

HOISTING AND TRANSFER FUNCTIONS AT NUCLEAR FACILITIES

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continues

As regards new nuclear facilities, this Guide is valid as of 1 March 2009 until further notice. At operating nuclear facilities and those under construction, the Guide will be enforced by a separate STUK decision. This Guide replaces Guide YVL 5.8, issued on 5 January 1987.

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Authorisation

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

Rules for application

The publication of a YVL Guide does not, as such, alter any previous decisions made by STUK. After having heard those concerned, STUK makes a separate decision on how a new or revised YVL Guide applies to the operating nuclear facilities or to those under construction, and to the licensees' operational activities. The Guides apply as such to new nuclear facilities.

When considering how new safety requirements laid down in YVL Guides apply to the operating nuclear facilities or to those under construction, STUK takes into account Section 7 a of the Nuclear Energy Act (990/1987), which prescribes that *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.*

In accordance with Section 7 r, paragraph three, 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 the procedure or solution by which the safety level set forth is achieved.*

1 Introduction

Safety control exerted by Radiation and Nuclear Safety Authority (STUK) includes controlling hoisting and transfer functions at nuclear facilities and nuclear safety-classified hoisting device units used for them insofar as they affect nuclear and radiation safety of the facilities. STUK's control does not replace the control of hoisting equipment required by other official regulations or safety requirements for hoisting equipment established in them. STUK does not inspect equipment belonging to class EYT (non-nuclear) but supervises the licensee's inspection operations and appropriateness of its administrative procedures. Guide YVL 2.1 describes the criteria for safety classification.

In handling nuclear fuel, special requirements are set for hoisting and transfer functions by the equipment at nuclear facilities. The purpose of these requirements is to prevent damage to the nuclear fuel and to ensure that the inspections are conducted correctly. Guide YVL 6.8 "Storage and handling of nuclear fuel" deals with safety requirements pertaining to the procedures to be followed in the storage and handling of nuclear fuel and the equipment to be used. Guide YVL 6.5 "Transport of nuclear material and nuclear waste" deals with safety requirements concerning the hoisting and handling of nuclear fuel and nuclear waste during transports outside nuclear facilities and the equipment used for them.

This Guide defines the requirements for hoisting and transfer functions and device units at nuclear facilities that STUK sets on the licensee and describes the procedures by means of which STUK supervises fulfilment of the set requirements. The Guide pertains to the hoisting device units of a nuclear facility belonging to safety class 3 within the following scope:

- design and dimensioning
- supervision of the manufacture, inspections and testing
- installation and commissioning
- maintenance, modifications and repairs.

Similar procedures for acquisition, operation and maintenance shall be established for the hoisting device units belonging to class EYT. The steel structures of hoisting and transfer device units

belonging to safety class 4 and to class EYT shall comply with the regulations and instructions issued in the Finnish building code (RakMK) published by the Ministry of the Environment [1].

Typical hoisting and transfer functions at nuclear facilities include

- hoisting and transfer linked with refuelling and fuel storage
- hoisting and transfer linked with reactor dismantling and assembly
- hoisting and transfer of process equipment in the reactor and fuel buildings
- hoisting and transfer of tools, service platforms and hatches, and lids in the reactor and fuel buildings.

Typical hoisting device units used for hoisting and transfer operations at nuclear facilities include

- refuelling and transfer machine
- other auxiliary hoisting and transfer devices and structures required for fuel handling
- main cranes of the reactor buildings and fuel storage buildings
- other safety-classified auxiliary hoisting and transfer devices and structures.

2 Definitions

The following abbreviations and definitions are used in this Guide:

hoisting device unit

a hoisting or transfer device, including components that are parts of its mechanical structure and rail, instrumentation and control and electrical systems needed for operation, and other related auxiliary systems (hydraulic, pneumatic, etc.)

hoisting/ transfer carrier

a part of the hoisting or transfer device to which the load to be moved is fixed either directly or through a hoisting/transfer accessory

hoisting/ transfer accessory

an auxiliary device or a structure used to assist in hoisting or transfer

system description

design documentation, which describes the functional requirements, design bases and design requirements for a hoisting device unit

for the purpose of detailed design of the hoisting device parts, subsystems and components. Corresponds to the system design documentation of the final safety analysis report.

conceptual design plan

modification design documentation of a hoisting device unit, corresponding in general to the preliminary safety analysis report

construction plan

design documentation of a hoisting device unit for pre-inspection

hold inspection

a notified inspection or test beyond which activities must not proceed without witnessing by STUK or an STUK-approved inspection organization

witness inspection

a notified inspection or test beyond which activities can proceed without witnessing by STUK or an STUK-approved inspection organization

strategic spare parts

replacement parts whose availability ensures operability of the hoisting device unit.

3 Designer, manufacturer and testing and inspection organizations

3.1 Designer

The designer of a nuclear hoisting device unit shall have

- skilled and experienced personnel
- design tools required for the design
- systematic procedures for assessing, selecting and supervising its subcontractors
- previous experience with the design of similar hoisting device units
- a management system that meets the requirements set in Guide YVL 1.4 “Management systems for nuclear facilities”

Guide YVL 2.0 “Systems design for nuclear power plants” defines requirements for the design organization and the design of nuclear facility systems.

3.2 Manufacturer

The manufacturer of a nuclear hoisting device unit shall have

- skilled and experienced personnel
- equipment and tools required for the manufacture and qualified manufacturing methods
- systematic procedures for assessing, selecting and supervising its subcontractors
- previous deliveries of similar hoisting device units
- a management system that meets the requirements set in Guide YVL 1.4 “Management systems for nuclear facilities”.

The licensee shall ensure that the following documentation is produced during the manufacturing process:

- the documents required in Section 5.3 “Construction plan” of this Guide
- records concerning the manufacture and inspections
- requirements and recommendations for the purpose of installation, commissioning, operation, condition monitoring during operation, preventive maintenance, in-service inspections, repair and ageing management of the hoisting device unit.

3.3 Testing and inspection organizations

The testing organization that performs the materials testing of a nuclear hoisting device unit and the inspection organization whose tasks relate to assessment and approval of the compliance of design and manufacture with the requirements, shall be approved by STUK in accordance with Guide YVL 1.3 “Mechanical components and structures of nuclear facilities. Approval of testing and inspection organizations”.

Guide YVL 5.2 and Guide YVL 5.5 define requirements for the testing, type testing, suitability and commissioning inspection of electrical systems and instrumentation and control systems and equipment.

Parts of the hoisting and transfer devices that perform functions included in safety class 3 shall have a type approval in accordance with an applicable standard granted by an accredited or a correspondingly qualified inspection organization.

4 General principles pertaining to hoisting and transfer functions and hoisting and transfer equipment

The design, dimensioning, manufacture, inspections and testing of hoisting device units shall be based on commonly applied equipment and nuclear technology standards, e.g. those given in the references [2–10].

The design of hoisting operations and hoisting device units shall be based on both deterministic and probabilistic methods. By means of analyses in accordance with Guides YVL 2.0, YVL 2.2, YVL 2.8, YVL 5.2 and YVL 5.5 it shall be demonstrated that criticality prevention, fuel cooling and radiation protection have been reliably secured and that the probability of fuel damage is extremely low.

Hoisting operations and hoisting device units shall be subjected to a heavy load drop risk analysis, whose results shall be taken into account in the design and location of nuclear facility buildings, structures and systems. The hoisting operations and hoisting routes shall be designed in such a way that

- the handling of heavy loads above the fuel is avoided
- the handling of heavy loads above the safety-related equipment is avoided
- integrity of the storage pools and the fuel is not jeopardized.

The probabilistic risk analysis of a nuclear power plant (YVL 2.8) shall include an overall assessment of the risks of events leading to fuel damage, including all fuel handling phases and the risks posed by a heavy load drop.

The hoisting device unit shall fulfil the functional requirements set for it and the integrity of its parts shall remain unchanged under the design conditions throughout the planned lifetime, which shall be demonstrated with the aid of calculations, tests and operating experience data.

The design of load-bearing structures shall be based on applicable standards in the cases where separate strength calculations are not required.

Materials of the hoisting device unit shall be suitable for the purpose. The material properties, including manufacturing tolerances, shall fulfil the requirements set by the design conditions and related phenomena. The materials and filler metals of load-bearing structures shall be approved and their material properties shall be verified in accordance with Guide YVL 4.2 “Steel structures for nuclear facilities”.

It shall be possible to carry out the functional tests and in-service inspections of the hoisting device unit throughout the planned lifetime.

Seismic qualification of the hoisting device unit shall be demonstrated in accordance with Guide YVL 2.6 “Seismic events and nuclear power plants”.

The safety functions shall be verified fulfilling the requirements set in Guide YVL 2.7 “Ensuring a nuclear power plant’s safety functions in provision for failures”.

The hoisting and transfer equipment whose damage may result in the possibility of significant radiation exposure at the nuclear facility or in the environment shall contain safety-enhancing structures, equipment and safety functions such that the reliability of the load-bearing components and safety functions in the hazardous lifts concerned can be considered equal to the single-failure tolerance.

The hoisting device units used for handling the nuclear fuel shall not lose their ability to carry their loads safely as a result of single failure. The hoisting device units and their hoisting accessories referred to in this context shall be fitted with the necessary protective devices and functions, such as:

- protective devices that stop the movement as the load is considerably lightened
- protective devices to interrupt a hoisting and transfer movement in the event of a power cut, when the supply voltage lowers so as to endanger operation, and in overload and over-speed situations
- protective devices that limit the movements to allowable areas

- mechanical travel stops of the hoisting, lowering and transfer movements
- speed limiters in the area of reduced hoisting, lowering and transfer speeds
- prevention of simultaneous horizontal and vertical movements
- limit switches to prevent the movement of the carriage and the bridge outside the specified limits
- stop of the movement as the hoisting rope loosens
- indication of the reliable fastening and the unfastening of the load
- display of the load weight
- an emergency stop device to enable all work movements to be stopped simultaneously
- instrumentation to determine the exact location of the fuel
- sufficient lighting and monitoring systems.

The grabs of hoisting equipment involved in transferring the nuclear fuel shall be designed such that loosening the grip is prevented by two means independent of each other and that the grabs remain in a safe position in the event of a power cut.

Hoisting equipment, hoisting accessories and their components that are in contact with pool waters shall be designed such that they are not easily contaminated and that they can be decontaminated.

It shall be possible to continuously monitor the temperature, internal pressure and radiation level of the nuclear fuel transfer casks or it shall be demonstrated that this is not necessary. In case of dropping a fuel transfer cask and a transport container, necessary shock absorbers shall be designed to prevent the cask and container from breaking.

Instructions shall be drawn up for operation of the nuclear fuel hoisting and transfer device units and handling systems and for their malfunction and accidents. These instructions shall define, for instance, the functions to which the fuel is subjected, and the preconditions, measures, responsibilities and records of these functions.

The conditions linked with safety of the nuclear fuel handling shall be included in the Operational Limits and Conditions.

5 Design requirements and documents

5.1 Description and conceptual design of hoisting device units in the preliminary safety analysis report

A description of the hoisting device units for the nuclear power plant being planned shall be included in the preliminary safety analysis report in the same way as the nuclear power plant systems are described.

With regard to an extensive modification to new hoisting device units or to an operating hoisting device unit at an operating nuclear facility, a conceptual design plan concerning the modification shall be drawn up.

The basic requirements for the contents of the preliminary safety analysis report and the conceptual design plan are given in Guide YVL 2.0. Special requirements for the design of the electrical and instrumentation and control systems are dealt with in Guides YVL 5.2 and YVL 5.5.

5.2 System description of the hoisting device unit

The licensee shall be provided with a nuclear facility-specific system description of the hoisting device unit, which defines the requirements of principle for detailed design of the hoisting device unit in the different fields of technology. In addition to the design basis and studies of the preliminary safety analysis report on the hoisting device unit in accordance with Guide YVL 2.0, the system description shall include the following:

- a preliminary failure modes and effects analysis (FMEA)
- a preliminary reliability analysis
- a preliminary heavy load drop risk analysis
- an inspection plan
- a description of the documentation structure
- requirements for the manufacture, installation, maintenance, testing and inspection
- definitions of the requirements and the qualification plans
- deviations from the preliminary safety analysis report

- an assessment of the occupational safety and health risks.

As regards the design basis and dimensioning, information to be provided includes the design conditions of the nuclear facility hoisting device units, the requirements for structural materials, structures and operation of the hoisting device unit, and the equipment and nuclear technology standards applied to the dimensioning.

The inspection plan shall define the inspections and tests that are carried out for materials, structures and operation of the hoisting device unit before the hoisting device unit is put into operation. Inspection instructions shall be drawn up for the most important inspections and tests, specifying their performance, scope and acceptance criteria.

The description of the documentation structure shall contain a list of the documents produced during the design process of the hoisting device unit and their interrelations.

Requirements pertaining to the manufacturer shall include the requirements for quality management, experience with nuclear facilities, expertise and supply references of the manufacturers of the hoisting device unit.

Definitions of the requirements and the qualification plans shall be presented for the electrical and instrumentation and control systems of the hoisting device unit belonging to safety class 3 (YVL 5.2 and YVL 5.5) and for other separate systems.

5.3 Construction plan for the hoisting device unit

The licensee shall define the structural safety, operation and related safety equipment of the hoisting device unit by means of a construction plan. The construction plan for the hoisting device unit shall include the following information:

- the manufacturer and the testing organization
- detailed design information
 - design basis
 - structural design
- materials and coatings
- drawings

- updated failure modes and effects analysis, reliability analysis and heavy load drop risk analysis
- a risk analysis
- an inspection plan
- a description of the manufacture
- reports on operation
- information on the design documents of the electrical and instrumentation and control systems and other separate systems included in the hoisting device unit.

The construction plan for repairs and modifications shall include the above information where applicable.

As far as steel structures are concerned, the construction plan for the hoisting device unit shall fulfil the requirements laid down in Guide YVL 4.2.

The licensee shall submit the construction plan it has approved in three copies to STUK in accordance with Guide YVL 1.2 “Documents pertaining to safety control of nuclear facilities” or to an STUK-approved inspection organization in the way the inspection organization requires.

5.3.1 Manufacturer and the testing organization

A description of the management system of the hoisting device manufacturer and evaluations of the management system shall be included in the construction plan.

If the manufacturer or the manufacturer’s important subcontractor is a manufacturer evaluated by STUK, the construction plan shall include references to STUK’s decisions of approval and the validity periods of these decisions. Otherwise at least the management system quality certificates and supply references pertaining to the manufacturer of safety-classified hoisting device units shall be presented. Guide YVL 1.4 deals with general requirements for the management system.

As regards testing organizations, a reference shall be made to STUK’s decisions of approval of the testing organization, including the validity periods. If a testing organization has been approved on the basis of accreditation, the reference shall be made in the documents supplied to STUK for information.

If necessary, STUK assesses the manufacturer's management system by means of inspection visits to the manufacturer's premises in accordance with the procedures described in Guide YVL 1.14.

5.3.2 Design information

Design basis

The design basis for the hoisting device unit shall be based on the requirements and standards referred to in the safety analysis report, safety analyses and system description. The requirements set by operation, technical properties, operating environment and external conditions of the hoisting and transfer device shall be determined in the design information. The requirements shall be consistent with the assumptions and results of accident analyses concerning hoisting and transfer performed in accordance with Guide YVL 2.2. The design shall fulfil the requirements set in the regulations and the harmonized standards based on them, related to the Machinery Directive 98/37/EY [11] (as of 29 December 2009, 2006/42/EC [12]; implementation in Finland: Government Decision 1314/1994 [13], Government Decision 1104/1999 [14] and Government Decree 765/2000 [15]). Deviations from the information given in the preliminary or final safety analysis report shall be assessed separately. The standards on which the design is based shall be identified and presented.

The nuclear fuel transfer device units shall be capable of transferring the fuel safely from one place to another under a water layer shielding from radiation. In dimensioning the safety-classified hoisting and transfer device unit, safety shall be improved by, for instance, classifying operation of the hoisting and transfer device unit in the way hazardous lifts require.

Analyses included in the construction plan shall demonstrate that the hoisting device unit meets the safety requirements established as the design basis. These analyses include:

- functional analysis of the hoisting device unit, FMEA, reliability analysis and heavy load drop risk analysis
- structural analyses that prove resistance of the various components under the anticipated load conditions

- analyses of the electrical and instrumentation and control systems that prove their suitability for the designed hoisting device unit, and fulfilment of the requirements pertaining to the safety functions.

General requirements for analyses regarding the safety of cranes and their control devices have been defined in the safety standards related to the Machinery Directive (e.g. SFS EN ISO 14121-1, SFS EN ISO 12100-1, SFS EN ISO 12100-2, SFS EN ISO 13849-1).

Structural design

The construction plan shall define in which way a decision on the proposed dimensioning has been taken on the basis of the load combinations and material properties. Structural analyses shall prove resistance of the various components under the anticipated load conditions. The studies shall be sufficiently detailed (references to standards) such that they make it possible to assess accuracy of the calculation method applied and fulfilment of the design requirements.

The structural design of hoisting and transfer equipment is based on classification of the crane as a whole (e.g. SFS-ISO 4301-1[8] and FEM 1.001 [7]). The loading frequency class and load ratio of the device and the operating time class and load ratio of the machinery shall be justified by analysis of the load spectrum.

If a potential fatigue mechanism of a component of the hoisting and transfer device cannot be excluded, the component shall be subjected to a fatigue analysis.

5.3.3 Materials and coatings

In selecting materials of the hoisting device unit, the operating and environmental conditions and the requirements and restrictions caused by the manufacture shall be taken into consideration.

The licensee shall explain how the requirements set for coatings of the hoisting equipment inside the containment are fulfilled. These include

- radiation tolerance
- decontaminability
- chemical resistance
- resistance under operating conditions

- resistance in accidents
- fire resistance properties.

The quality inspection programme shall describe the methods by means of which fulfilment of the requirements set for coating materials and surface finishing systems and work is verified.

The requirements laid down in Guide YVL 4.2 shall be met in designing, selecting and manufacturing the materials and coatings of hoisting device units.

5.3.4 Drawings

Assembly and details of the construction of the hoisting device unit shall be shown by drawings in such a way that dimensioning, manufacture and installation of the hoisting and transfer device and its components can be seen in sufficient detail. The drawings shall be explicit and clear.

The following issues shall be explained in the drawings:

- safety classes and their limits
- location and connection to other structures
- assembly, including lists of the components, materials and filler metals and placing of the control devices
- measures and forms with allowable tolerances
- locations and measures of welded joints and types of joint preparation, and references to welding procedure specifications shall be given in the welding drawings
- coatings and surface finishings
- hydraulic and pneumatic system schemes
- layout drawings, which show the operating ranges and movement restrictions of the hoisting device
- catwalks and service platforms
- reference to the quality inspection programme or to the instructions for inspections and testing.

5.3.5 Inspection plan

An inspection plan shall be drawn up for the inspections and tests to which the materials, structures and operation of the hoisting device unit are subjected. With a view to carrying out the inspections and tests, the inspection plan shall include references to the corresponding inspection instructions and/or standards. The inspection

plan shall also state the hold and witness inspections for the purpose of control by STUK or an STUK-approved inspection organization. Quality inspection of the materials, welded joints, coatings, installation and finished structures shall be described in respect of each component.

The inspection plan shall include a construction inspection in accordance with Guide YVL 1.15 as one phase.

The inspection plan can be divided into an inspection and testing plan and inspection and testing instructions, which describe in greater detail the methods, reporting and supervision.

If welding procedure tests or production weld tests are needed to qualify the manufacturing methods, a separate plan shall be presented for their inspection. Furthermore, a separate plan is needed if properties of the materials or welded joints are altered during the manufacture such that the information provided in the materials report is no longer valid.

As regards every inspection and test entered in the plan, the facts to be presented include the date of the inspection vs. the manufacturing phase, the inspection facilities, the inspector, the reporting and those responsible for the supervision.

Inspection instructions shall be given for inspection and supervisory measures that are linked with the manufacture, installation and functional tests of the hoisting and transfer device. The inspection instructions shall describe the inspection method, scope and requirements, and the reporting. In the details, references can be made to standards or to the valid safety regulations and instructions published by the authorities that supervise hoisting equipment. A test loading plan shall be presented and the inspections to be carried out during the test loading shall be defined.

The instructions shall include destructive testing of the materials, including requirements for material certificates and supervision, manufacturing methods, non-destructive testing, and the tests (e.g. tightness and functional tests) and inspections to which the finished products are subjected. The testing organizations that conduct non-destructive testing of the hoisting and transfer equipment shall be qualified in accordance with Guide YVL 1.3.

5.3.6 Description of the manufacture

The manufacture shall be based on manufacturing instructions approved in accordance with the management system. The manufacturing instructions and the people involved in the manufacture shall be qualified in accordance with the procedures described in the management system. With regard to welding, the welding procedure specifications qualified by welding procedure tests in accordance with standard SFS-EN ISO 15614-1 [16] or corresponding procedures can be considered acceptable as far as the most demanding welded joints are concerned. The welders shall be qualified in accordance with standard SFS-EN 287-1 [17] prior to the beginning of welding.

5.3.7 Instructions for and reports on operation

Before commissioning the hoisting and transfer device, the operating, maintenance and inspection instructions for the device shall be approved for use in accordance with the requirements set by the manufacturer's and the licensee's management systems. The instructions for safety-classified hoisting and transfer device units shall be available to STUK.

Hoisting and transferring heavy loads shall be avoided in places where a potential drop of the load would risk equipment or structures important for safety. Safe heavy load handling areas shall be defined and shown in the construction plan. Before commissioning the hoisting and transfer device unit, these areas shall also be marked at the facility. If necessary, operation of the hoisting and transfer device shall be prevented in areas assessed as dangerous.

5.3.8 Design documents of electrical and instrumentation and control systems and other separate systems

As part of the construction plan for the hoisting device unit, the licensee shall present the design documents and reports pertaining to the electrical and instrumentation and control systems and any other support systems. This documentation shall demonstrate that the support systems of the hoisting device unit function reliably and without being overloaded in all designed operating conditions and environmental conditions and that they fulfil the requirements defined in the system description of the hoisting device unit.

For the purpose of inspection of the electrical and instrumentation and control systems of the hoisting and transfer device units, the licensee shall present the definitions, designs and suitability assessments in accordance with Guides YVL 5.2 and YVL 5.5. They shall cover the couplings of systems and equipment and the functions related to power supply units, controls, shieldings and lockings. Section 4.6 of Guide YVL 5.5 defines special requirements for programmable systems.

The following safety analyses shall be presented for the electrical and instrumentation and control systems belonging to safety class 3 with a view to demonstrating fulfilment of the functional and performance requirements:

- failure mode and effect analysis
- common cause failure analysis
- operating experience analysis
- selectivity analysis
- safety assessment.

Suitability assessments shall be made of the equipment and cables of the electrical and instrumentation and control systems belonging to safety class 3 and of other separate systems belonging to safety class 3 to demonstrate, for instance, whether the requirements for functional and performance properties are fulfilled and whether the equipment and cables are resistant to ambient conditions and their reliability of operation is sufficient. The suitability assessment of electromechanical equipment can be replaced by the corresponding construction plan documents.

Instrumentation and control equipment performing safety functions included in safety class 3 shall have type approval in accordance with applicable standards. The suitability of the equipment for the system requirements shall be justified in the suitability assessment on the basis of type approval reports or corresponding information.

The type approval report shall include the observations made in the theoretical and experimental type tests of the device, an assessment of the device quality management, a justified decision on acceptability of the product and the conditions linked with validity of the approval.

The type approval of a device implemented

with programmable technology shall cover the assessment of both software and hardware.

Evaluating the quality management shall include inspecting the documents pertaining to the device manufacture and assessing the product manufacture. Those evaluating the quality management shall have the qualifications proved in practice to assess the quality management system and the fulfilment of the technical requirements set for the device used for the safety application. As part of evaluating the quality management, particular attention shall be focused on measures by means of which it is verified that the devices manufactured in series are equivalent to the inspected device.

The pre-inspection documents of other auxiliary systems (hydraulic, pneumatic) related to the hoisting device unit shall include, where applicable, corresponding reports in accordance with the requirements set in Guide YVL 2.0 and other applicable YVL Guides.

6 Manufacture

The licensee shall ensure that the manufacture of the hoisting and transfer device unit is controlled in accordance with the requirements set in Guide YVL 1.14.

The hoisting and transfer device unit shall be subjected to a construction inspection in accordance with Guide YVL 1.15 prior to the beginning of installation. Test loading can be performed as a part of the commissioning inspection. The construction inspection of steel structures to be welded in accordance with Guide YVL 4.2 shall be conducted before surface finishing.

7 Inspections and tests

7.1 General requirements

The licensee shall ensure that the materials, structures and operation of the hoisting device unit are subjected to the required inspections and tests and that STUK or an STUK-approved inspection organization has the opportunity to supervise the manufacture, inspections and tests within the scope it considers necessary.

The licensee shall arrange the construction inspection of the hoisting device unit and other hold and witness inspections defined in the ap-

proved inspection plan or otherwise required.

Guides YVL 3.0, YVL 3.1, YVL 3.3, YVL 5.2, YVL 5.3, YVL 5.4, YVL 5.5 and YVL 5.7 give requirements for factory tests, construction, acceptance and installation inspections, testing and functional tests of the hoisting device unit support systems and equipment.

7.2 Construction inspection

The hoisting and transfer device unit shall be subjected to a construction inspection in accordance with Guide YVL 1.15 prior to the beginning of installation. Test loading can be performed as a part of the commissioning inspection.

The purpose of the construction inspection of the hoisting and transfer device unit is to verify that

- the materials, manufacture, structures and operation conform to the approved construction plan
- the scope of the inspections and tests of materials and structures has kept to the inspection plan and the results are acceptable.

The construction inspection comprises visual inspection of the hoisting device unit, including component markings, supervision of the tests and inspection of the result documentation of the manufacture. The result documentation of the manufacture approved by the persons in charge and the approved construction plans, including reference material, shall be available during the construction inspection.

8 Installation

Before installation, the licensee shall carry out acceptance inspections to verify that the entire hoisting device unit has been delivered to the nuclear facility free of defects and conforming to the construction plan. Records shall be drawn up of the acceptance inspections.

The licensee shall draw up an installation plan for installation of the hoisting device unit. The plan shall contain the following information:

- installation instructions and drawings
- qualified welding instructions, if the installation involves welding
- inspection plan for the installation.

For the purpose of maintenance and operation, the hoisting and transfer device unit shall be fitted with safe catwalks and service platforms, which shall be submitted for approval as a part of the construction plan concerning installation of the hoisting and transfer device.

The inspection plan for installation shall propose, if necessary, the erection welding, alignment etc. inspections that enable acceptability of the mechanical installation of the hoisting device unit to be demonstrated.

The licensee shall arrange the installation inspections, whose purpose is to verify acceptability of the hoisting device unit installation and implementation of the installation inspection plan.

9 Commissioning

9.1 General requirements

The manufacturers' instructions shall be followed in commissioning the hoisting device unit.

The licensee shall ensure that the preconditions for beginning the inspection exist. The commissioning inspection can begin after

- the construction plan has been approved
- the installation plan has been approved
- the hoisting device unit, travel stops of its rails, auxiliary systems, auxiliary structures and rails have been installed in their final locations
- the hoisting device unit has been approved in the construction inspection and the installation inspections.

Additional requirements set in the inspections and all non-conformances discovered during them shall be dealt with in the manner approved by STUK and required by the licensee's management system.

The licensee shall commission the electrical and instrumentation and control systems and other support systems of the hoisting device unit in accordance with the applicable YVL Guides (e.g. YVL 3.7, YVL 5.2, YVL 5.3, YVL 5.5, YVL 5.7) prior to operation of the hoisting device unit.

The person responsible for operation of the hoisting device unit and the personnel needed for the functional tests shall be present at the commissioning inspection of the hoisting device

unit. A request for the commissioning inspection shall be made in writing early enough before the planned date of inspection. The commissioning inspection is divided into two phases: a test operating licence, which is a precondition for beginning the functional tests, is granted in the first phase (verification inspection). The functional tests are carried out in the second phase. Approved functional tests are a precondition for granting the operating licence.

9.2 Phase 1

In the verification inspection it is shown that the construction plan for manufacture and installation of the hoisting and transfer device installed in its place of operation has been approved and that the crane has been found to conform to the design in the construction inspections. Location of the hoisting and transfer device, travel stops of the rails and acceptability of the trails as well as safety of the catwalks and service platforms are inspected.

In commissioning phase 1 of the hoisting and transfer equipment, the licensee shall present an inspection document, which shall contain the following items:

- a list of the documents
- covering letters and flyleaves of the documents
- STUK's decisions and letters
- original construction inspection and installation inspection records
- written reports on how the non-conformances detected during inspections have been dealt with
- design data of the equipment
- assembly drawings
- a list of the accessories, including reference data
- the operating instructions.

In addition to the inspection document, the approved construction plan and a written report on fulfilment of the conditions laid down in a conditional decision shall be presented in the commissioning inspection. Furthermore, an in-service inspection programme and preliminary plans for supervision and maintenance of operability of the device shall be presented.

During the verification inspection the licensee

shall demonstrate that the functional inspections and tests linked with installation of the electrical and instrumentation and control systems have been conducted acceptably.

At a later date, the inspection document shall be supplemented with inspection records and result material concerning repairs, modifications and design significant for supervision of the device operation or with summaries of and references to this material. Information on the implemented maintenance measures of the hoisting and transfer device shall be recorded.

9.3 Phase 2

In phase 2, the licensee shall carry out functional tests of the hoisting device unit, whose aim is to demonstrate that the hoisting device unit meets the functional requirements set for it in its place of operation. As part of the functional tests, it is also possible to check that the requirements for certain technical values are met, e.g. quantities measurable after installation (electric quantities, safety clearances, etc.).

A functional test programme shall be drawn up for the hoisting or transfer device unit, which contains information on the functional testing and test loading. A precondition for beginning the tests is that STUK has approved the functional test programme.

Functioning in the different parts of the operating range and the limits of the operating range shall be tested under the most unfavourable loading conditions, if no other procedure has been justified in the functional test programme.

A record shall be kept of the functional tests, describing explicitly the functional test situation, the performed tests with their results, and acceptability of the results.

10 Operation, maintenance and modifications

The licensee shall operate and maintain the hoisting and transfer device units in such a way that they fulfil the requirements set for them throughout the planned lifetime. The instructions and plans concerning operation, condition monitoring and maintenance of the hoisting device units (preventive maintenance, in-service inspec-

tions and repairs) shall be available to the licensee. The instructions and plans shall be based on the manufacturers' requirements and recommendations and on official regulations. They shall be continuously maintained and improved with the aid of operating experience gathered.

Strength and operability of the hoisting and transfer equipment shall be inspected and tested at regular intervals. The in-service inspection programme shall take account of the requirements for in-service inspections established in the design basis. In phasing and defining the scope of in-service inspections, the requirements for operation and reliability, ageing monitoring and Government Decision 856/1998 [18] shall be taken into consideration.

The in-service inspection programme shall be submitted to STUK for approval in good time before commissioning of the hoisting and transfer device at a nuclear facility. The in-service inspection programme shall describe the following:

- points and scopes of inspection
- phasing of inspections
- regulations and standards to be applied
- competence requirements for the inspection personnel
- preparation of the point to be inspected for inspection
- inspection methods and equipment to be used
- calibration requirements for the inspection equipment
- acceptance criteria for the inspection results
- reporting on the inspections and filing of the documents.

Preventive maintenance work shall be scheduled such that the remaining lifetime of wearing parts is always longer than the design-basis uninterrupted operating cycle without maintenance. In purchasing spare parts and ensuring the availability of strategic spare parts, the approved construction plans shall be followed.

For the repairs and modifications the licensee shall draw up a conceptual design plan and the construction, installation and testing plans, and arrange the construction, installation and commissioning inspections. The plans and inspections shall correspond to the plans and inspections required of a new hoisting device, where applicable.

Table 1. Supervision of the hoisting device units at nuclear facilities and division of the inspection areas.

| Safety class | 3 | 4 |
|--|---------|---------|
| Design | | |
| Conceptual design | STUK | STUK |
| System description | STUK | STUK |
| Construction plan | STUK | STUK/IO |
| Manufacture | | |
| Construction inspection | STUK | IO |
| Installation | | |
| Installation plan | STUK/IO | IO |
| Installation inspection | STUK/IO | IO |
| Commissioning | | |
| Phase 1 and 2 | STUK | STUK |
| Functional test plan | STUK | STUK |
| Operation | | |
| In-service inspection programme | STUK/IO | IO |
| In-service inspections | STUK/IO | IO |
| Repair and modification plans, construction and installation inspections | STUK/IO | IO |
| Commissioning inspection of repairs and modifications | STUK | STUK/IO |

STUK = Radiation and Nuclear Safety Authority, IO = inspection organization

The licensee shall maintain a data system, where the documents pertaining to condition monitoring, maintenance and modifications are recorded. The licensee shall also ensure that these documents are available to STUK on request.

The spare parts specified in the construction plan for the hoisting device unit shall be available to the licensee for preventive maintenance and repairs.

11 Regulatory control by STUK

11.1 General

STUK supervises the safety-classified hoisting device units of a nuclear facility with the aid of the procedures established in this Guide.

STUK supervises appropriateness and implementation of the procedures pertaining to acquisition, operation and maintenance of the licensee's hoisting device units belonging to class EYT at a nuclear facility.

The licensee shall request STUK or an STUK-approved inspection organization to carry out or supervise inspections or tests in good time before the proposed date.

11.2 Design

The licensee shall have approved the designs for the hoisting device unit before submitting them to STUK or an STUK-approved inspection organization for approval.

STUK shall have approved the system description of the hoisting device unit before submitting the construction plan for the hoisting device unit to STUK for approval.

The design documentation of the construction plan for the hoisting device unit or a part of it and for the related auxiliary systems shall be approved by the licensee before it is submitted to STUK or this documentation shall be approved by an STUK-approved inspection organization before manufacture of the hoisting device unit or a part of it and of an auxiliary system begins.

In this context, the manufacture means the manufacturing stage of a prefabricated product or a part of the hoisting device unit that is closely connected with acceptability of the structural or functional design of the hoisting device.

11.3 Inspections and tests

STUK or an STUK-approved inspection organization carries out or supervises the inspections and tests of the hoisting device unit that have been specified in the approved inspection plan or otherwise required to be conducted.

STUK or an STUK-approved inspection organization shall have approved the construction inspections before installation of the hoisting device unit begins.

11.4 Manufacture and installation

STUK or an STUK-approved inspection organization shall have approved the installation plan for the hoisting device unit before the installation begins.

STUK or an STUK-approved inspection organization shall have approved the installation inspection before commissioning the hoisting device unit.

STUK supervises at its discretion manufacture of the electrical and instrumentation and control systems and equipment that are within the scope of pre-inspection by means of inspection visits. For the purpose of any inspections at the manufacturer's or supplier's premises, the testing schedules of the systems shall be submitted to STUK for information. A programme for the factory tests that STUK reports to supervise shall be submitted to STUK for information.

STUK supervises at its discretion installation of the electrical and instrumentation and control systems and equipment belonging to safety class 3. With a view to supervising the installation, the licensee shall submit, on request, to STUK for information the installation schedule for the electrical and instrumentation and control systems belonging to safety class 3 and being within the scope of pre-inspection before the installation begins.

11.5 Commissioning

STUK or an STUK-approved inspection organization conducts the commissioning inspection of the safety-classified hoisting device unit.

Before beginning functional tests, the verification inspection shall be conducted approv-

ingly; furthermore, STUK or an STUK-approved inspection organization shall have approved the functional test programme.

If a special test apparatus is used in functional tests of the hoisting device unit, STUK or an STUK-approved inspection organization shall have approved the test procedure.

11.6 Operation, maintenance and modifications

STUK or an STUK-approved inspection organization supervises adequacy of and compliance with the instructions and plans concerning operation and maintenance of the safety-classified hoisting device units.

STUK supervises in-service inspections of the hoisting device unit conducted in accordance with the in-service inspection programme approved by STUK or an STUK-approved inspection organization within the scope it considers necessary.

STUK or an STUK-approved inspection organization shall have approved the plans for structural, installation and functional tests related to modifications and repairs before starting the corresponding stage of a repair of or a modification to the hoisting device.

Construction inspections of a modification and a repair and a strategic spare part acquired for them shall be approved by STUK or an STUK-approved inspection organization before installation.

The installation inspection of a modification and a repair shall be approved by STUK or an STUK-approved inspection organization before installation.

The commissioning inspection of a modification and a repair shall be approved by STUK or an STUK-approved inspection organization before the hoisting device unit is put into operation.

12 References

1. The Finnish building code, RakMK.
2. SFS-EN ISO 12100-1 Safety of machinery. Basic concepts, general principles for design. Part 1: Basic terminology, methodology.
3. SFS-EN ISO 12100-2 Safety of machinery. Basic concepts, general principles for design. Part 2: Technical principles.
4. KTA 3902 (6/99) Design of Lifting Equipment in Nuclear Power Plants.
5. KTA 3903 (6/99) Inspection, Testing and Operation of Lifting Equipment in Nuclear Power Plants.
6. F.E.M 1.001 1998 Rules for design of hoisting appliances.
7. SFS-ISO Valid standards on cranes included in the list of standards.
8. IEC 62061, 2005-01, Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems.
9. IEC 61513, 2001-03, Nuclear power plants – Instrumentation and control for systems important to safety – General requirements for systems.
10. IEC 62138, 2004-01, Nuclear power plants – Instrumentation and control important for safety – Software aspects for computer-based systems performing category B or C functions.
11. The Machinery Directive 98/37/EY.
12. The revised Machinery Directive 2006/42/EC; valid as of 29 December 2009.
13. Government Decision on the Safety of Machinery 1314/1994.
14. Government Decision on an amendment to the Government Decision on the Safety of Machinery (1104/1999).
15. Government Decree on an amendment to Section 15 of the Government Decision on the Safety of Machinery (765/2000).
16. SFS-EN 288-3 Specification and qualification of welding procedures for metallic materials. Part 3: Procedure tests of arc welding of steels.
17. SFS-EN 287-1 Qualification test of welders. Fusion welding. Part 1: Steels.
18. Government Decision 856/98 on the purchase, safety, operation and inspection of machines and other tools used at work (under revision to become a decree).