STUK

GUIDE **YVL E.8** / 15 NOVEMBER 2013

VALVES OF A NUCLEAR FACILITY

continues

With regard to new nuclear facilities, this Guide shall apply as of 1 December 2013 until further notice. With regard to operating nuclear facilities and those under construction, this Guide shall be enforced through a separate decision to be taken by STUK. This Guide replaces Guide YVL 5.3.

First edition
Helsinki 2014

ISBN 978-952-309-139-9 (print) Kopijyvä Oy 2014
ISBN 978-952-309-140-5 (pdf)
ISBN 978-952-309-141-2 (html)

STUK • **SÄTEILYTURVAKESKUS**
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Osoite/Address • Laippatie 4, 00880 Helsinki
Postiosoite / Postal address • PL / P.O.Box 14, FIN-00881 Helsinki, FINLAND
Puh./Tel. (09) 759 881, +358 9 759 881 • Fax (09) 759 88 500, +358 9 759 88 500 • www.stuk.fi

Authorisation

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

Rules for application

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

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

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

Translation. Original text in Finnish.

1 Introduction

101. Valves are used for many applications at a nuclear facility. During normal operation and transients, valves are needed for the nuclear facility's process control and regulation, and during accidents valves are used to manage safety functions. It is important to the safety of a nuclear facility that the integrity and performance of valves installed at the plant is assured until the end of their specified service life in those postulated situations and conditions that may prevail in their service places.

102. This Guide sets requirements for the design, manufacture, installation, commissioning, operation, condition monitoring and maintenance of valves and describes STUK's oversight procedures to verify compliance with the requirements.

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 the Government Decree (717/2013) [3], *the systems, structures and components that implement or are related with safety functions shall be designed, manufactured, installed and used so that their quality level, and the assessments, inspections and tests, including environmental qualification, required to verify their quality level, are sufficient considering the safety significance of the item in question.*

Under Section 7 of the Government Decree (736/2008) [4], *the systems, structures and components of a nuclear waste facility shall be classified on the basis of their significance in terms of the operational safety of the facility, or the long-term safety of disposal. The required quality level of each classified object, and the inspections and testing necessary for verifying the quality, shall be adequate as regards the significance of the object in terms of safety.*

2 Scope of application

201. This Guide applies to safety class 1, 2 and 3 valves in nuclear facilities in all phases of their service life. The Guide's requirements apply to licensees as well as parties involved in the valve supply chain.

202. The system design requirements on which valve design is based are presented in the B series YVL Guides.

203. The requirements for the electrical and I&C equipment of valves are presented in Guide YVL E.7 "Electrical and I&C equipment of a nuclear facility".

204. Strength analyses are addressed in Guide YVL E.4 "Strength analyses of nuclear power plant pressure equipment".

205. The requirements for the processes and functions of the licensee's and suppliers' management system are presented in Guide YVL A.3 "Management system for a nuclear facility".

206. STUK approves inspection organisations to conduct inspections of nuclear facility valves in accordance with Guide YVL E.1 "Authorised inspection organisation and the licensee's in-house inspection organisation".

207. STUK approves inspection organisations to conduct tests of nuclear facility valves in accordance with Guide YVL E.12 "Testing organisations for mechanical components and structures of a nuclear facility".

3 Licensee's component requirement specification

301. The licensee shall have a component requirement specification for the nuclear facility's

valves, which contains the general design and quality control requirements for safety class 1, 2, 3 and EYT (specified non-nuclear) valves set by the licensee, as well as the regulatory requirements to be observed. In the context of procurement of individual valves, the design and quality control requirements shall based on the component requirement specification. In the valve construction plan, the requirements of the component requirement specification shall be supplemented by requirements specific to the service place.

302. The design requirements of the component requirement specification of valves shall specify:

- the design bases (normal operation, transients and accident conditions) such as design pressure, temperature and capacity, forces and moments, seismic loads, etc.
- mechanical engineering as well as electrical and I&C design criteria such as bonnet and stem sealing, actuator, leakage control, limit switches, etc.
- construction material and material certificate requirements;
- applicable standards, procedures and criteria based on which valves are designed and dimensioned
- inspectability and maintainability requirements
- all other structural and functional requirements set by the licensee for valves to be purchased to the nuclear facility.

303. The quality control requirements of the component requirement specification shall specify the following for valves:

- inspections and tests conducted on materials and valves during procurement, manufacturing, installation and commissioning;
- parties conducting control of inspections and testing
- reporting requirements for inspections and testing
- inspection and testing procedures
- reference standards for inspections and testing.

304. The component requirement specification shall make reference to the YVL Guides to be complied with and the requirements presented in separate STUK decisions relating to valve design, dimensioning or quality control.

305. The design or quality control requirements for built-to-order products, serially manufactured products and commercial-grade products shall be separately specified in the valve component requirement specification if the licensee sets requirements that differ from each other for them.

306. The licensee's component requirement specification, its reference documents and their updates shall be STUK-approved before their use as the basis for valve requirements.

307. When requirement specifications of plant contractor or component suppliers are applied, these shall not contradict the licensee's component requirement specification. These requirement specifications shall be STUK-approved before their use a the basis for valve requirements or before they are referred to in valve documents submitted to STUK or an authorised inspection body.

308. The licensee shall submit the STUK-approved component requirement specification for valves for information to the authorised inspection bodies it uses.

4 Manufacturer

401. The valve manufacturer shall have an appropriate certified or equivalent management system that has been independently evaluated by a third party. In addition, a manufacturer of safety class 1 and 2 valves shall fulfil the management system-related requirements of Guide YVL A.3.

402. The manufacturer shall have in their employ competent and experienced personnel, as well as the methods, facilities and equipment required for operation.

403. The manufacturer shall have documented procedures for the qualification of manufacturing methods and personnel, validity of qualifications, manufacturing, testing and handling of nonconformances.

404. If the manufacturer uses special processes on the valve's pressure retaining parts, the licensee shall apply for workplace-specific approval from STUK in accordance with Guide YVL E.3. These special processes include welding, heat treatment as well as hot and cold working.

405. The manufacturing procedures for special processes shall be qualified by procedure tests before manufacturing. As regards demanding components, STUK or an authorised inspection body can request for a review of the suitability of manufacturing procedures by works tests before manufacturing or production tests during manufacturing.

406. As regards the supply chains of parts important to valve operability, the manufacturer shall ensure that subcontractors know the requirements relating to their delivery, and to be ensured before assembly is that the components manufactured by the subcontractors fulfil these requirements.

5 Design

5.1 General

501. The requirement specifications for the nuclear facility's process systems shall specify all requirements of the service place (design bases), which are required as input data for valve design and dimensioning and which the valve shall fulfil in normal operation as well as during transients and accident conditions.

502. The valve's structural design and dimensioning shall be based on the standard ASME Boiler & Pressure Vessel Code (Section III, Division 1); for safety class 1 on subsection NB-3500 [6] and for safety class 2 on subsection NC-3500 [7]. Other standards are acceptable provided that it can be demonstrated that by design and dimensioning based on them an equivalent assurance of valve integrity and operability can be achieved.

503. The structural design and dimensioning of safety class 3 valves shall be based on a design standard generally applied by the valve manufacturing industry.

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

505. The same standard series shall apply in valve design and manufacturing. In case of a deviation from this rule, the licensee shall justify the acceptability of the deviation.

506. A technically justified assessment of the service life for the duration of which the valve will maintain reliable operability shall be specified.

507. The valve shall maintain its design basis integrity, leaktightness or performance even in the event of a limit switch failure

508. The operability of safety class 1 and 2 valves shall be monitored on-line when a valve's real time condition monitoring enhances the nuclear facility's safety in comparison to corresponding measurements conducted periodically.

509. Valve position data significant for the nuclear facility's safety shall be available in real time in the control room.

510. The design of the valve's electrical and I&C equipment shall fulfil the design requirements of Guide YVL E.7.

5.2 Structure

511. The valve's design solutions shall employ proven technology. Fulfilment of the valve's performance requirements shall be experimentally demonstrated if no other reliable evidence can be obtained on conformity.

512. If the valve contains commercial-grade parts, these shall be suitable, in terms of their characteristics and quality, for their intended use so as not to degrade valve operability.

513. The valve shall have such material thicknesses that loads exerted by the piping and actuator do not cause such deformations in moving parts and sealing surfaces during design basis events that could impair its operability.

514. The valve's structural materials, structure and operating environment shall enable monitoring, inspection and maintenance of its integrity and leaktightness and performance in the service place.

515. Thermal expansion of valve structures or flowing medium shall not impede valve operation. In a gate valve, for example, such phenomena would include thermal binding and pressure locking.

516. The valve stem shall be fitted with leakage control when a valve is inaccessible during operation and located in pipeline containing a radioactive substance. A stem bellows and secondary seal are recommended in case of a risk of an external leakage through the stem.

517. Valve bonnets shall be fitted with a sealing solution that reliably prevents external leakages.

518. In case of a double seal solutions in a safety class 1 valve, an alarm of a leakage through the first seal shall be relayed to the nuclear facility's control room.

519. Set values of a safety valve shall be sealable.

520. Valves and their pilot valves which perform safety functions and can be kept on stand-by and switched off, shall be equipped with a key-operated switch on/off mechanism and the licensee shall have administrative procedures in place to prevent erroneous switching.

5.3 Materials

521. Valve materials and hard-facings shall withstand stresses arising from design basis operating conditions. Material selection shall ensure that corrosion, erosion, radiation or other corresponding harmful phenomena do not endanger valve operability.

522. The materials of the valve's pressure-retaining parts essential for operation shall be standardised materials, which have, in use, proved suitable for the applications. However, approval shall be separately obtained for the materials in accordance with Guide YVL E.3 if the structural materials are not based on a material standard generally known in Finland.

523. 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 delivery condition of the materials, in accordance with the standard, is altered during valve fabrication by heat treatment, forming or welding, ensuring that the changed values are used in analyses associated with the valve's acceptability.

524. Austenitic cast steel shall not be used as the material for the casings of valves subject to in-service inspection in accordance with Guide YVL E.5, unless their inspectability can be reliably demonstrated.

525. Materials containing elements that could become activated shall be avoided in any such sealing and guiding surfaces or similar surfaces of valves coming into contact with primary circuit water from which material could peel off due to erosion-corrosion or some other phenomenon. The concentrations of elements that could become activated shall be sufficiently low for them to have no significant effect on the level of radiation at the nuclear facility.

6 Construction plan

601. The licensee shall submit a valve construction plan containing the following documents:

- licensee's summary of justifications
- preliminary suitability analysis for electrical and I&C equipment
- manufacturer report
- design bases
- design data
- calculations
- operating experience 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 valve's integrity or performance if the structure or material of the spare part changes.

The construction plan of a valve equipped with a non-electrically operated actuator (in which case a preliminary suitability analysis in accordance with Guide YVL E.7 is not submitted) shall include such data on the actuator's manufacturer and design, as well as the quality control of manufacturing, that enables the assessment of its acceptability based on the data submitted.

602. When the procured valve is built-to-order product and belongs to safety class 1 or 2, the licensee shall apply for approval for the construction plan before the commencement of valve manufacturing. Application for a separate approval of the dimensioning and inspection plan (material manufacturing) of a valve part is, however, recommended before material procurement begins if the prefabricated product, such as body casting or forging, to be ordered for the manufacture of this particular part fixes the valve's final dimensioning.

603. For a safety class 3 built-to-order valve or a serially manufactured valve without type approval, the licensee shall apply for approval of the construction plan no later than before the valve's construction inspection.

604. In case the construction plan must be updated later on, the licensee shall apply for approval for the revisions. Minor revisions can be submitted for information.

6.1 Summary of justifications

605. The construction plan shall include a summary of justifications in which the licensee presents the scope, results and approval criteria for their in-house inspection. With the construction plan data, the summary of justifications shall justify why:

- the manufacturer and its subcontractors have the readiness for a delivery
- the valve design bases correspond to the requirements posed by its service place and operating conditions
- calculations, operating experience and type tests demonstrate fulfilment of the design criteria
- manufacturing quality can be extensively verified by inspections and testing conducted on the structural materials, parts and valves.

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

607. The summary of justifications shall designate testing organisations conducting destructive or non-destructive testing of the valve's materials or parts during manufacture and draw up a status summary of the approvals. A status summary shall also be provided on manufacturer approvals when special processes are used in valve manufacture.

6.2 Preliminary suitability analysis of electrical and I&C equipment

608. The construction plan shall include a preliminary suitability analysis of the valve's electrical and I&C equipment in accordance with Guide YVL E.7.

6.3 Manufacturer report

609. The construction plan shall include a manufacturer report containing information on the manufacturer's organisation, operations, qualifications of the personnel and manufacturing methods, copies of valid certification decisions, 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 the information is unchanged.

610. A manufacturer report shall also be submitted on suppliers or alternative subcontractors manufacturing valve actuators and other valve parts significant for operability. A manufacturer report information shall also be submitted on the material manufacturers of pressure-retaining parts of the valve's body in safety classes 1 and 2.

6.4 Design bases

611. The construction plan shall present the valve design bases:

- highest allowable system pressure and temperature of the process system
- design basis service and operability requirements
- loads and stresses exerted on the valve
- process driving power and ambient conditions

- valve service life and number of operating cycles during service life
- other requirements placed on the valve by its service place

612. Valve operability requirements (integrity, leaktightness and operability) in design basis operating conditions and after them shall be specified.

613. Loadings shall be presented to the extent they are considered the valve design bases. They typically include

- forces and moments exerted by piping and supports
- mechanical and thermal load fluctuations
- obturator pressure difference
- impact loads (accelerations caused by pipe breaks and seismic events)
- actuator forces in case of switch-off failure
- ambient stresses (temperature, humidity, radiation)

6.5 Design data

614. The construction plan shall present valve design and other values and technical data to the extent they apply to the valve to be approved. Based on the data, it shall be possible to assess whether the valve is designed to fulfil the requirements set by its service place.

- service place code and safety class
- design pressure, design temperature and design capacity
- 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
- valve's allowable forces and moments in piping connections
- range of actuator torque and force (in an electric actuator with undervoltage and with overvoltage)
- opening and closure times
- flow factor (for a control valve, as a function of opening)
- fail safe position
- design data for and types of limit switches and position indicators.

615. In addition to the valve's main dimensions, the construction plans shall indicate dimensions used as input data for calculations, essential clearances and plays, part markings, part materials, hardfacings, surface treatment and welded joints.

6.6 Calculations

616. Calculations to be included in the construction plan shall demonstrate that the valve's operability requirements are fulfilled in design basis events. Nominal size and safety class-specific minimum requirements for the calculations, which shall be included in the construction plan, are provided in Appendix C.

617. The valve'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.

618. Acceptability of commercial-grade parts shall be justified in the construction plan. This shall be done by calculations, dimensioning sheets, applicable operating experience and other analyses confirming the conformity of the part.

619. As input data for the calculations, the most unfavourable combination of loads and conditions the valve could be exposed to shall be used. Such approval criteria shall be used for the results that the valve reliably maintains its operability in the design basis service.

620. Of the calculations, the standards applied, loads and material properties used as input data, calculation methods, visualised results, approval criteria and conclusions shall be presented.

621. 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 valve having an equivalent construction and design values if the valve's conformity can be equally demonstrated by this data. The manufacturing

quality of the valve submitted for approval shall also be equal to that of the reference valve, which is to be demonstrated in the construction plan.

6.7 Operating experience and type test data

622. The construction plan shall include such references and type test records that can be used to assess the capabilities of the manufacturer and the subcontractors as well as and the valve's suitability for its intended application.

623. Acceptable delivery references are valves whose design values, design bases and design solutions have been equivalent to the valve to be approved. Of these, the construction plan shall present at least the type markings, design values, materials, quantities, delivery years and purchasers of the valves and actuators. It is recommended that operating conditions and periods as well as other corresponding operating experience history are included in the data.

624. Acceptable type test records are those that present the results of tests conducted on a valve with equivalent design values, design bases and design solutions. By the results, it shall be possible to unambiguously verify the conformity of the design solutions of the valve to be approved.

625. In the absence of acceptable delivery references or type test reports, a valve's approval requires a type test, and the type test plan drawn up based on the test shall be attached to the construction plan. The type test plan shall unambiguously describe the test arrangements and conditions as well as specify the test criteria whose fulfilment provides reliable information on the valve's conformity.

6.8 Manufacturing procedures

626. When special processes are used in the manufacture of a safety class 1 or 2 built-to-order valve, the manufacturing procedures for the special processes and their qualification data shall be included in the construction plan. This requirement also applies to the hard-facing of sealing and guiding surfaces.

6.9 Inspection plan and procedures

627. A plan for inspections and testing during valve manufacturing shall be included in the construction plan.

628. The inspection plan shall present the inspections, tests and other control of valves, including:

- part markings and references to drawings
- construction material (standard marking and material certificate requirement)
- reference information for the instructions and standards to be observed in inspections/tests
- performers of inspections/tests
- records of inspections/tests (reporting requirements)
- hold points and witness points (STUK, authorised inspection body, licensee, third party, others)

629. Referred instructions shall define inspection and testing scope, approval criteria for the results, methods, equipment and tester qualification requirements.

630. The construction plan shall include instructions for at least the pressure tests of pressure-retaining parts, obturator strength and leak-tightness tests, and valve functional tests. In safety classes 1 and 2, the construction plan shall also include inspection procedures for the non-destructive testing of valve parts during manufacturing.

631. The inspection plan shall define the scope of valve disassembly after functional testing and the valve parts that will then be accessible for visual inspection. The scope of disassembly shall typically enable inspection of the condition of sealing and guiding surfaces as well as other parts significant for the valve's integrity and operability.

632. Factory tests shall primarily be conducted using valve's original parts – i.e. the assembly to be installed at the nuclear facility. If deviations are made from this rule, the test assembly shall be indicated in the inspection plan. In this case, it shall also be justified why the valve's conformity can be demonstrated by means other than the valve's original parts.

633. Functional tests shall be conducted in a test bench primarily using the valve's operating parameters (pressure, temperature, flow). If deviations are made from this requirement, the use of non-conforming test parameters shall be justified in the inspection plan or functional test procedures.

7 Type test

701. Conformity of the valve's design solutions shall have been experimentally verified by type tests. A type test is not required when earlier type test results or operating experience can be used to demonstrate the valve's conformity in a similar way.

702. The construction, dimensions and materials of a type-tested item shall correspond to those of the valve to be approved.

703. Type testing shall be implemented in conditions corresponding to design basis operating conditions using testing parameters by which the valve's conformity can be unambiguously demonstrated based on the test results. This requirement specifically concerns design solutions whose conformity cannot be reliably verified by analytical methods.

704. The type test of an actuator valve shall be conducted using the limit values of actuating force parameters, such as voltage and frequency, and their design basis durations.

705. Verification of the conformity of the valve's electrical and I&C equipment shall fulfil the requirements of Guide YVL E.7.

706. When a type test is conducted on a valve subject to approval the licensee shall apply for the approval of the type test plan before the type test is conducted and submit the type test result report for information before the valve's installation.

8 Manufacturing

801. The valve shall be manufactured and manufacturing quality controlled in accordance with an approved construction plan and the associated inspection plan.

802. The licensee shall, prior to the start of manufacturing, ensure that the manufacturer has the administrative and technical readiness for operations in conformance with requirements, as well as an approved construction plan and the decision pertaining to it.

803. The machines, equipment and facilities used in manufacturing shall facilitate achievement of a quality compliant with 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 so that they can be presented on request.

804. Those structural materials for which a batch-specific material certificate is required shall be identifiable and traceable from their batch-specific melting up until the finished structure. The minimum requirements for the material certificates of construction materials are provided in Appendix B.

805. The manufacturer shall identify the non-conformances detected in manufacturing, establish their causes, assess their importance and carry out corrective actions. The licensee shall apply for approval from STUK or an authorised inspection body for any non-conformances remaining in the valve that are significant in terms of operability. Requirements related to the management of non-conformances are provided in Guides YVL A.3 and YVL A.5.

806. For the manufacturing documentation, the manufacturer shall compile testing, inspection and oversight records that comply with the approved construction 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 manufacture, control of manufacturing, and testing shall be attached to the manufacturing documentation.

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 valve's commissioning at the nuclear facility.

9 Construction inspection

901. The licensee shall arrange for STUK or an authorised inspection body a construction inspection to demonstrate that the materials, manufacturing, construction and operation of the valves are as described in the construction plan. In the construction inspection, the manufacturing documentation is assessed, visual inspections are conducted and factory tests witnessed.

902. Every valve shall be subject to a construction inspection. The construction inspection scope of serially manufactured valves may be reduced on a case-by-case basis by the licensee's application so that a full construction inspection is conducted by STUK or an authorised inspection body only on some of the valves belonging to a delivery batch. When making a construction inspection, an inspector selects the valves to be inspected.

903. When making a construction inspection, an inspector of STUK or an authorised inspection body shall have access to an approved construction plan, possible modification documents and the related decisions of approval. Construction plan reference documents not included in the construction plan shall also be presented on request.

904. At the construction inspection, the inspectors shall be provided with adequate lighting, calibrated measuring instruments and auxiliary devices, as well as the necessary assisting personnel.

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
- the review status of the final suitability analysis of the electrical and I&C equipment in accordance with Guide YVL E.7

and arrange the inspection of structure in the scope specified by the inspection plan:

- structural inspection (visual inspections, dimension inspections, verification of part identification markings)
- witnessing of pressure, leaktightness and functional tests.

906. Factory tests shall be conducted in accordance with approved procedures. Factory tests belonging to the construction inspection can be conducted once a review of the result documentation and an inspection of structure have been conducted, and an inspector of STUK or an authorised inspection body has verified the readiness for testing.

907. In safety classes 1 and 2, all valves and, in safety class 3, at least one of a set of identical valves shall be visually inspected after factory tests. The scope of valve dismantling after factory tests to check the condition of valve parts shall be as approved in connection with the construction plan review.

908. If the valve or its parts essential for operability are repaired or modified, or wearing parts other than those that are disposable are replaced after factory tests, the valve's conformity shall be verified by repeating factory tests.

909. The final suitability analysis of electrical and I&C equipment shall have been reviewed as defined in Guide YVL E.7 before the completion of the valve's construction inspection.

910. When a spot check construction inspection of serially manufactured valves is only conducted on some of the identical valves in a delivery batch and if shortcomings essential for valve operability are then detected, a construction inspection shall be conducted on the entire delivery batch in question.

911. Construction inspection shall be acceptably conducted before the valve's transfer to its installation position.

10 Installation

1001. The licensee shall conduct an acceptance inspection on the valve before storage and installation. In the acceptance inspection, the valve shall be disassembled from its packaging and visually inspected.

1002. The licensee shall have a construction plan for the valve's installation. The installation construction plan shall present the following:

- procedures, drawings and part lists required in installation
- qualified welding procedures (if the valve is connected to piping by welding)
- inspection plan
- inspection procedures

The installation construction plan can be submitted as an individual document or as part of other documentation, such as the construction plan of the valve's manufacturing or piping.

1003. The valve's installation inspection plan shall contain the inspections conducted to reliably verify the conformity of the installation. Inspection procedures shall be in place, and their references shall be presented in the inspection plan.

1004. The licensee shall arrange an installation construction inspection to demonstrate that the valve installation and the quality control of the installation comply with the installation construction plan.

1005. The licensee shall present an approved installation construction plan at the construction inspection event. Construction plan reference documents not included in the construction plan shall also be presented on request.

1006. Before valve installation, the licensee shall apply for approval of the installation construction plan.

1007. The installation construction inspection shall be acceptably completed before the valve's commissioning inspection.

11 Commissioning

1101. The licensee shall arrange for STUK or an authorised inspection body a commissioning inspection, which in two phases demonstrates the valve'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.

1102. The first phase of the commissioning inspection verifies that

- the valve construction plan, construction inspection and installation construction inspection have been approved and that the earlier inspection shows no unresolved issues preventing the test run
- the licensee has verified the conformity of the electrical and I&C equipment installations by means of an inspection report
- the valve's test run plan has been approved
- the valve's operating and maintenance procedures are available for use
- the valve assembly and process interface comply with the plans
- the valve is inspectable and maintainable
- the position is acceptable as regards safety of use, and potential valve malfunctions do not pose a nuclear safety risk

1103. In the second phase of the commissioning inspection, the operability of a valve installed in its service place shall be demonstrated by a test run. At facilities under construction, this is typically done in connection with a system's commissioning tests, while at operating facilities separate test run arrangements are employed. For the test run, a test run plan shall be drawn up containing

- test run arrangements and measurements
- description and phases of the test run
- approval criteria for the results

The test run plan may be a separate document, or it can be included in a process system's commissioning plan.

1104. The second phase of the commissioning inspection verifies, by means of records and supervising the testing, that

- the licensee has confirmed the conformity of the commissioning of electrical and I&C equipment by means of an inspection report
- non-conformances preventing operation are not detected
- the scope of the test run complies with the test run plan, and the results are acceptable

1105. The first phase of the commissioning inspection shall be acceptably conducted before the commencement of the test run.

1106. Both phases of the commissioning inspection shall be acceptably conducted before a valve operating licence is granted. An operating licence can also be granted for a fixed period when it is not possible to complete all the test run phases specified in the plan at the same time, and the valve is operationally ready to enter the next test run phase.

12 Operation, condition monitoring and maintenance

1203. A valve's operating parameters as well as its load, process and ambient conditions, shall be monitored and maintained within the limits of design basis operating conditions. Unnecessary loads and unfavourable operating conditions shall be avoided.

1204. The valve shall reliably maintain its operability over the maintenance interval in all design basis service. Overhaul needs shall be reliably detected before failure.

1205. There shall be instructions in writing for valve operation, condition monitoring and maintenance. The instructions (operating procedures as well as maintenance, inspection and testing programmes, and related instructions) shall be based on manufacturer recommendations and operational experiences of the licensee or other nuclear facilities. Furthermore, the instructions shall be regularly assessed and the modification needs detected analysed.

1206. The valve condition monitoring instructions shall present the parameters, methods, inspection intervals and acceptance limits to be monitored. Depending on valve type, the monitoring shall cover the following:

- integrity of pressure-retaining parts
- leaktightness of obturator
- leaktightness of external seals (stem penetration, bonnet and other external seals)
- condition of seal, clearance and guiding surfaces
- condition of load path parts
- set pressures (safety valve opening and closure pressures)
- closure and opening time
- free movability of the obturator
- functioning of position indicators
- current consumed by electronic actuator.

1207. The valve'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.

1208. If special processes are used in valve maintenance, the operator shall have STUK's facility-specific approval in accordance with Guide YVL E.3.

1209. If a maintenance task is not part of the valve's maintenance programme, the maintenance task is considered a repair work for which the licensee shall draw up a repair plan. A repair plan is not required for repair work where parts are only replaced with approved spare parts and during which no special processes are used.

1210. The repair plans shall include all information needed to conduct the work and inspections. The information is required to assess the acceptability of the repair work and it typically includes manufacturing and inspection procedures, illustrative drawings as well as an inspection plan covering manufacturing, installation and commissioning.

1211. The licensee shall apply for approval of a valve repair plan before the commencement of repair work.

1212. The licensee shall arrange a construction inspection for repair work. The repair work construction inspection shall be acceptably completed before valve operation.

13 Modifications

1301. A valve modification shall not compromise the nuclear facility's safety or the prerequisites for the valve's condition monitoring or maintainability. The procurement of a spare part significant in terms of operability shall also be considered a modification if the structure or material of the spare part is changed.

1302. The licensee shall draw up a valve modification construction plan. To be presented in the modification construction plan are design data and design bases, dimensioning calculations, manufacturing procedures, an inspection plan and inspection procedures. The inspection plan and related instructions shall cover all phases of the modification from manufacturing to commissioning. In safety classes 1 and 2, the modification construction plan shall include an analysis of the modification's safety effects.

1303. Any needs to update drawings, procedures and other documents as a result of a valve modification shall be identified and the updates implemented without delay in conjunction with the modification. It shall be ensured that the potential effects of the modification on valve operation, condition monitoring and maintenance are communicated to the maintenance organisation.

1304. If special processes are used during a valve modification, the operator shall have facility-specific approval from STUK in accordance with Guide YVL E.3.

1305. The licensee shall apply for approval of the valve modification construction plan before the start of the modification work.

1306. The licensee shall arrange a modification construction inspection. The modification construction inspection shall be have been acceptably completed before the valve is operated.

14 Type approved valves

1401. A valve type-examination and declaration of conformity assessment by a third party are an alternative procedure to a design and construction inspection performed by STUK or an authorised inspection body. If the procedure is used, it shall unambiguously demonstrate that the valve's structure and operation correspond to the requirements specified.

1402. A valve's type approval requires a type-examination certificate by which a third party has confirmed the acceptability of the valve design and dimensioning against the valve design bases. In addition to this, a conformity certificate by which the third party, based on product verification and testing, has confirmed the conformity to type of the manufactured valves. The type-examination and verification of conformity shall be implemented applying modules B and F of Decision 768/2008/EC of the European Parliament and of the Council [8].

1403. A third party licensed to conduct valve type-examination and conformity to type assessments is a certification body in accordance with the standard SFS-EN ISO/IEC 17065 [9] that has been accredited to assess the conformity of applicable standards, or an inspection organisation in accordance with the Standard SFS-EN ISO/IEC 17020 [10] that has been accredited to conduct a corresponding task. An applicable qualification in accordance with the standard SFS-EN ISO/IEC 17025 [11] is required of a certification body or inspection organisation overseeing testing. A certification body or inspection organisation shall also be a notified body suitable for the a task.

1404. An accreditation decision issued by an organisation conducting type-examinations and conformity to type assessment shall be attached to an application for using a type approved valve in a nuclear facility. If the same organisation conducts several type approvals, the accreditation decision can be sent once only but the application shall refer to the previously sent documentation.

1405. A third party shall type-examine a valve as a combination of design type and production type

in compliance with module B. In this context, the third party shall have access to technical documents containing the valve's design values and data, dimensioning calculations, test reports and operating experience data. The third party shall be reserved the possibility of conducting inspections and testing in the scope they consider necessary to ensure the valve's product conformity in accordance with module F.

1406. The type-examination certificate or assessment report shall show all such data (technical specifications) verified by the type-examination which is required in assessing the valve's acceptability for use in its service place. Such data typically includes:

- design values for valve pressure, temperature and capacity, as well as obturator leaktightness and pressure difference
- allowable forces and moments exerted by piping and supports
- ambient conditions
- other design basis requirements
- assembly and sectional drawings
- construction and coating materials

1407. A third party shall make a conformity assessment based on product verification in accordance with module F in the following scope:

- in safety class 1, all valves are inspected
- in safety class 2, no less than 10% of a manufacturing batch of identical valves are inspected; at least one valve is inspected if the valves number less than ten
- in safety class 3, at least one in a batch of identical valves is inspected

Valves are selected for inspection at random from a manufacturing batch. In the minimum scope, the third party shall conduct the following with regard to the selected valves:

- inspect the material certificates of pressure-bearing and functionally significant components
- review the inspection records of non-destructive testing during manufacturing
- witness pressure, leaktightness and functional tests
- conduct visual inspections of valve parts

1408. A declaration of conformity granted on the basis of product verification and testing shall indicate

- delivery batch-specific valve identification and identification of individually inspected valves in a delivery batch
- inspection and testing scope of individually inspected valves in a delivery batch.

1409. The declaration of conformity shall make reference to the type-examination certificate and verify that the construction, dimensions and materials of the valves inspected are of the same valve type for which the type-examination certificate was granted.

1410. The licensee shall draw up an application for the use of the type approved valve at the nuclear facility. The application shall include

- a summary of justifications drawn up by the licensee
- a copy of the type-examination certificate granted by a third party
- a copy of the type-examination assessment report drawn up by a third party
- a copy of the conformity certificate granted by a third party
- valve installation and pre-operational testing plan

1411. The licensee shall in their summary of justifications

- present valve position(s) and the valve requirements resulting from the position(s)
- justify with the type-examination and conformity certificate data why the valve fulfils its integrity and operability requirements as specified for its service place
- justify why the valve manufacturer has the readiness for delivery

1412. The licensee shall apply for valve approval with the above documentation before valve installation at the latest.

1413. The operation of a valve approved by type-examination and conformity to type assessment is always position-specific and the valve shall not be installed in other positions without a specific approval.

1414. The licensee shall on request submit to STUK or an authorised inspection body for information documents relating to valve type-examination and/or conformity to type assessment, such as dimensioning calculations and test reports.

15 Regulatory oversight by the Radiation and Nuclear Safety Authority

15.1 General

1501. The oversight conducted by STUK or an authorised inspection body encompasses valve 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.

1502. STUK may grant inspection rights in accordance with Guide YVL E.1 to an authorised inspection body it has approved. Appendix A defines the principles for the division of inspection responsibilities between STUK and an authorised inspection body, which can be supplemented by separate decisions.

1503. STUK or an authorised inspection body will prepare a decision on their design review. Even approval decisions can contain requirements and deadlines for the responses to be submitted on them.

1504. The licensee shall by means of in-house inspections ensure in advance that the necessary prerequisites exist for the approval of the design.

1505. The licensee shall request STUK or an authorised inspection body to provide oversight (construction and commissioning inspections as well as other control/oversight procedures) approx. two weeks before the actual event. The manufacturer – (in case of plant deliveries) the plant supplier –, a third party and the licensee shall in advance by their own inspections ensure the existence of the necessary prerequisites for the requested inspections.

1506. STUK or an authorised inspection body draws up a record of their inspections itemising the inspection object and the inspections conducted. Potential requirements and deadlines are entered in the record.

1507. The inspection operations end and the record is closed once all the inspections specified have been completed and any possible requirements presented during the inspections have been resolved. An inspector signs the record and the licensee's representative acknowledges its receipt by his/her signature.

15.2 Component requirement specifications

1508. STUK assesses the acceptability of the licensee's valve-related component requirement specifications.

1509. STUK or an authorised inspection body oversees compliance with the requirement specifications for valves in connection with design and construction inspections.

15.3 Approval of the manufacturer

1510. STUK's approval is required for valve manufacturers and installation organisations using special processes in manufacturing or installation. The requirements as well as approval and oversight procedures are presented in Guide YVL E.3.

1511. STUK assesses the acceptability of manufacturers other than those using special processes based on the manufacturer information included in the construction plan.

15.4 Approval of a third party

1512. A notified body or a recognised third party in accordance with the Pressure Equipment Directive [12] as well as an authorised inspection body approved in accordance with STUK Guide YVL E.1 may, within their scope of accreditation, act as a third party that oversees and verifies sampling, destructive or non-destructive testing or qualifications without separate approval from STUK. If this third party is a STUK-approved authorised inspection body, it cannot act as an inspection organisation conducting public administrative tasks on the same structure or component.

1513. The expertise of a third party conducting control of manufacturing is assessed based on a report included in the construction plan.

15.5 Construction plan

1514. STUK or an authorised inspection body reviews the construction plan of the valve submitted by the licensee and issues a decision on it. Approved valve design bases at system level are the prerequisite for a construction plan review.

15.6 Control of manufacturing, and construction inspection

1515. STUK or an authorised inspection body can oversee valve manufacturing by means factory visits during manufacturing before the valve's final construction inspection.

1516. STUK or an authorised inspection body conducts a construction inspection, as specified in this Guide, on completed valves.

15.7 Type approved valves

1517. A notified body reviews the documents and conducts inspections in the scope specified in this Guide to establish conformity of design and dimensioning. If conformity can be verified, the body grants the valve a type-examination certificate.

1518. A notified body conducts product inspections and oversees testing in the scope specified in this Guide in order to establish the conformity of manufacturing. If conformity can be verified, the body grants the valve a conformity certificate.

1519. STUK or an authorised inspection body reviews the valve type approval documentation and issues a decision on the matter. The type approval documentation includes the documents specified in this Guide.

15.8 Type test witnessing

1520. If a type test is conducted on a valve subject to approval, STUK or an authorised inspection body reviews the type test plan and the type test result report. STUK or an authorised inspection body shall also be invited to witness type testing conducted in accordance with the plan.

15.9 Control of installation, and installation construction inspection

1521. STUK or an authorised inspection body reviews the installation construction plan submitted by the licensee, which shall contain the documents specified in this Guide.

1522. STUK or an authorised inspection body conducts an installation construction inspection, as specified in this Guide, on the valve.

15.10 Commissioning inspection

1523. STUK or an authorised inspection body conducts a two-phased commissioning inspection on the valve as specified in this Guide.

15.11 Operation, condition monitoring, and maintenance

1524. STUK oversees the operation, condition monitoring and maintenance of the nuclear facility's valves during inspections belonging to its periodic inspection programme (KTO). The oversight also covers instructions and plans relating to these inspections.

1525. STUK or an authorised inspection body reviews the valve repair plan submitted by the licensee and issues a decision on it.

1526. STUK or an authorised inspection body conducts a repair construction inspection in a scope based on the repair work inspection plan.

1527. STUK or an authorised inspection body reviews the inspection and testing records for valve maintenance work (maintenance, overhauls and repairs) as well as feedback. If valves are disassembled during maintenance work, STUK or an authorised inspection body visually inspects the parts before assembly.

15.12 Modifications

1528. STUK or an authorised inspection body reviews the construction plan for the valve modification submitted by the licensee and issues a decision on it.

1529. STUK or an authorised inspection body conducts a modification construction inspection in a scope based on the modification inspection plan.

Definitions

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.

Commercial-grade product

Commercial-grade product shall refer to a standard-quality product (seal, bearing, bolt etc.), for which the part manufacturer has defined design parameters, and the conformity to requirements of the design and manufacture of which can be established when necessary.

Modification

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

Serially manufactured valve

Serially manufactured valve shall refer to a valve that is manufactured in large batches. The structure, dimensions and materials of the valve, and the methods and quality of manufacture, do not essentially differ within or across manufacturing batches.

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 valve

Type approved valve shall refer to a valve, 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.

Safety valve discharge coefficient

Safety valve discharge coefficient shall refer to the ratio between the measured and theoretical flow capacity.

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.

Valve

Valve shall, in the context of Guide YVL E.8, refer to an entity (valve unit) consisting of the valve, its actuator and pilots, and any other structures and parts that are essentially involved in the entity. Whenever a specific part of a valve is discussed in Guide YVL E.8, it is mentioned separately.

Valve flow factor

Valve flow factor shall refer to a measured constant that can be used to calculate the volumetric flow of the valve when the pressure difference across the valve is known.

References

1. Nuclear Energy Act (990/1987).
2. Nuclear Energy Decree (161/1988).
3. Government Decree on the Safety of Nuclear Power Plants (717/2013).
4. Government Decree on the safety of disposal of nuclear waste (736/2008).
5. SFS-EN ISO 9001, Quality management systems. Requirements.
6. ASME Boiler & Pressure Vessel Code, Section III, Division 1, Subsection NB-3500 Valve Design.
7. ASME Boiler & Pressure Vessel Code, Section III, Division 1, Subsection NC-3500 Valve Design.
8. Decision of the European Parliament and of the Council No 768/2008/EC.
9. SFS-EN ISO/IEC 17065, Conformity assessment. Requirements for bodies certifying products, processes and services.
10. SFS-EN ISO/IEC 17020, Conformity assessment. Requirements for the operation of various types of bodies performing inspection.
11. SFS-EN ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories.
12. Pressure Equipment Directive 97/23/EY
13. SFS-EN 10204 Metallic products. Types of inspection documents.

APPENDIX A Valve control scope and division of inspection responsibilities

Approval or control IO=Authorised inspection body, TP=Third party	Safety class		
	1	2	3
Licensing			
Manufacturer (when special processes are used in manufacturing)	STUK	STUK	STUK
Manufacturer information (as part of the construction plan)	STUK	STUK/IO1)	IO
Component requirement specification	STUK	STUK	STUK
Design bases	STUK	STUK	STUK
Construction plan	STUK	STUK/IO [1)]	IO
Type test witnessing	STUK	STUK/IO [1)]	IO
Type approval documentation [2)]	STUK	STUK/IO [1)]	IO
Type approval design review [2)]	TP	TP	TP
Manufacturing			
Manufacturing control	STUK	STUK/IO [1)]	IO
Construction inspection	STUK	STUK/IO [1)]	IO
Product verification of type approval [2)]	TP	TP	TP
Installation and commissioning			
Installation construction plan	STUK	STUK/IO [1)]	IO
Installation construction inspection	STUK	STUK/IO [1)]	IO
Pre-operational testing plan	STUK	STUK	STUK
Commissioning inspection	STUK	STUK	IO
Maintenance, repairs and modifications			
Inspection of maintenance work	STUK	STUK/IO [1)]	IO
Plan for repairs and modifications	STUK	STUK/IO [1)]	IO
Inspection of repairs and modifications	STUK	STUK/IO [1)]	IO

1) STUK: blowdown and safety valves as well as nominal size DN>50 valves fitted with electrical, pneumatic or hydraulic actuators or medium-operated valves; IO: all other valves in safety class 2.

2) Type approved valves

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

APPENDIX B Material certificate requirements for valve construction materials and welding filler materials

Table B01. Material certificate requirements for valve construction materials (SFS EN 10204 [13])

Valve part	Safety class		
	1	2	3
Valve pressure-retaining main parts	3.2	3.2	3.1
Pressure-retaining bolts, obturator, stem	3.1	3.1	2.2
Other parts significant for valve integrity or operability	2.1	2.1	2.1

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

Weld	Safety class		
	1	2	3
Pressure-retaining valve welds	3.2	3.1	3.1
Welded claddings	3.1	2.2	2.2
Other welds significant for valve integrity or operability	2.2	2.2	2.2

A higher level material certificate is always acceptable.

APPENDIX C Construction plan calculations

Nominal size	**DN ≤ 50**			**DN > 50**		
Safety class	**1**	**2**	**3**	**1**	**2**	**3**
All valves						
Pressure dimensioning [1)]		X	X			X
Stress analysis for pressure-retaining main components [2)]	X			X	X	
Strength calculations for other parts [3)]	X	X		X	X	X
Dynamic analysis [4)]				X	X	
Actuator valves						
Actuator torque calculations [5)]	X	X	X	X	X	X
Obturator surface pressure calculations [6)]	X			X		
Safety and blowdown valves						
Flow capacity calculations [7)]	X	X		X	X	

1) In compliance with the applicable design standard, definition of minimum wall thickness based on the valve design pressure. The calculation of minimum wall thickness considers the effect of temperature as well as nozzle forces and moments.

2) Design standard-compliant stress analysis, or stress analysis based on detailed structural modelling. Fatigue analysis shall be presented for parts subjected to fatigue-inducing loads. If a stress analysis based on the design standard is not possible due to a non-conformant structure or if the valve is subject to loads the resulting stresses of which cannot be reliably analysed, a detailed stress analysis shall be conducted on the valve. The requirements for a detailed stress analysis are presented in Guide YVL E.4.

3) Strength calculations for valve pressure-retaining or other load-bearing parts (other than pressure-retaining main components), which can be based on the applicable design standard or a detailed stress analysis. Such typical parts include the obturator, stem and the pressure-retaining or load path parts of the actuator. A fatigue analysis is required for parts subjected to loading fluctuations.

4) Valve structural damping as well as the margin between natural frequencies and the excitations transferred by piping and supports shall be large enough for the valve to maintain its operability in design basis operating conditions. The fulfilment of this requirement shall be justified by a vibration analysis or an equivalent analysis.

5) Calculations for the maximum torque resulting from friction forces exerted by the valve obturator, stem seals and other parts vs. the minimum torque generated by the actuator. If the valve design bases include limit switch failure, strength analyses shall be presented demonstrating valve conformity even in the situation in question. The aforementioned calculations are required in safety class 3 only for valves intended for severe accident management.

6) Surface pressure calculations for the sealing surfaces of main valves and pilot valves.

7) Calculations to demonstrate the adequacy of flow capacity. A discharge coefficient determined for the valve type subject to approval shall be used in the calculations, and the calculations shall include the effect of piping pressure losses and other external factors on valve flow capacity.