Radiation and Nuclear Safety Authority

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Guide YVL E.11, Lifting and transfer equipment of a nuclear facility

1 Introduction

Lifting and transfer equipment are used at several different locations in a nuclear power plant. The majority of these are not relevant to nuclear safety (EYT) and represent conventional lifting equipment technology to which the Government Decree on machinery safety (400/2008) is applied. However, according to Guide YVL B.2 “Safety classification of systems, structures and components in nuclear facilities”, a limited number of devices shall be classified into safety class 3 either because they are used to handle nuclear fuel or because their usage poses a nuclear or radiation safety risk with regard to the falling, collision and tangling of the load. Safety-classified lifting and transfer equipment is available in nuclear power plants, spent fuel storages and the final disposal facility. Occupational safety relating to equipment in safety class 3 can be achieved by complying with the machinery safety decree and the Government Decree on the Safe Use and Inspection of Work Equipment (403/2008). Nuclear safety can be achieved by complying, in addition to the former, with the requirements of Guide YVL E.11 for the design, manufacture, installation, commissioning, use and decommissioning of lifting and transfer equipment of nuclear facilities. The Guide also describes the regulatory control procedures used by the Radiation and Nuclear Safety Authority to verify compliance with the set requirements.

2 Scope of application

This Guide presents the requirements for the design, manufacture, installation, commissioning and decommissioning of safety-classified lifting and transfer equipment and its related structures, such as lifting accessories. Besides nuclear power plants, the Guide applies to equipment related to the intermediate storage, processing and disposal of spent fuel.

Typical hoisting and transfer functions at nuclear facilities include the following:

- hoisting and transfer linked with refuelling, fuel storage, and final repository of fuel
- hoisting and transfer linked with reactor internals
- hoisting and transfer of process equipment in the reactor and fuel buildings
- hoisting and transfer of tools, service platforms and hatches as well as lids in the reactor and fuel buildings.

According to Guide YVL B.2, typical hoisting device units and hoisting accessories of nuclear facilities in safety class 3 include the following:

- the refuelling and transfer machine
- other hoisting and transfer equipment and hoisting accessories required for handling spent fuel
- main cranes of the reactor buildings and fuel storage buildings
- other hoisting and transfer equipment and hoisting accessories relevant to nuclear and radiation safety.

3 Justifications of the requirements

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

According to Section 63(1)(3) of the Nuclear Energy Act, the Radiation and Nuclear Safety Authority (STUK) is authorised to *require that nuclear fuel or the buildings and equipment 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 licence holder or licence applicant to arrange for STUK sufficient opportunity to control the manufacture of the fuel or such buildings or equipment.*

According to Section 63(1)(4) of the Nuclear Energy Act, STUK is also authorised to *receive necessary information and be provided with the plans and contracts and their grounds concerning the fabrication, quality control or processing of nuclear materials, nuclear waste, the nuclear facility and its structures and equipment as well as any material, device and equipment referred to in paragraph 5 of Section 2 subsection 1.*

To ensure nuclear radiation safety, Guide YVL E.11 defines special requirements and supervision forsuch systems that have been classified into safety class 3 in accordance with Guide YVL B.2. This can be done by means of design basis and manufacturing quality management. The starting point is that machines shall comply with the safety level determined by the decree on machinery safety (machinery safety), which is a good starting level in terms of nuclear and radiation safety. The design basis requires, as a rule, single-failure tolerance or its equivalent by means of dimensioning security margins and safety functions. EN hoisting equipment standards use the term “high-risk applications” for equipment requiring additional safety. To achieve additional safety, there are implementation methods in the standards *KTA 3902* and *ASME NOG-1*, prepared for nuclear use.

Special nuclear requirements comply with IAEA’s requirements and guides (see the following chapter) and STUK’s regulations STUK Y/1/2018 and STUK Y/4/2018.

According to the nuclear energy legislation, manufacturers of hoisting device units cannot be required to obtain separate authority approval. The licence holder shall be required to evaluate the manufacturer, and the manufacturer information shall be set out in the construction plan. The NDT organization used in manufacturing quality management shall be approved by STUK.

The requirements for the manufacturer and testing facilities as well as manufacturing are in line with Guide YLV E.3 “Pressure vessels and piping of a nuclear facility”.

The requirements for manufacturing and commissioning control are in line with what is set out in YVL Guides concerning pressure equipment, valves and pumps.

The requirements for in-service supervision are based on Section 63(1)(1) of the Nuclear Energy Act, giving right to inspect and control operations referred to in paragraphs 1–6 of section 2 subsection 1, and in paragraph 2 of section 2 subsection

2, and for this purpose have access to any place where such an operation is being carried out, as well as to carry out measurements required for supervision, to take and to receive samples and to install equipment necessary for such supervision. STUK's regulatory activities focus on KTO inspections and continuous assessment, wherein the extent to which the licence holder meets the obligations of the Government Decree 403/2008 is monitored.

4 International provisions concerning the scope of the Guide

"IAEA Specific Safety Requirements SSR-2/1, Safety of Nuclear Power Plants: Design" includes the safety requirements for the design of nuclear power plants. Guide YVL E.11 follows the principles of requirement 76 "Overhead lifting equipment" and requirement 80 "Fuel handling and storage systems" as well as general principles.

"IAEA SAFETY GUIDE NS-G-1.4, Design of Fuel Handling and Storage Systems for Nuclear Power Plants" includes instructions on the processing of fresh and spent fuel. The requirements of Guide YVL E.11 have similar aspects as the IAEA guide concerning fuel lifting and transfers. For example, Section 6.5 of the IAEA guide corresponds almost word-for-word with the requirements of Guide YVL E.11.

"WENRA Reactor Safety Reference Levels, January 2008" includes generic principles, of which none directly refer to hoisting operations or fuel processing. "Appendix E, Issue: Design Basis Envelope for Existing Reactors, Reference Level 5. Set of design basis events" Section 5.1 contains a reference to some of the many initiators of internal hazards: load drop due to a hoisting equipment failure and a fuel processing accident. Guide YVL E.11 follows generic principles in terms of, for example, design basis, PRA, ageing management and modification work.

Standards and guides applicable to nuclear power plant hoisting equipment include the German "KTA 3902, Design of Lifting Equipment in Nuclear Power Plants" and "KTA 3903, Inspection, Testing and Operation of Lifting Equipment in Nuclear Power Plants" and the American "NUREG-0554 Single-failure-proof Cranes for Nuclear Power Plants", "NUREG-0612 Control of Heavy Loads at Nuclear Power Plants, Resolution of Generic Technical Activity A36" and "ASME NOG-1-2010 Rules for Construction of Overhead and Gantry Cranes". The NUREG guide sets out principles that help achieve nuclear safety with hoisting equipment. The guides have proven to be insufficient and partly ambiguous, which is why ASME has prepared the standard *NOG-1* to deliver detailed technical implementations and bases for design and dimensioning, which are included in the KTA standards. KTA 3902, KTA 3903 and ASME NOG-1 are suitable for specifying the requirements of Guide YVL E.11.

5 Impacts of the Tepco Fukushima Dai-ichi accident

The Fukushima accident has not directly impacted Guide YVL E.11. The Guide already contains a requirement for analysing seismic incidents.

6 Needs for changes taken into account in the update

The needs for changes due to changes made to international and national laws/regulations and the change proposals made in connection with the preparation

of the YVL Guide implementation decisions (SYLVI) together with others recorded in STUK's change proposal database have been considered when updating the requirements. In addition, the possibilities to reduce the so-called administrative burden have been considered.

A separate decision has already been made for the operating plants of Loviisa and Olkiluoto as regards two requirements (710 and 732), but these changes have now been added to the Guide. Requirement 710 for transferring material markings originates from the supervision of pressure equipment and, in practice, is too demanding for machine industry. Requirement 709 is sufficient; therefore, requirement 710 has been removed. Requirement 732 has been specified so that it applies exactly to its intended purpose: NDT inspections of welded structures. The original wording of the requirement suggested that destructive testing of materials implemented in the internal quality assurance of steel rope (hoisting rope) manufacturers would have required the approval of the operator in accordance with Guide YVL E.12.

As a significant change, chapter 6.2.9 (Type approval of serially manufactured mechanical components) has been rewritten because the previous content contradicted the Government Decree on machinery safety 400/2008. The new requirements set the base level for the approval procedure of serially manufactured components. The requirements can be met, for example, in accordance with standard KTA 3903 or with a type approval if it is available to the component.

Requirements for risk assessment have been reworded so that the new content highlights the assessment of overall safety, meaning machine and nuclear safety risks without limiting the latter to load drops, collision and tangling (for example, the risk posed by foreign material is real).

In terms of electrical and I&C technology, there are references to Guides YVL B.1 and E.7; this Guide shall not set technical requirements and document processing requirements.

Otherwise, the changes made specify the content.

The administrative burden has been reduced by updating the control or supply method of certain documents. General specifications for equipment requirements are monitored in the framework of inspection programmes; project/delivery-specific requirement definitions and document structure are only needed for information. Annual reporting of the remaining safe service life has been reduced: it will be implemented in connection with thorough periodic inspections (every 10 years, on average) based on the observations made in relation to the prepared service life analyses.