requirements related to procurement set by the licensee for the pumps of the nuclear facility.

[2020-01-20 ]

303. With regard to the quality control requirements of the pumps, the general equipment requirement specification shall describe safety class-specifically the inspections and tests (general inspection plan) to be conducted on the structural materials, parts and finished pump during procurement, manufacturing, installation and commissioning. The following shall be presented for each inspection/testing target:

- description of the inspection or testing
- inspection or testing procedure reference (excluding manufacturer-specific procedures)
- reporting requirement (inspection report, certificate, etc.)
- supervisory parties (witness or hold point).

[2020-01-20 ]

303a. Inspection and testing procedures referred to in the general inspection plan shall be submitted to STUK for information upon a separate request. The requirement does not apply to publicly available standards used as inspection or testing procedures. [2020-01-20 ]

304. Removed. [2020-01-20 ]

305. The design and quality control requirements for built-to-order and serially manufactured pumps shall be separately specified in the general equipment requirement specification if the licensee sets mutually non-conformant requirements for them. [2020-01-20 ]

306. The licensee shall periodically verify the validity of the general equipment requirement specification. The general equipment requirement specification, its reference documents and updates shall be approved by STUK before their application as the pump requirement basis. [2020-01-20 ]

307. Possible requirement specifications regarding the pumps of the plant or component supplier shall not contradict the licensee's general equipment requirement specification. [2020-01-20 ]

308. The licensee shall submit the STUK-approved general equipment requirement specification for pumps for information to the authorised inspection bodies it uses. [2020-01-20 ]

## 4 Manufacturer

401. The management system of a pump manufacturer in Safety Class 1 and 2 shall be appropriately certified for the nuclear industry. If the management system has not been specifically certified for the nuclear industry, the management system shall be supplemented with a delivery-specific quality plan. The quality plan shall describe such quality-control ensuring procedures that implement the requirements regarding quality control of Guide YVL A.3 in a pump delivery. The quality plan shall be submitted in connection with a possible manufacturer approval or together with the construction plan of the pump. [2020-01-20 ]

401a. The management system of a pump manufacturer in Safety Class 3 shall be appropriately certified. Otherwise, the licensee may separately apply for approval for other management system assessment performed by an independent third party. [2020-01-20 ]

401b. The licensee shall audit Safety Class 1 and 2 pump manufacturers when an approval according to Guide YVL E.3 "Pressure vessels and piping of a nuclear facility" is required of the manufacturer. [2020-01-20 ]

402. The manufacturer shall have in its employment competent and experienced personnel as well as the methods, equipment and tools required for its operations. [2013-11-15 ]

403. The manufacturer shall have documented procedures for qualification of manufacturing procedures and personnel, validity of qualifications, manufacturing, testing and handling of non-conformances. [2013-11-15 ]

404. If the manufacturer uses special processes in manufacturing of the pump's pressure-retaining parts, the licensee shall apply for a workplace-specific approval for the manufacturer from STUK in accordance with Guide YVL E.3. A separate manufacturer approval is not, however, necessary for joint welds of small nozzles (DN32 or smaller), cladding of sealing and guiding surfaces or for spot and lock welding. [2020-01-20 ]

405. The manufacturing procedures for special processes shall be qualified by procedure tests before manufacturing. As regards demanding components, STUK or an AIO can request for a review of the suitability of manufacturing procedures by works tests before manufacturing or production tests during manufacturing. [2020-01-20 ]

405a. Persons making permanent joints shall be qualified under the supervision of a recognised third-party supervisor, and, in addition to demonstrating the person's practical skills, the qualification shall verify the job knowledge of the person to be qualified concerning joining technology. Recognised third parties for procedure and personal qualification include notified bodies and recognised third-party organisations (certification bodies) as defined in the Pressure

Equipment Directive. In addition to certification bodies accordant with the Pressure Equipment Directive, also other accredited certification bodies shall be accepted within the scope of their area of qualification. In such a case, the accreditation shall be covered by the Multilateral Agreements (MLA) or Mutual Recognition Arrangements (MRA) entered into by FINAS and the accreditation shall be conducted against the requirements of Standard EN ISO/IEC 17020, 17021, 17024 or 17065. [2020-01-20 ]

406. As regards the supply chains of parts important to pump operability, the manufacturer shall ensure that subcontractors are familiar with the requirements relating to their delivery and also make sure before assembly that the components manufactured by the sub-contractors fulfil these requirements. [2020-01-20 ]

## 5 Design

### 5.1 General

501. The system documentation of a nuclear facility shall specify all such service place-specific data, which is required as design bases, when a pump is being designed and dimensioned to maintain the required operability during operational, transient and accident situations.

[2020-01-20 ]

502. The pump's structural design and dimensioning shall be based on a standard meant for designing nuclear power plant pumps, such as "ASME Boiler & Pressure Vessel Code" (Section III, Division 1); as regards Safety Class 1 on Subsection NB-3400 [6] and as regards Safety Class 2 on Subsection NC-3400 [7]. Standards other than those intended for the design of nuclear power plant pumps are acceptable provided that it can be demonstrated that by design and dimensioning based on them an equivalent assurance of pump integrity and operability can be achieved [2020-01-20 ]

503. The structural design and dimensioning of Safety Class 3 pumps shall be based on a generally applied pump design standard. [2020-01-20 ]

504. If the standards applied present different requirement levels for design and dimensioning requirements, the requirement levels applied shall correspond to the pump's safety class.

[2013-11-15 ]

505. The same standard series shall be applied in pump design and manufacturing. In case of deviations from this rule, the licensee shall justify the acceptability of the procedure.

[2013-11-15 ]

506. A technically justified assessment of pump service life shall be provided indicating the time it reliably maintains operability. [2013-11-15 ]

507. The margins between excitations (internal and external) and natural frequencies and/or structural damping in the pump shall be large enough for the pump to maintain its operability in all design basis operational, transient and accident situations. [2020-01-20 ]

508. The pump shall maintain its required operability during an exceptional connection situation of supply voltage, e.g., restarting in phase opposition, provided that this connection situation is the pump's design basis. [2020-01-20 ]

509. The condition monitoring of the pump in Safety Classes 1 and 2 shall be fixed and produce online data when the pump operates in cases where such condition monitoring substantially enhances the effectiveness of the pump's condition monitoring as compared to condition

monitoring conducted periodically. [2020-01-20 ]

510. A pump's NPSH a shall be at least equal to its NPSH r with an added margin of 0.5 m. Pumps intended for long-term operation under accident conditions shall apply as the NPSHr the NPHS at which incipient cavitation occurs with the cavitation having no effect as yet on the head. In other cases the pump's NPSHr shall not be less than the NPSH at which the head measured over the pump's first-stage impeller decreases by 3%. [2020-01-20 ]

511. The pump shall be protected with a minimum line or electrical protection that reliably prevents pumping against a closed system. [2020-01-20 ]

512. The pump shall be capable of starting under the most unfavourable start-up conditions. Drive torque must not be lower than the pump's counter torque during start-up under any design basis operational conditions. [2013-11-15 ]

513. The design of the pump's electrical and I&C equipment shall fulfil the design requirements of Guide YVL E.7. [2013-11-15 ]

## **5.2 Structure**

514. The pump's design solutions shall employ proven technology. Fulfilment of the pump's performance requirements shall be experimentally demonstrated if this is the only reliable method to verify conformity. [2013-11-15 ]

515. In the selection of parts, classified as serially manufactured products, to be used in the pump, it shall be ensured that they are suitable in terms of characteristics and quality for their intended use and that they do not weaken the operability required of the pump in design basis operational, transient and accident situations. [2020-01-20 ]

516. The pump shall have such material thicknesses that stresses exerted by piping or other components on the pump structures do not cause deformations in moving parts and clearance surfaces that would impair performance during design basis operational, transient and accident situations. [2020-01-20 ]

517. The pump's structural materials and structure as well as the operating environment and process system shall be such that the pump can be inspected, tested and maintained in order to ensure its design basis operability. [2020-01-20 ]

518. The potential leak points of pumps transferring radioactive liquid, e.g. shaft seals shall be equipped with a leakage collection system. [2013-11-15 ]

519. The pump shaft shall be fitted with a throttling ring or an equivalent solution to prevent external leak in case of a shaft seal failure. [2013-11-15 ]

520. The pump's frame structures shall be fitted with wearing or sealing rings to prevent loss of pump integrity in case of bearing damage or in other situations leading to a potential contact between the rotor and frame. [2013-11-15 ]

521. The cooler of a water-cooled drive in Safety Class 1 and 2 pumps shall be equipped with leakage control. Leakage data shall be available in real time in the nuclear facility's control room. [2020-01-20 ]

### **5.3 Materials**

522. The pump's structural materials and hard-facings shall withstand stresses arising from design basis service. Material selection shall ensure that corrosion, erosion, radiation or other corresponding harmful phenomena do not endanger pump operability. [2013-11-15 ]

523. The structural materials of the pump's pressure-retaining parts and parts essential for operation shall be standardised materials, which have been proven suitable in practise for the intended applications. However, the structural materials shall be separately approved in accordance with Guide YVL E.3 if they are not based on a material standard generally known in Finland. [2020-01-20 ]

524. The conformity of material properties shall be demonstrated in the material manufacturing documentation as extensively as required by the material standard. Changed material properties shall be specified whenever the standards-compliant delivery condition is altered during pump manufacturing by heat treatment, forming or welding, and it shall be ensured that the changed values are used in analyses associated with the pump's acceptability. [2013-11-15 ]

525. Austenitic cast steel shall not be used as the structural material of the casings of pumps subject to in-service inspections in accordance with Guide YVL E.5 "In-service inspection of nuclear facility pressure equipment with non-destructive testing methods", unless their inspectability can be reliably demonstrated. [2020-01-20 ]

526. Structural materials containing elements that could become activated shall be avoided in the clearance and guiding surfaces or similar surfaces of pumps injecting water to the primary circuit or in other equivalent surfaces from which material could peel off due to erosion-corrosion or some other phenomenon. The concentrations of elements that could become activated shall be low enough for them to have no significant effect on the level of radiation at the nuclear facility. [2013-11-15 ]

## 6 Construction plan

601. The licensee shall submit the pump's construction plan containing the following data:

- licensee's summary of justifications
- manufacturer report
- design bases
- design data
- dimensioning calculations
- operating experiences and type test data
- manufacturing procedures
- inspection plan and procedures.

A corresponding construction plan shall also be presented of a spare parts procurement significant for the pump's integrity or performance if the structure or material of the spare part changes.

In the case of replacing a drive to a pump in operation, the construction plan shall cover only the operability analysis according to Appendix C.

The construction plan of a pump equipped with a non-electrically operated drive shall include such data on the drive manufacturer, design and manufacturing quality control that the acceptability of the drive can be assessed based on the data submitted. [2020-01-20 ]

602. In Safety Classes 1 and 2, the licensee shall apply for approval for the construction plan before the commencement of pump manufacturing. [2020-01-20 ]

603. In Safety Class 3, the licensee shall apply for approval for the construction plan no later than before the pump's construction inspection. [2020-01-20 ]

603a. In Safety Class 1, a separate approval shall be applied for commencing the material manufacturing of the pump's pressure-retaining frame structures. A description of the manufacturing process, material inspection and testing plans and preliminary strength analyses of the parts in question shall be appended to the application. [2020-01-20 ]

603b. The pump's operability analysis according to Appendix C can be submitted separately if necessary. In that case, the licensee shall seek an approval for it before installing the drive to its service place at the latest. [2020-01-20 ]

604. In case the construction plan is updated before the construction inspection, the licensee shall apply for approval for the revisions. Minor revisions can be submitted for information. [2020-01-20 ]

## 6.1 Summary of justifications

605. The licensee shall append to the construction plan a summary of justifications prepared on the conformity of the pump. It shall include justifications based on the construction plan data as to why:

- manufacturer and their subcontractors, testing organisations and third parties have readiness for a delivery, inspections and supervision
- pump design bases correspond to the requirements set for the pump during operational, transient and accident situations
- dimensioning calculations, analyses, type tests or operating experiences reliably demonstrate the fulfilment of the pump's design bases
- manufacturing quality can be extensively verified by inspections and testing conducted on the structural materials, parts and finished pump.

[2020-01-20 ]

606. The justifications shall make reference to individual documents of the construction plan and, where necessary in case of extensive documents, also to their chapter or page numbers.

[2020-01-20 ]

607. The summary of justifications shall designate testing organisations conducting destructive or non-destructive testing of the pump's structural materials or parts during manufacturing and draw up a summary of the approvals. A summary shall also be given on manufacturer approvals when special processes are used in pump manufacturing. [2013-11-15 ]

608. Removed. [2020-01-20 ]

## 6.2 Manufacturer report

609. The construction plan shall include a manufacturer report containing data on the manufacturer's organisation, operation, qualification of personnel and manufacturing procedures, copies of valid management system certification decisions and other assessments and the manufacturer's recent delivery references. A reference to a manufacturer report possibly submitted earlier or a valid approval of manufacturer in accordance with Guide YVL E.3 is sufficient when data is unchanged. [2020-01-20 ]

610. When the pump belongs to Safety Class 1 or 2, the manufacturer report shall be presented on the materials manufacturers of pressure-retaining parts of the frame structure and those subcontractors who manufacture parts significant to the pump's operability. [2020-01-20 ]

### 6.3 Design bases

611. The construction plan shall give the pump design bases:

- highest allowable system pressure and temperature of the process system
- system flow requirement, pressure loss and back pressure
- available net positive suction head
- design basis operational, transient and accident conditions
- operability requirements
- loading and stresses exerted on the pump
- process, driving power and ambient conditions
- pump service life and number of start-ups during service life
- other service place-related pump requirements.

[2020-01-20 ]

612. The pump's design bases shall be determined in the scope of the requirements that have been set for the pump's operability in normal operation, during anticipated operational occurrences, postulated accidents, design extension conditions and severe reactor accidents.

[2020-01-20 ]

613. Loadings and stresses shall be presented to the extent they are considered the pump's design bases. They typically include

- forces and moments exerted by piping and supports
- mechanical and thermal load fluctuations
- exceptional connection situations of the drive
- impact loading (accelerations caused by pipe breaks and seismic events)
- ambient conditions (temperature, humidity, radiation).

[2013-11-15 ]

## 6.4 Design data

614. The construction plan shall present the pump's dimensioning values and technical data to the extent they apply to the pump to be approved. Based on the data, it shall be possible to assess whether the pump fulfils its design basis requirements:

- service place code and safety class
- design pressure and temperature
- characteristic curves
- purpose in the process system and functional description (including PI diagrams for local control and auxiliary systems)
- construction drawings (assembly and sectional drawings)
- part lists
- structural and coating materials as well as welding filler materials
- the pump's allowable forces and moments in piping connections
- quality requirements for lubricants as well as for seal and cooling water.

[2020-01-20 ]

615. The pump's characteristic curves shall be presented for head, the required suction head (NPSHr) and output as a function of flow as well as of drive torque and pump counter torque as a function of rotation speed in rated and dimensioning conditions. [2013-11-15 ]

616. In addition to the pump's main dimensions, the construction plans shall indicate dimensions, part markings, part materials, hard-facings, surface treatments and welded joints used as both input data for calculations and essential for functioning. [2020-01-20 ]

## 6.5 Calculations

617. Calculations to be included in the construction plan shall demonstrate that the pump's operability requirements are fulfilled in design basis operational, transient and accident situations. The requirements regarding the calculations to be included in the construction plan are given in Appendix C. [2020-01-20 ]

618. The pump's structural strength shall primarily be demonstrated by classification in accordance with an applicable standard and/or computational analyses, such as a stress analysis based on a standard or one based on detailed modelling of the structure.

[2013-11-15 ]

619. Acceptability of parts which are classified as serially manufactured and important to pump integrity or performance shall be justified in the construction plan. This justification shall be done by calculations, manufacturer's dimensioning tables, operating experiences or other reports confirming the conformity of such parts. [2020-01-20 ]

620. As input data for the calculations, the most unfavourable combination of loading and conditions that the pump could be exposed to shall be used. Such approval criteria values shall be used for the results that the pump reliably maintains the required operability in the design basis operational, transient and accident situations. [2020-01-20 ]

621. Of the calculations, the standards applied, loading used as initial data and material properties, calculation methods, visualised results, acceptance criteria and conclusions shall be presented. [2013-11-15 ]

622. In Safety Classes 2 and 3, the construction plan's calculations can be replaced by the operating experience feedback or type test data of a pump having an equivalent construction and design values if the pump's conformity can be equally demonstrated by this data. [2020-01-20 ]

## **6.6 Operating experience feedback and type test data**

623. The construction plan shall include such delivery references and type test records that can be used to assess the delivery capabilities of the manufacturer and the suitability of the pump to be approved for its intended application. In addition, delivery references shall be presented for such subcontractors that manufacture parts significant to the pump's operability. [2020-01-20 ]

624. Acceptable delivery references are pumps whose design parameters, bases and solutions have been equivalent to the pump to be accepted. Of these, the construction plan shall present at least the types, design parameters, materials, quantities, delivery years and purchasers of the pumps and drives. It is recommended that operating conditions and periods and other corresponding operational experience history is included in the data provided. [2013-11-15 ]

625. Acceptable type test records are those that present the testing results of a pump that is representative in terms of the design values and solutions. With the report results, it shall be possible to unambiguously confirm the conformity of the design solutions of the pump to be accepted. [2020-01-20 ]

626. In the absence of previously conducted type tests or representative operating experiences, a pump's acceptance requires a type test. [2020-01-20 ]

## 6.7 Manufacturing procedures

627. When special processes are used in the manufacture of a Safety Class 1 or 2 pump, the manufacturing procedures of the special processes and their qualification data shall be included in the construction plan. This requirement does not apply also to the surfacing of clearance and guiding surfaces whose qualification is verified in the construction inspection. [2020-01-20 ]

## 6.8 Inspection plan and procedures

628. A plan for inspections and testing during pump manufacturing shall be included in the construction plan. [2013-11-15 ]

629. The inspection plan shall present the inspections and testing conducted on the pump's structural materials, parts and the finished pump. The following shall be presented for each inspection/testing target:

- identification data (heat, serial and part number, drawing number, structural material, etc.)
- description of the inspection or testing
- inspection or testing procedure reference
- reporting procedure (inspection report, certificate, etc.)
- supervisory parties (witness or hold point).

[2020-01-20 ]

630. Referred instructions shall define the scope of inspections and testing, approval criteria of results, methods, equipment and qualification requirements of the persons carrying out testing. [2013-11-15 ]

631. The construction plan shall include procedures for the factory tests that allow the verification of the pump's conformity. Typically, such tests include pressure tests of pressure-retaining parts and different functional tests, such as performance and endurance tests. In addition, in Safety Classes 1 and 2, the construction plan shall include inspection procedures for non-destructive testing during pump part manufacturing. [2020-01-20 ]

632. The inspection plan shall define the scope of pump disassembly after functional testing and which parts are then available for visual inspection. The scope of disassembly shall typically enable the inspection of the condition of clearance and guiding surfaces of hydraulic parts as well as other parts significant for the pump's performance. [2020-01-20 ]

633. Factory tests shall be primarily conducted with the pump's final installation assembly. When deviating from this requirement, the use of some other test assembly shall be justified in order to achieve corresponding certainty on the conformity of the pump. [2020-01-20 ]

## 7 Type test

701. The conformity of the pump's design solutions shall have been demonstrated with a type test that allows confirming the pump's design basis performance. A new type test is not needed if conformity can be demonstrated with a previously conducted type test. The type test can be replaced with operating experiences, if the operating experiences represent the design basis conditions and stresses of the pump's service place. [2020-01-20 ]

702. The structure, dimensions and materials of the type-tested pump shall correspond to the pump to be approved. [2020-01-20 ]

703. Type testing shall be implemented in conditions corresponding to the design basis operational, transient and accident situations using such testing parameters by which the pump's conformity can be unambiguously demonstrated based on the test results. This requirement specifically concerns such performance which cannot be reliably verified by calculations or operating experiences. [2020-01-20 ]

704. Removed. [2020-01-20 ]

705. Verification of conformity of the pump's electrical and I&C equipment shall fulfil the requirements of Guide YVL E.7. [2013-11-15 ]

706. When a type test is conducted on the pump in connection with procurement, a type test plan shall be prepared to describe the test arrangements and conditions, to set the acceptability criteria for the results and to present the control scope of STUK or an AIO. The licensee shall apply for approval for the type test plan before the type test is conducted and submit the type test results report for information before the pump is installed. [2020-01-20 ]

## 8 Manufacturing

801. The pump shall be manufactured and manufacturing quality controlled in accordance with an approved construction plan and the associated inspection plan. [2013-11-15 ]

802. The licensee shall prior to the start of manufacturing ensure that the manufacturer has the administrative and technical readiness for conformity-compliant operation and that the manufacturer has the approved construction plan and the decision pertaining to it at its disposal. [2013-11-15 ]

803. The machines, equipment and tools used in manufacturing shall ensure the achievement of a quality level set by the requirements. The machines and equipment shall be periodically tested and calibrated as required by the manufacturer's quality management system. The test results shall be recorded and presented upon request. [2013-11-15 ]

804. The structural materials for which a batch-specific material certificate is required shall be identifiable and traceable from their lot-specific melting up until the finished structure. The minimum requirements for the material certificates of structural materials are given in Appendix B. [2013-11-15 ]

804a. Within the scope of the inspection plan, a third party shall:

- witness the sampling, stamp transfer and destructive testing of materials and confirm the results with a certificate of type 3.2 under standard SFS-EN 10204 [13]
- witness and confirm procedure and personnel qualifications
- witness and confirm the manufacturing of the component, such as welding, forming and non-destructive testing.

During witnessing, the third party shall identify the material before the removal of the samples to be tested and ensure the traceability of the samples to the product either by stamping or by other applicable methods. The witnessing person shall be present in the testing event that he/she is to witness, if the inspection plan does not indicate otherwise. [2020-01-20 ]

805. The manufacturer shall identify the manufacturing non-conformances detected, determine their causes, assess their importance and carry out corrective actions. The licensee shall apply approval from STUK or an AIO for any non-conformances remaining in the pump that are significant in terms of operability. Non-conformance management-related requirements are given in Guides YVL A.3 and YVL A.5. [2020-01-20 ]

806. The manufacturer shall compile into manufacturing documentation the testing, inspection and control records that comply with the approved inspection plan and were drawn up during manufacturing. Inspection documents for construction materials and welding filler materials, qualification certificates of personnel, the non-conformance reports as well as other records drawn up during control of manufacturing and qualification shall be attached to the manufacturing documentation. [2020-01-20 ]

807. The licensee shall ensure that the manufacturer compiles and hands over to the licensee the manufacturing documentation as well as the installation, operation and maintenance instructions before the pump's commissioning at the nuclear facility. [2020-01-20 ]

## 9 Construction inspection

901. The licensee shall request from STUK or an AIO a construction inspection to establish the acceptability of the pump's manufacturing documentation, to conduct the inspections and to witness the tests in the scope of the approved inspection plan. [2020-01-20 ]

902. The construction inspection shall establish evidence that the pump's materials, manufacturing, structures and operation are in compliance with the construction plans. The construction inspection shall be conducted on each pump of the delivery batch. [2020-01-20 ]

903. When making a construction inspection, an inspector of STUK or an AIO shall have available the approved construction plan, possible modification documents and the related decisions of approval. Reference documents of the construction plan that are not attached to the construction plan shall be presented upon request. [2020-01-20 ]

904. At the construction inspection, the inspector shall be provided with adequate lighting, calibrated measuring instruments and auxiliaries as well as the necessary assisting personnel. [2013-11-15 ]

905. At the construction inspection, the licensee shall present

- the necessary regulatory approvals (testing organisations, manufacturer)
- systematically compiled and licensee-approved documentation including the manufacturing records in the scope specified in the inspection plan

and arrange in a scope specified by the inspection plan

- structural inspection (visual quality inspections, dimension inspections, verification of part identification markings)
- witnessing of factory tests (pressure, performance and endurance tests).

[2020-01-20 ]

906. Factory tests shall be conducted in accordance with the approved procedures.

[2020-01-20 ]

906a. Factory tests cannot begin until an inspector of STUK or an AIO has confirmed testing readiness. If the pump's manufacture has made use of special processes and the manufacturer has been approved according to Guide YVL E.3, the person responsible for manufacture shall prepare before the factory tests a written declaration to be included in the manufacturing documentation stating that the manufacturing of the pump has taken place in accordance with the accepted construction plan and YVL guides. [2020-01-20 ]

907. A performance test shall measure the head, flow, output, vibration and other parameters significant for performance within the pump's operating range. [2013-11-15 ]

908. The minimum length of a non-stop endurance test in Safety Classes 1 and 2 shall be 48 h and every pump shall be tested. In Safety Class 3, the minimum length of the endurance test shall be 24 hours and at least one of equivalent pumps shall be tested. During the endurance test, the pump shall be driven in different service positions, started up and stopped at least ten times and operational parameter trends measured. [2020-01-20 ]

909. In Safety Classes 1 and 2 all pumps and in Safety Class 3 at least one of identical pumps in the delivery batch shall be inspected when dismantled after factory testing. The scope of dismantling shall comply with the accepted construction plan. [2020-01-20 ]

910. If the pump or its parts essential for operability are repaired or modified or wearing parts other than those that are disposable are replaced at the factory after factory tests, the pump's conformity shall be verified by repeated factory tests after the modifications. [2020-01-20 ]

911. Removed. [2020-01-20 ]

912. Removed. [2020-01-20 ]

913. The construction inspection of the pump shall be acceptably conducted before installing the pump. [2020-01-20 ]

## 10 Installation

1001. The licensee shall conduct an acceptance inspection on the pump before storage and installation. In the acceptance inspection, the pump shall be removed from its packing and its flawless condition verified before installation. [2013-11-15 ]

1002. The licensee shall have a construction plan for the pump's installation. The installation construction plan shall present

- procedures, drawings and part lists required in the installation
- qualified welding procedures (if the pump is connected to piping by welding)
- inspection plan
- inspection procedures (or their reference data).

The installation construction plan can be submitted as an individual document or as part of other documentation, such as the construction plan of the pump's manufacturing or piping. [2020-01-20 ]

1003. The pump's installation inspection plan shall contain inspections and their procedures that enable reliable verification of the conformity of the installation. [2020-01-20 ]

1004. The licensee shall request from STUK or an AIO an installation construction inspection to establish the acceptability of the installation documentation and to conduct the inspections in the scope of the approved inspection plan. [2020-01-20 ]

1004a. The installation construction inspection shall establish evidence that the pump installation work and its quality control have been performed according to the installation construction plan. [2020-01-20 ]

1005. At the installation construction inspection event, the licensee shall present the following where applicable

- approved installation construction plan
- approval of the operability analysis (Appendix C) of a pump.

Construction plan reference documents not included in the installation construction plan shall also be presented on request. [2020-01-20 ]

1006. Before the pump's installation, the licensee shall apply for approval of the installation construction plan. [2013-11-15 ]

1007. The installation construction inspection shall be acceptably completed before the pump's commissioning inspection. [2013-11-15 ]

## 11 Commissioning

1101. The licensee shall request from STUK or an AIO commissioning inspections to demonstrate the pump unit's readiness for a test run and operation. The licensee is responsible for the availability of the documents and records required in the inspection as well as for guidance to the plant. [2020-01-20 ]

1102. The first phase of the commissioning inspection verifies that

- the pump construction plan, construction inspection and installation construction inspection have been approved
- the preliminary and final suitability assessments of the electrical and I&C equipment have been processed according to the submittal method specified in Guide YVL E.7
- the licensee has successfully conducted the licensee's installation inspection of the electrical and I&C equipment
- the pump's test run plan has been prepared
- the operating and maintenance procedures are available for use
- the pump assembly and process interfaces comply with the plans
- there are no obstacles to the safe operation, inspection and maintenance of the pump.

[2020-01-20 ]

1103. The test run requires a test run plan which enables the performance of the test run in a manner yielding evidence on the required performance of the pump and drive. The test run plan, which may be a separate document or it can be included in a process system's commissioning plan, shall present the test and measurement arrangements, test phases and result acceptance criteria. [2020-01-20 ]

1104. In the second phase of the commissioning inspection, the test run of the pump and drive is conducted in compliance with the test run plan. It is verified from the test run records and by witnessing the test run that

- the licensee has acceptably completed the licensee's commissioning inspection of electrical and I&C equipment
- the test run has been completed in a scope complying with the test run plan and the results are acceptable
- there are no non-conformances preventing the commencement of operation.

At facilities under construction, the test run is typically done in connection with a system's test run, while at operating facilities separate test run arrangements are employed. [2020-01-20 ]

1105. The first phase of the commissioning inspection shall be acceptably conducted before the start of the test run. [2013-11-15 ]

1106. Both phases of the commissioning inspection shall be acceptably conducted before a pump operating licence is granted. An operating licence can be granted for a fixed period, if the operation of the pump is safe regardless of the shortcomings preventing the granting of a permanent operating licence. [2020-01-20 ]

## 12 Operation, condition monitoring and maintenance

1201. The pump's operating parameters as well as loading, process and ambient conditions shall be monitored and maintained within the limits of design basis service. Unnecessary loading and unfavourable operating conditions shall be avoided. [2013-11-15 ]

1202. The pump shall reliably maintain its operability over the maintenance interval in all design basis operation. Overhaul need or failure shall be detected before any significant safety risk is caused by debilitation or loss of pump operability. [2020-01-20 ]

1203. Instructions shall be given for the pump's operation, condition monitoring and maintenance. The instructions (operating procedures as well as maintenance, inspection and testing programmes and the related instructions) shall be based on the manufacturer's recommendations and operational experience feedback of the licensee or that from other nuclear facilities. The instructions shall be regularly assessed and the modification needs detected analysed. [2020-01-20 ]

1204. The pump's condition monitoring instructions shall present the parameters, methods, inspection and test intervals and acceptance limits to be monitored. The targets and parameters of the pump that allow confirming the fulfilment of the operability requirements set for the pump shall be monitored. These targets and parameters may include

- flow and head
- bearing vibration (horizontal, vertical and axial) and temperatures
- leak tightness of shaft seals and other seals
- integrity of pressure retaining parts
- condition of bearings, clearance and guiding surfaces
- condition of load path parts
- the drive's power consumption and coil temperature
- number of start-ups and cumulative operating time.

[2020-01-20 ]

1205. The pump's maintenance instructions shall define the work and inspections to be carried out during periodic maintenance, timing of the maintenance work as well as the spare parts and supplies required. [2013-11-15 ]

1206. If special processes are used in pump maintenance, the party shall have STUK's facility-specific approval in accordance with Guide YVL E.3. [2013-11-15 ]

1207. If a maintenance task is not part of the pump's maintenance programme the maintenance task is considered repair work for which the licensee shall draw up a repair plan. A repair plan is not, however, required for repair work where parts are only replaced with approved spare parts and during which no special processes are used. [2020-01-20 ]

1208. The repair plan shall include justifications for the acceptability of the repair method and all data related to the completion of the work and quality control that are needed to verify the conformity of the repaired pump and that typically include a description of the repair method, illustrative drawings and an inspection plan covering manufacturing, installation and commissioning. [2020-01-20 ]

1209. The licensee shall apply for approval of the pump's repair plan before the repair is started. [2013-11-15 ]

1210. The licensee shall request from STUK or an AIO a construction inspection to establish the acceptability of the documentation of the repair work, to conduct the inspections and to witness the tests in the scope of the approved construction plan. The repair work construction inspection shall be acceptably conducted before the pump is used. [2020-01-20 ]

## 13 Modifications

1301. A pump modification shall not compromise the nuclear facility's safety or the prerequisites for the pump's condition monitoring or maintenance. Modifications shall also include the procurement of a spare part significant in terms of operability, if the structure or material of the spare part changes. [2013-11-15 ]

1302. The licensee shall draw up a pump modification construction plan. The construction plan shall include justifications for the acceptability of the modification and all data related to the implement and quality control that are needed to verify the conformity of the modified pump and that typically include a description of the modification, applicable calculations, illustrative drawings and an inspection plan covering manufacturing, installation and commissioning. In Safety Classes 1 and 2, the modification construction plan shall also include an analysis of the modification's safety effects. [2020-01-20 ]

1303. Update needs arising from a pump modification to drawings, procedures and other documents shall be identified and the updates implemented without delay after the modification. It shall be ensured that the potential effects of the modification on pump operation, condition monitoring and maintenance are communicated to the operation and maintenance organisation. [2020-01-20 ]

1304. If special processes are used during a pump modification, the actor shall have a facility-specific approval from STUK in accordance with Guide YVL E.3. [2013-11-15 ]

1305. The licensee shall apply for approval of the construction plan of the pump modification before the start of the modification. [2013-11-15 ]

1306. The licensee shall request from STUK or an AIO a modification construction inspection to establish the acceptability of the modification documentation, to conduct the inspections and to witness the tests in compliance with the approved construction plan. The modification construction inspection shall be acceptably conducted before the operation of the pump. [2020-01-20 ]

## 14 Serially manufactured pumps

1401. Removed. [2020-01-20 ]

1402. Removed. [2020-01-20 ]

1403. Removed. [2020-01-20 ]

1404. Removed. [2020-01-20 ]

1405. Removed. [2020-01-20 ]

1406. Removed. [2020-01-20 ]

1407. Removed. [2020-01-20 ]

1408. Removed. [2020-01-20 ]

1409. Removed. [2020-01-20 ]

1410. Removed. [2020-01-20 ]

1411. Removed. [2020-01-20 ]

1412. Removed. [2020-01-20 ]

1413. Removed. [2020-01-20 ]

1414. It is possible to have a pump classified as a serially manufactured product (serially manufactured pump) approved in Safety Classes 2 and 3 for nuclear facility use, if the pump design, dimensioning and manufacturing quality can be demonstrated to fulfil the requirements of the service place. The licensee shall submit for the serially manufactured pump a construction plan that includes the summary of justifications, manufacturer report, product description, operability analysis of a pump and a drive and an inspection plan for manufacturing quality control.

- The summary of justifications shall present justifications for the implementation of the design values given in the pump's product description. Evidence, which allows the unambiguous justification of the correctness of the design values, may include a type approval granted by an assessment body, qualification records, the manufacturer's dimensioning table, a clarification on the fulfilment of the requirements of the applied dimensioning standard, computational analyses or operating experiences. In addition to this, it shall be justified with measures related to the manufacturing quality assurance and control that the pump's quality level is sufficient to ensure the maintenance of its design values until the end of its design service life in the service place conditions.

- The manufacturer report shall be appended with proof of an acceptably certified (ISO 9001 or similar) management system that also covers possible special processes employed in manufacturing. Otherwise, the licensee may apply for STUK's approval for other management system assessment performed by an independent third party.
- The product description shall include the design values and structural material data, drawings and other necessary documentation needed to establish the pump's structure and operation.
- The operability analysis of a pump and a drive shall include assessments according to Appendix C. If necessary, it can be submitted separately.
- The inspection plan shall include the inspections and tests that are employed to monitor manufacturing quality at least in the form of random inspections (at the factory or plant site) and that allow the conformity of the pump to be justified. The licensee's further inspections may include NDT and DT tests, material identification (PMI) and a pressure test with an elevated test pressure.

If the pump's service place is known, the construction plan shall justify the sufficiency of the pump's design values in view of the requirements set by the service place. [2020-01-20 ]

1415. The licensee shall apply for an approval from STUK or an AIO for the construction plan of a serially manufactured pump before the construction inspection of the pump. [2020-01-20 ]

1416. The licensee shall request from STUK or an AIO a construction inspection for a serially manufactured pump to establish the acceptability of the manufacturing documentation, to conduct the inspections and to witness the tests in the scope of the inspection plan approved in connection with the processing of the construction plan. The pump shall be inspected before its installation. The operability analysis of a pump and drive shall also be approved before its installation. [2020-01-20 ]

1417. If the construction inspection of serially manufactured pumps is performed in the form of random inspections only to a part of the delivery batch and the inspections reveal significant shortcomings, the whole delivery batch shall be inspected. [2020-01-20 ]

1418. The licensee shall have a plan or procedure in place for installing a serially manufactured pump according to which the installation shall take place and the installation work quality ensured. In case the pump has not already been approved for its service place in connection with the processing of the construction plan, the installation plan shall justify as to why the pump's design values fully fulfil the requirements set forth by the service place. In such a case, an approval shall be sought for the installation plan before the installation. [2020-01-20 ]

1419. The licensee shall request from STUK or an AIO an installation inspection for a serially manufactured pump to establish the acceptability of the installation documentation, to conduct the inspections and to witness the tests in the scope of the installation plan or procedure. The installation inspection shall be approved before the commissioning inspection of the pump.

[2020-01-20 ]

1420. The licensee shall have a plan or procedure in place for commissioning a serially manufactured pump according to which the commissioning shall take place and the pump's performance at the service place ensured. [2020-01-20 ]

1421. The licensee shall request from STUK or an AIO an commissioning inspection for a serially manufactured pump to establish the acceptability of the commissioning documentation, to conduct the inspections and to witness the tests in the scope of the commissioning plan or procedure. The commissioning inspection shall be approved before the operation of the component. The preliminary and final suitability assessments of the pump's electrical and I&C equipment shall have been processed according to the submittal method and schedule specified in Guide YVL E.7. [2020-01-20 ]

## 15 Regulatory oversight by the Radiation and Nuclear Safety Authority

### 15.1 General

1501. The oversight conducted by STUK or an AIO encompasses pump design approvals at system and component level as well as inspections to be conducted during manufacturing, installation, commissioning and operation as specified in this Guide. [2020-01-20 ]

1502. STUK may grant inspection rights in accordance with Guide YVL E.1 to an AIO it has approved. Appendix A defines the principles for the division of inspection responsibilities between STUK and an AIO, which can be supplemented by STUK's decisions. The same party shall inspect all pump parts regardless of, e.g., a possible part-specific classification based on its safety significance. [2020-01-20 ]

1503. STUK or an AIO makes a decision about their design review. Even approval decisions can contain requirements and deadlines for the responses to be submitted on them. [2020-01-20 ]

1504. Removed. [2020-01-20 ]

1505. The licensee shall invite STUK or an AIO to the plant or factory inspections at least 7 days prior to the inspection, however, so that there is sufficient time to prepare for the inspection and to make the necessary travel arrangements. [2020-01-20 ]

1505a. The licensee shall justify and ensure to STUK or an AIO the acceptability of the submitted documents in advance with the help of its own inspections. In the same way, the licensee shall ensure preconditions for the performance of the inspections in accordance with the inspection invitation at the plant and factory inspections. [2020-01-20 ]

1506. STUK or an AIO draws up a record of their inspections describing the inspection object and itemising the inspections and tests conducted. Potential requirements presented in connection with the inspections are entered in the record together with the due dates or times of the measures given in the requirements. [2020-01-20 ]

1507. The record is closed and the inspector hands over the signed record to a representative of the licensee once all the specified inspections have been completed and any requirements entered in the record have been resolved. [2020-01-20 ]

## **15.2 General equipment requirement specifications**

1508. STUK processes the licensee's general equipment requirement specifications regarding pumps and issues a decision on it. [2020-01-20 ]

1509. STUK or an AIO oversees compliance with the general equipment requirement specification for pumps in connection with design and factory inspections. [2020-01-20 ]

## **15.3 Approval of manufacturer**

1510. STUK's approval is required for such pump manufacturers and installation organisations that employ special processes in the manufacture or installation of parts significant for the pump's operability. The requirements as well as approval and oversight procedures are presented in Guide YVL E.3. [2020-01-20 ]

1511. STUK assesses the acceptability of manufacturers other than those using special processes based on the manufacturer report included in the construction plan. [2020-01-20 ]

## **15.4 Approval of third party**

1512. A notified body or a recognised third-party organisation pursuant to the Pressure Equipment Directive [12] may, within the scope of their areas of qualification without separate approval, operate as a third party that witnesses and confirms sampling, destructive and non-destructive testing and qualifications. In addition to these, also other accredited certification bodies shall be accepted. In such a case, the accreditation shall be covered by the Multilateral Agreements (MLA) or Mutual Recognition Arrangements (MRA) entered into by FINAS and the accreditation shall be conducted against the requirements of Standard EN ISO/IEC 17020, 17021, 17024 or 17065. [2020-01-20 ]

1513. The expertise of the third-party conducting control of manufacturing is assessed by STUK based on the report included in the construction plan. [2013-11-15 ]

## **15.5 Construction plan**

1514. STUK or an AIO reviews the pump's construction plan and makes a decision on it. The pump's approved design bases at system level are the prerequisite for the construction plan review. [2020-01-20 ]

### **15.6 Control of manufacturing and construction inspection**

1515. STUK or an AIO can witness pump manufacturing by factory visits during manufacturing before the pump's final construction inspection. [2020-01-20 ]

1516. STUK or an AIO conducts on the ready pump the construction inspection specified in this Guide. [2020-01-20 ]

1517. Removed. [2020-01-20 ]

1518. Removed. [2020-01-20 ]

1519. Removed. [2020-01-20 ]

### **15.7 Type test witnessing**

1520. If a type test is conducted on a pump subject to approval in connection with procurement, STUK or an AIO reviews the type test plan, witnesses the performance of the type test and assesses the test results. [2020-01-20 ]

### **15.8 Installation witnessing and construction inspection**

1521. STUK or an AIO reviews the installation construction plan submitted by the licensee, which contains the documents specified in this Guide. [2020-01-20 ]

1522. STUK or an AIO conducts on the pump the installation construction inspection specified in this Guide. [2020-01-20 ]

### **15.9 Commissioning inspection**

1523. STUK or an AIO conducts a two-phased commissioning inspection on the pump as specified in this Guide. [2020-01-20 ]

### **15.10 Operation, condition monitoring and maintenance**

1524. STUK oversees the operation, condition monitoring and maintenance of the nuclear facility's pumps during inspections belonging to its inspection programme during operation. The monitoring also covers instructions and plans relating to the inspections. [2013-11-15 ]

1525. STUK or an AIO reviews the pump repair plan submitted by the licensee and issues a decision on it. A plan for a minor routine repair work under the responsibility of STUK may be submitted for approval by a STUK inspector at the plant site. [2020-01-20 ]

1526. STUK or an AIO carries out the repair work construction inspection in the scope specified in the repair inspection plan. [2020-01-20 ]

1527. STUK or an AIO reviews the inspection and testing records for pump maintenance work (maintenance, overhauls and repairs) as well as feedback. If pumps are disassembled during maintenance work, STUK or an AIO visually inspects the parts before assembly. [2020-01-20 ]

### **15.11 Modifications**

1528. STUK or an AIO reviews the pump's modification construction plan submitted by the licensee and makes a decision on it. [2020-01-20 ]

1529. STUK or an AIO carries out the modification construction inspection in the scope specified in the modification inspection plan. [2020-01-20 ]

## 16 APPENDIX A Pump inspection scope and division of inspection responsibilities

Approval or witnessing AIO=authorised inspection organisation	Safety Class		
	1	2	3
<b>Design</b>			
Manufacturer (when special processes are used in manufacturing)	STUK	STUK	STUK
General component requirement specification	STUK	STUK	STUK
Design bases	STUK	STUK	STUK
Construction plan	STUK	STUK/AIO <sup>1)</sup>	AIO
Preliminary suitability assessment of electrical and I&C equipment YVL E.7	-	STUK	STUK
Type test oversight	STUK	STUK/AIO <sup>1)</sup>	AIO
<b>Manufacture</b>			
Manufacturing control	STUK	STUK/AIO <sup>1)</sup>	AIO
Construction inspection	STUK	STUK/AIO <sup>1)</sup>	IO
Final suitability assessment of electrical and I&C equipment YVL E.7	-	STUK	STUK
<b>Installation and commissioning</b>			
Installation construction plan and inspection	STUK	STUK/AIO <sup>1)</sup>	AIO
Commissioning inspections	STUK	STUK/AIO <sup>1)</sup>	AIO
<b>Maintenance, repairs and modifications</b>			
Maintenance work inspection	STUK	STUK/AIO <sup>1)</sup>	AIO
Plan for repairs and modifications	STUK	STUK/AIO <sup>1)</sup>	AIO
Inspection of repairs and modifications	STUK	STUK/AIO <sup>1)</sup>	AIO

<sup>1)</sup> STUK: Pumps other than those of low-energy systems/AIO: Pumps of low-energy systems

If special processes are used in pump manufacturing, the minimum scope of qualification and control of manufacturing complies with Annex A of Guide YVL E.3 as regards these manufacturing procedures.

[2020-01-20 ]

## 17 APPENDIX B Material certificate requirements for pump structural materials and welding filler materials

B01. Table 1: Material certificate requirements for pump structural materials (SFS EN 10204 [13]).

Pump part	Pump Safety Class		
	1	2	3
Pressure-retaining parts of the frame structure	3.2	3.2	3.1
Pressure-retaining bolts	3.2	3.1	2.1
Impeller, shaft	3.2	3.1	2.1
Other parts significant for operability	3.1	2.1	2.1

A higher-level material certificate is always acceptable. [2020-01-20 ]

B02. Table 2: Material certificate requirements for pump welding filler materials (SFS EN 10204 [13]).

Weld	Safety Class		
	1	2	3
Pressure-retaining pump welds	3.2	3.1	3.1
Welded claddings	3.1	2.2	2.2
Other welds significant for pump integrity or performance	2.2	2.2	2.2

A higher-level material certificate is always acceptable. [2020-01-20 ]

## 18 APPENDIX C Construction plan calculations

Shaft output	≤ 15kW			> 15kW		
	1	2	3	1	2	3
Safety Class						
Pressure dimensioning of the pump's pressure-retaining parts of the frame structure <sup>1)</sup>		X	X			X
Strength analysis of the pump's pressure-retaining parts of the frame structure <sup>2)</sup>				X	X	
Dimensioning of the other pump parts <sup>3)</sup>		X		X	X	X
Hydraulic dimensioning of the pump <sup>4)</sup>		X		X	X	X
Operability analysis <sup>5)</sup>		X		X	X	(X)
Calculations for pumps positioned in an open tank <sup>6)</sup>					X	X

<sup>1)</sup> In compliance with the applicable design standard, definition of minimum wall thickness based on the pump design pressure.

<sup>2)</sup> Strength analysis based on detailed structural modelling or compliant with an applied design standard. If a strength analysis based on the design standard is not possible due to a non-conformant structure or if the pump is subject to loads the stresses induced by which cannot be reliably analysed, a detailed stress analysis shall be conducted on the pump. The requirements for a detailed stress analysis are presented in Guide YVL E.4. Fatigue analysis shall be presented for parts subjected to fatigue-inducing loads, if the impact of fatigue on the pump's service life cannot be excluded.

<sup>3)</sup> Strength calculations of load-bearing parts important to pump integrity or performance that can be based on a detailed stress analysis, standard formulae or a similar report confirming sufficient strength. Examples of such parts include shafts, keys, couplings, flywheels, supports, fastening bolts and auxiliaries such as coolers. A fatigue analysis is required, if a part is subject to loading fluctuations and the impact of fatigue on the service life of the part cannot be excluded.

<sup>4)</sup> Hydraulic calculations based on the process system's pressure losses and level differences that can be used to demonstrate the sufficiency of the pump's head, flow and NPSH<sub>r</sub> in design basis operational conditions

<sup>5)</sup> The operability analysis (required in Safety Class 3 only if the pump unit is intended for severe accident management) includes the torque, vibration and play analysis of the pump unit (pump, coupling, gear, drive, supports, foundations) and a possible strength analysis in an exceptional connection situation of its drive's supply voltage. The analyses shall demonstrate that the torque of the drive is sufficient in design basis operational conditions and that vibrations and or changes caused by thermal expansion on the operational clearances do not weaken the performance of the pump unit in design basis operational conditions. If the design bases of the pump unit include an exceptional connection situation of the supply voltage, a strength analysis shall also be presented to demonstrate the maintenance of the pump unit operability in such a situation.

<sup>6)</sup> Hydraulic calculations to demonstrate that the air intake of a pump or pumps does not take place from a free surface and parallel pumps do not compromise each other's operation. Can be replaced by mock-up tests.

[2020-01-20 ]

## 19 References

1. Nuclear Energy Act (990/1987). [2013-11-15 ]
2. Removed. [2020-01-20 ]
3. Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (STUK Y/1/2018). [2020-01-20 ]
4. Radiation and Nuclear Safety Authority Regulation on the Safety of Disposal of Nuclear Waste (STUK Y/4/2018). [2020-01-20 ]
5. Removed. [2020-01-20 ]
6. ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NB-3400 Pump Design. [2020-01-20 ]
7. ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NC-3400 Pump Design. [2020-01-20 ]
8. Removed. [2020-01-20 ]
9. Removed. [2020-01-20 ]
10. Removed. [2020-01-20 ]
11. Removed. [2020-01-20 ]
12. Pressure Equipment Directive 2014/68/EU. [2020-01-20 ]
13. SFS-EN 10204 Metallic products. Types of inspection documents. [2013-11-15 ]

# Definitions

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## **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.

## **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.

## **Appropriate certification**

Appropriate certification shall refer to the certification of a quality system based on auditing in which the accreditation of the certification body has been done against the requirements of standard EN ISO/IEC 17021 and the accreditation is covered by the Multilateral Agreements (MLA) or Mutual Recognition Arrangements (MRA) entered into by FINAS.

## **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.

## **Operability**

Operability shall refer to the integrity and performance of SSC in conformance with its design bases.

## **Low energy equipment**

Low energy equipment shall refer to Safety Class 2 equipment with a design pressure of up to 20 bar(g) and a design temperature of up to 120 °C and to which the design, dimensioning and quality-control requirements of a corresponding equipment from Safety Class 3 can be applied with technical justifications without having a risk to lose the operability of the equipment.

**Modification**

Modification shall refer to introducing changes to a system, structure or component so that it no longer corresponds to previous specifications.

**Pump**

Pump shall refer to a mechanical component (hydraulic machine transferring liquid), which transfers liquid and produces head for it. In the context of Guide YVL E.9, a pump is considered to include the pump's auxiliaries and other parts forming an integral part of the pump structure and operations, excluding electrical and I&C equipment, such as the electric motor driving the pump.

**Pump NPSH value**

Pump NPSH (Net Positive Suction Head) value shall refer to the difference between the pressure at the intake flange and the steam pressure corresponding to the temperature of the fluid pumped. Pump NPSHa value shall refer to an NPSH value available at the service place, and the NPSHr value shall refer to an NPSH value that the pump requires to operate without the adverse effects of cavitation.

**Serially manufactured component**

Serially manufactured component shall refer to a component which has not been designed particularly based on the customer's specification but it is procured from an existing product line of the manufacturer. Typically one is manufactured in large quantities, and can be used for other applications, too. Functionality, structure, dimensions, materials, manufacturing process and quality of the component do not essentially differ within and between production lots.

**Built-to-order product**

Built-to-order product shall refer to a product designed and manufactured for a special application as single pieces or in small manufacturing batches.

**Type approved pump**

Type approved pump shall refer to a pump, the conformity to requirements of which a third party verifies by applying the modules of Decision 768/2008/EC.

**Witness point**

Witness point shall refer to an inspection for which advance invitations have been sent to the parties defined in the inspection plan but whose supervision is not a condition for proceeding with the work. Having received the invitation, the invited parties may, however, separately require that they be present in order for the work to be continued.

**Manufacturer**

Manufacturer shall refer to an individual or organisation responsible for the design, manufacture, testing, inspection and installation of equipment or sets of assemblies. A manufacturer may subcontract one or more of the said tasks under its responsibility.

**Spare part**

Spare part shall refer to a back-up part for an SSC that can be used to restore the reduced or lost operability to the required level.

**Hold point**

Hold point shall refer to an inspection for which advance invitations have been sent to the parties defined in the inspection plan and whose supervision is a condition for proceeding with the work unless the parties have given written permission to proceed without their presence.

**General equipment requirement specification**

General equipment requirement specification shall refer to a document that includes general equipment group-specific design and quality control requirements for safety classes 1, 2 and 3. When an equipment is procured, the requirements set out in this document will be completed with site-specific requirements.