STUK

GUIDE **YVL 3.7** / 26 SEPTEMBER 2008

PRESSURE EQUIPMENT OF NUCLEAR FACILITIES

Commissioning inspection

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 3.7, issued on 12 December 1991.

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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 General

The safety of pressure equipment is part of the safety of nuclear facilities. The control and inspection of pressure equipment ensure that the pressure equipment belonging to all safety classes and to class EYT (non-nuclear) fulfil the requirements set for it. Equipment-specific YVL Guides determine the types of equipment that are subject to a separate commissioning inspection carried out by the Radiation and Nuclear Safety Authority (STUK).

Guide YVL 2.5 defines the requirements for commissioning the process systems of a nuclear power plant. Licences granted for individual pieces of equipment are a precondition for commissioning the systems.

This Guide has been drawn up for the commissioning inspections of pressure equipment to be registered in particular. Similar procedures are applied to all mechanical equipment in accordance with the requirements set in equipment-specific YVL Guides.

Pressure equipment is subject to a commissioning inspection in accordance with this Guide prior to the commissioning of a nuclear facility. As regards repairs and modifications during operation, the requirements concerning commissioning inspections are applicable to inspections carried out in accordance with Guide YVL 1.8. If the repairs and modifications are very extensive and include, e.g., the construction and installation of new pressure equipment or other large units, the commissioning inspections shall be conducted in accordance with this Guide.

The requirements for safety classification are defined in Guide YVL 2.1. In accordance with that guide, nuclear pressure equipment refers to pressure equipment classified into safety class 1, 2, 3 or 4 and ordinary pressure equipment refers to pressure equipment classified into class EYT. Pressure equipment subject to registration is pressure equipment referred to in Section 3 of the Decision of the Ministry of Trade and Industry on the safety of pressure equipment (953/1999). Detailed definitions are given in Guide YVL 3.0.

Guide YVL 3.0 deals with the general principles concerning the control of pressure equipment of nuclear facilities and the inspection area division between STUK, an inspection organization approved by STUK and the licensee.

2 Contents of the commissioning inspection

In the commissioning inspection it is verified that the installed pressure equipment and its accessories and their performance comply with the approved designs, and that adequate inspections and tests have been carried out to ascertain this. It is further verified that any defects and shortcomings discovered during tests and inspections have been corrected. The pressure equipment may be brought into operation only after it has been approved in a commissioning inspection and the allowable operating parameters have been confirmed for it. After a repair or a modification, an operating licence may be granted for pressure equipment by a repair and modification protocol once the repair or modification has been subjected to a construction inspection.

With a view to facilitating the operating licence procedure of a nuclear facility, commissioning inspections are carried out for as large wholes as possible, such as all the piping of a system. Pressure vessels, heat exchangers and pump units are always inspected separately, however.

The commissioning inspection is conducted in two phases:

1. In the first phase, the pressure equipment is granted a test operating licence, which is a precondition for starting performance tests of the accessories of the pressure equipment. The inspection is carried out for pressure equipment installed in its place.
2. The second phase consists of conducting the performance tests. Approved performance tests are a precondition for granting an operating licence.

An operating licence for pressure equipment can also be granted for a fixed period. If necessary, the licensee shall ask STUK for registration of the pressure equipment as part of the commissioning inspection.

3 First phase of the commissioning inspection

3.1 Preconditions

The licensee shall ensure that the preconditions for starting the inspection exist.

The inspection can be started if the nuclear pressure equipment has been approved in the following inspections:

- inspection of the construction plan
- construction inspection of the pressure equipment
- inspection of the location plan
- inspection of the installation plan
- construction inspection of the installation

or the essential safety requirements set for non-nuclear pressure equipment have been found to be fulfilled and the pressure equipment has been approved in

- the inspection of the location plan
- the inspection of the installation plan
- in the construction inspection of the installation.

Additional requirements laid down in previous inspections and all non-conformances discovered shall be dealt with in the manner approved by STUK and required by the licensee's quality management system. The structure of the pressure equipment shall be safe, and it shall include reliable accessories required to ensure safety.

The inspection is aimed at assessing whether the performance tests can be performed safely. The licensee shall verify the equipment's compliance with the requirements and its readiness for operation before the commissioning inspection.

The location of the pressure equipment shall meet the requirements laid down in Section 6 of the Decision of the Ministry of Trade and Industry (953/1999).

Attention shall be drawn to accessibility to the pressure equipment as early as when drawing up the location plan to enable maintenance and in-service inspections of the equipment, since any changes in the location may be difficult to implement later.

3.2 Inspection of the pressure equipment dossier

The pressure equipment dossier means a set of documents referred to in Section 5 of the Decision of the Ministry of Trade and Industry (953/1999). In the dossier the licensee shall gather essential documents concerning the pressure vessel and the heat exchanger. These include, e.g., decisions of approval, inspection records, list of accessories, and operating instructions supplied by the manufacturer.

The pressure equipment dossier shall be submitted to the commissioning inspector in the first phase of the commissioning inspection.

During inspection of the pressure equipment dossier it is verified that the pressure equipment and its location and accessories have been approved in the previous inspection phases and that the related documents have been appropriately drawn up and arranged for final storage and the operation of the pressure equipment.

The pressure equipment dossier shall be stored and kept up to date as long as the pressure equipment is in operation.

3.3 Inspection of the location

STUK examines the location plans for the pressure equipment belonging to safety classes 1 to 4 and its accessories as part of the review of the preliminary safety analysis report and the design documentation of the process system. In accordance with Guide YVL 3.0, STUK may delegate the review of location plans for the pressure equipment belonging to safety classes 3 and 4 and to class EYT to an inspection organization approved in accordance with Guide YVL 1.3. An exception to this is the pressure equipment referred to in Section 6 of the Decision of the Ministry of Trade and Industry on pressure equipment (938/1999), whose location plan and location are reviewed by the licensee.

The location plans shall be so detailed that fulfilment of the requirements stated below can be assessed as early as when reviewing the plans.

In the first phase of the commissioning inspection it is verified that the pressure equip-

ment and its accessories have been located and that the surrounding rooms and structures have been built in accordance with the approved plans, such that

- any pressure discharges in the event of failures or operational transients do not cause damage to people, property or the environment
- the pressure equipment and its all accessories can be properly operated, maintained, repaired, tested and inspected, and that special attention has been paid to accessibility during in-service inspections carried out in accordance with Guide YVL 3.0 and Guide YVL 3.8, and
- the requirements for radiation safety laid down in Guide YVL 7.18 are fulfilled.

3.4 Inspection of the accessories

The pressure equipment shall be fitted with reliable accessories that are required for operation and operational safety; it shall be marked in the system's flow sheet and the list of accessories. During pre-examination of the systems, STUK considers the flow sheet also in terms of the pressure equipment safety. To this end, it is verified that both design and operating pressures and operating temperatures have been correctly chosen and that the pressure equipment has been fitted with the following accessories required to ensure safety:

- safety accessories
- shut-off and drainage valves
- pressure and temperature measuring instruments
- pressure and temperature control and relief devices, and
- liquid level control and measuring instruments.

In the first phase of the commissioning inspection it is verified that the pressure equipment and its accessories have been installed in accordance with a flow sheet and the installation plan approved by STUK. The accessories shall bear individual identification markings on the basis of which it is possible, if necessary, to trace the materials and the manufacturer and to verify the allowable operating parameters.

A list of the accessories of the pressure equipment to be drawn up shall include the following information:

- component identification markings
- designations
- exhaust capacities and set pressures of the safety accessories
- type markings
- serial numbers
- nominal sizes
- nominal pressures
- nominal temperatures
- materials of the pressure retaining parts
- the necessary references to standards, and
- the manufacturers.

The list shall be approved by the licensee.

Accessories and electrical power and instrumentation systems and components are discussed in more detail in Guides

- YVL 5.2 Electrical power systems and components at nuclear facilities
- YVL 5.3 Nuclear facility valve units
- YVL 5.5 Instrumentation systems and components at nuclear facilities
- YVL 5.7 Nuclear facility pump units.

4 Second phase of the commissioning inspection (performance tests of the accessories)

4.1 General requirements

An approved first phase of the commissioning inspection is the prerequisite for granting a licence for a test run of pressure equipment or a set of pressure equipment. As part of the start-up testing of a nuclear facility, performance tests shall be conducted on all safety-related accessories of the installed pressure equipment. The purpose of these tests is to prove that

- the safety accessories function reliably and have an adequate exhaust capacity
- the pressure and temperature measuring instruments and control and relief devices, and the liquid level control and measuring instruments function correctly

- the valves and pumps function according to design
- the limit positions of actuators of the shut-off valves have been correctly set
- the thermal expansion joints and supports of the piping perform as designed
- other equipment affecting the safety of pressure equipment is in working condition, and
- the pressure equipment is leakproof.

The results of the performance tests shall be recorded in such a way that they can be used as basic values when carrying out periodic performance tests during operation.

The valves and other controllers that shall be locked in the open or closed position during operation and that affect the safety of pressure equipment shall be listed.

4.2 Safety accessories

By means of the performance tests of safety accessories it shall be demonstrated that all safety valves and other safety accessories function reliably under operating conditions and that their exhaust capacity is adequate. The supervision and result records of the tests shall be submitted to the commissioning inspector. Performance testing of the safety valves is dealt with in Guide YVL 5.3.

The type testing certificate, type plate contents and installation of the bursting disk shall be inspected.

Once the performance test has been performed, the safety valve shall be sealed such that it is impossible to alter the opening pressure and time, the closing pressure and the exhaust capacity without breaking the seal.

If the performance of a safety valve is tested in a test stand, the safety valve can be given final approval in the commissioning inspection only after the valve has been installed in its place.

4.3 Valves

Notwithstanding their safety classification, all safety-related valves of the pressure equipment, such as shut-off valves, shall undergo performance tests in accordance with a test programme approved in advance. The commissioning inspector reviews the documents of testing results, which shall have been approved by the licensee. Performance testing of the valves is described in Guide YVL 5.3.

4.4 Pumps

The performance tests of pumps shall be carried out during the testing of the system concerned. Performance testing of the pumps is dealt with in Guide YVL 5.7.

4.5 Measuring instruments and control devices

As part of the testing, it shall be verified that the pressure, temperature and liquid level measuring instruments and control and relief devices, which are required to ensure the pressure equipment operational safety, are in working condition. The commissioning inspector reviews all documents of testing results of the measuring instruments and control devices, which shall have been approved by the licensee. The measuring instruments and control devices belonging to safety classes 1, 2, 3 and 4 shall fulfil the performance requirements defined in Guides YVL 5.2 and YVL 5.5.

4.6 Pipe supports, thermal expansion and vibrations

As part of the testing, it shall be verified that the piping supports perform as designed. Elasticity of the piping shall be checked, and the functioning of thermal expansion and supports of the piping as well as vibrations of the piping shall be measured in accordance with the requirements set in Guide YVL 3.3.

Guide YVL 3.3 deals with requirements pertaining to the commissioning inspection of the piping. In certain cases, inspections of the piping performance shall be continued even after the start-up of a nuclear facility in order to verify the performance with normal operating parameters of the piping.

5 Registration and markings of the pressure equipment

Pressure equipment is registered in a commissioning inspection in accordance with the Decision of the Ministry of Trade and Industry

on the safety of pressure equipment (953/1999). Nuclear pressure equipment and pressure equipment belonging to class EYT to be registered in accordance with Section 3 of the Decision of the Ministry of Trade and Industry (953/1999) shall not be brought into operation before STUK's inspector has approved it in the commissioning inspection.

As part of the registration, it is verified that the following information is marked on the registration plate of the pressure equipment: equipment location code, serial number, the highest and lowest allowable operating temperature, the highest and lowest allowable operating pressure, and the date and pressure of performance of the pressure test and the inspector's identity code.

The date and type of the next in-service inspection of the pressure equipment shall be fixed during the commissioning inspection of registered pressure equipment.

6 Obligations imposed on the licensee and the manufacturer

The licensee shall appoint a person responsible for operation of the pressure equipment.

The licensee shall store the pressure equipment dossier and keep it up to date as long as the pressure equipment is in operation.

If the pressure equipment is not a type of pressure equipment to be registered and yet it shall fulfil essential requirements set in Sections 4 and 5 of the Decision of the Ministry of Trade and Industry on pressure equipment (938/1999), the licensee is obliged, in accordance with its own quality management system, to ensure that the equipment is in working condition and the necessary in-service inspections are carried out irrespective of whether the equipment is nuclear or non-nuclear pressure equipment. The licensee is responsible for on-site condition monitoring of non-nuclear pressure equipment that complies with good European engineering practice, referred to in Section 6 of the Decision of the Ministry of Trade and Industry on pressure equipment (938/1999), following the manufacturer's operating and maintenance instructions and the procedures established in the licensee's own quality management system.

The manufacturer or importer of pressure equipment shall submit the operating and maintenance instructions of the pressure equipment to the licensee.

7 Regulatory control by STUK

All sets of pressure equipment of a nuclear power plant are subjected to commissioning inspections. STUK conducts inspections of the pressure equipment belonging to safety classes 1, 2 and 3 and of the selected pressure equipment belonging to safety class 4 and to class EYT to be registered in accordance with Section 3 of the Decision of the Ministry of Trade and Industry on the safety of pressure equipment (953/1999). As regards the rest of pressure equipment belonging to safety class 4 and to class EYT, their commissioning inspections are conducted by an inspection organization approved by STUK. Furthermore, the licensee carries out commissioning inspections of the pressure equipment referred to in Section 6 of the Decision of the Ministry of Trade and Industry on pressure equipment (938/1999).

STUK grants rights to supervise the testing of safety valves applying the same criteria as when granting rights to conduct construction inspections.

STUK or an inspection organization approved by STUK conducts the in-service inspections of registered pressure equipment. The general principles pertaining to the inspection area division are described in Guide YVL 3.0.

STUK controls the functioning of the inspection area division made in accordance with Guide YVL 3.0 as part of its inspection operations or with the aid of separate visits to manufacturers, inspection organizations and facility sites.

8 References

1. Decision of the Ministry of Trade and Industry on the safety of pressure equipment (953/1999).
2. Decision of the Ministry of Trade and Industry on pressure equipment (938/1999).