STUK

GUIDE **YVL 1.14** / 4 OCTOBER 1999

MECHANICAL EQUIPMENT AND STRUCTURES IN NUCLEAR FACILITIES

Control of manufacturing

1	GENERAL	3
2	OBLIGATIONS OF LICENSEE	3
3	REQUIREMENTS SET FOR MANUFACTURER	4
3.1	General	4
3.2	Construction and welding materials	4
3.3	Machinery and equipment	4
3.4	Manufacturing instructions	4
3.5	Manufacturing	4
3.6	Inspection and testing	5
3.7	Sub-contracting	5
4	CONTROL BY STUK	5
4.1	General	5
4.2	Auditing of manufacturer quality system	5
4.3	Construction materials	6
4.4	Qualification of manufacturing methods	6
4.5	Welding	7
4.6	Heat treatment	7
5	RECORDS	7
6	REFERENCES	7

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Authorisation

By virtue of the below acts and regulations, the Radiation and Nuclear Safety Authority (STUK) issues detailed regulations that apply to the safe use of nuclear energy and to physical protection, emergency preparedness and safeguards:

- Section 55, paragraph 2, point 3 of the Nuclear Energy Act (990/1987)
- Section 29 of the Council of State Resolution (395/1991) on the Safety of Nuclear Power Plants
- Section 13 of the Council of State Resolution (396/1991) on the Physical Protection of Nuclear Power Plants
- Section 11 of the Council of State Resolution (397/1991) on the Emergency Preparedness of Nuclear Power Plants
- Section 8 of the Council of State Resolution (398/1991) on the Safety of a Disposal Facility for Reactor Waste
- Section 30 of the Council of State Resolution (478/1999) on the Safety of Disposal of Spent Nuclear Fuel.

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 operating nuclear power plants, or to those under construction, and to licensees' operational activities. The guides apply as such to new nuclear facilities.

When considering how new safety requirements presented in YVL guides apply to operating nuclear power plants, or to those under construction, STUK takes into account section 27 of the Council of State Resolution (395/1991), which prescribes that *for further safety enhancement, measures shall be taken which can be regarded as justified considering operating experience and the results of safety research as well as the advancement of science and technology.*

If deviations are made from the requirements of a YVL guide, STUK shall be presented with some other acceptable procedure or solution by which the safety level set forth in the guide is achieved.

Translation. Original text in Finnish.

1 General

In accordance with the second paragraph of section 21 of the Council of State Resolution (395/1991) on the general regulations for the safety of nuclear power plants, *the systems, structures and components important to safety shall be designed, manufactured, installed and operated so that their quality level and the inspections and tests required to verify their quality level are adequate considering any item's safety significance.*

Factors essentially affecting quality include construction materials, manufacturing methods and equipment, personnel qualifications and the quality systems of the manufacturing organisation. The overall quality of a manufactured product, or that of a related work performance, cannot be fully ascertained by post-manufacturing inspections conducted according to the quality control programme. Quality can only be verified by sufficient control during manufacturing. Manufacturing control is a process to ensure that a product or delivery is in compliance with design.

This guide presents general requirements and procedures for the manufacturing control of mechanical equipment and structures of nuclear power plants. These requirements also apply to the repairs and modifications of mechanical equipment and structures according to Guide YVL 1.8. Detailed requirements for the manufacturing and manufacturing control of individual equipment or structures are determined by safety class and are presented in equipment group specific YVL guides and applicable standards referred to in the guides. Manufacturing control and the applicable requirements are presented in the construction plan.

For the purposes of this guide, licensee means a licensee referred to in the Nuclear Energy Act. Chapter 2 sets forth the general obligations of the licensee in ensuring that the manufacturing of products intended for use in a nuclear facility is controlled. It is the licensee's responsibility to verify that the manufacturer complies with the requirements set for manufacturer operations in Chapter 3. Chapter 4 describes STUK's regulatory control processes. The concept of *mechanical equipment and structures* is defined in Guide YVL 1.15.

2 Obligations of licensee

The licensee shall have procedures for the assessment, choosing and monitoring of manufacturers and suppliers. Prior to the commencement of manufacturing, the licensee shall ascertain that organisations manufacturing equipment or structures have the technical and administrative prerequisites for high quality operation. The licensee shall also ensure that the manufacturers have the permits and qualifications required in the YVL guides.

Conformity with the manufacturing requirements shall be ensured. In case of nonconformities, manufacturing shall be discontinued and the manufacturing process corrected before manufacturing is resumed. The licensee shall reserve in contracts the right to conduct audits also in the sub-contractor's premises.

It is the licensee's responsibility to ensure that all the relevant technical data and requirements as well as regulatory requirements are available to the manufacturer. The licensee shall ensure by sufficient control that approved quality assurance programmes are employed in the manufacturing of equipment or structures. If considered necessary, the licensee may use external companies for manufacturing control. The construction plan shall present control of manufacturing and of related inspections exercised by the parties defined in this guide. Control exercised by an independent external company shall be defined in the procurement documents. A description of the expertise of the external company, or reference to a document submitted in some other connection, shall then be appended to the construction plan of the piece of equipment or structure in question.

3 Requirements set for manufacturer

3.1 General

The manufacturer of a structure or a piece of equipment shall see to it that sufficient prerequisites exist for high quality operations and that manufacturing is carried out in accordance with the applicable regulatory requirements and decisions as well as manufacturing documents. The manufacturers of mechanical equipment and structures shall have a quality system whose functionality is monitored. The operational preconditions of pressure equipment manufacturers shall be evaluated according to Guide YVL 3.4.

The manufacturer shall define procedures for personnel qualification and for the maintenance of qualifications.

Work performances whose final quality cannot be verified by inspection of the final product shall be carried out by qualified personnel. The manufacturer's quality system shall specify those work performances that are to be carried out by specifically qualified personnel.

The manufacturer shall have available competent welding co-ordination personnel who plan, draw up and qualify the necessary welding and work instructions. The welder qualification process shall consider the welds to be manufactured and the resulting requirements. The qualifications of welders shall be maintained and reviewed.

3.2 Construction and welding materials

The manufacturer shall draw up instructions that describe procedures relating to the handling of construction and welding materials. The instructions shall consider recommendations issued by the suppliers of the materials. The handling, storage and transport of the materials shall be arranged in a way that does not impair their quality. The materials shall be traceable in every phase of the production process. Only inspected and approved construction and welding materials may be used. The construction and and welding filler materials of pressure equipment are discussed in Guide YVL 3.9.

3.3 Machinery and equipment

The manufacturer shall have a maintenance programme for manufacturing machines and equipment. Their faultless operation shall be ensured by regular testing. The test results shall be recorded.

3.4 Manufacturing instructions

The manufacturer shall have working instructions for demanding working methods, i.a. welding, cold and hot working and heat treatment. Welding instructions that apply during manufacturing shall be qualified by welding procedure tests. In the case of demanding jobs, the applicability of manufacturing instructions shall be qualified, prior to the commencing of manufacturing, by performance tests or production tests conducted as part of manufacturing.

3.5 Manufacturing

The manufacturing of mechanical equipment and structures shall comply with the construction plan. The machinery and equipment used and the circumstances of manufacturing shall support the achievement of the required quality level.

The manufacturer shall monitor demanding working phases. In welding work control, edges, fits, temperatures and heat production shall be measured if they essentially affect weld characteristics and the required quality level. Manufacturing control shall be appropriately recorded.

A piece of equipment or a structure shall be heat treated according to applicable standards and instructions approved in the construction plan. The manufacturer shall oversee the heat treatment. A report with the following information shall be drawn up of the heat treatment: identification of the piece of equipment or structure heat-treated, heat treatment temperature, holding time, temperature increase and decrease

rates as well as the instructions applied. If the piece of equipment or structure is subject to post-weld heat treatment, post-heat treatment repair welding is only allowed when a repair plan approved by STUK is adhered to.

The manufacturer has to inspect the surface quality and cleanliness of the product after manufacturing and must ensure that its quality does not deteriorate during storage and transport.

3.6 Inspection and testing

The manufacturer shall employ competent and qualified personnel for manufacturing-related inspection, testing and control. Guide YVL 1.3 applies to the qualification of testing personnel who conduct non-destructive examinations.

The inspection, measurement and testing equipment shall be regularly checked and calibrated. The results shall be recorded. An approved quality control programme and inspection plans shall be followed in the inspection and testing of equipment or structures. If the accessibility of work areas subject to inspection is reduced during the manufacturing process the necessary inspections shall be conducted during various manufacturing phases. If nonconformities or defects occur their causes shall be identified and, if necessary, corrective action shall be taken. Any significant changes made to the manufacturing description presented in the construction plan shall be submitted to STUK for approval. Nonconformities shall be reported and they are subject to STUK's approval in accordance with Guide YVL 1.15.

3.7 Sub-contracting

If necessary, the manufacturer may commission part of the manufacturing or inspections to a sub-contractor. The use of sub-contractors shall be presented in the section of the construction plan that describes the manufacturer. The manufacturer shall ensure the effectiveness of the sub-contractor's quality system and ascertain that the sub-contractor has the prerequisites for delivering products or services that satisfy requirements. The manufacturer is responsible for the operations of the sub-contractor as well. It is the manufacturer's responsibility to ensure that the subcontractor has available all the relevant technical data and requirements. The manufacturer's quality system shall describe how subcontractors are chosen and monitored.

When the manufacturer commissions welding to a sub-contractor he shall ascertain welder competence for example by having the welders undergo a sufficient number of pre-production welding tests and by providing training pertaining to the manufacturer's requirements, for example the welding instructions. Appropriate records shall be kept of the tests.

4 Control by STUK

4.1 General

STUK's control procedures depend on the safety significance of the piece of equipment or structure, the technical manufacturing requirements, and the data available to STUK on organisations performing manufacturing, testing and quality control. Table 1 outlines STUK's control procedures by equipment group and manufacturing stage. Following the aforementioned principles, STUK decides the scope of control of an individual piece of equipment and structure in connection with the approval of the construction plan. Partial construction inspections in accordance with Guide YVL 1.15 may be conducted in connection with manufacturing control, if necessary. For the purpose of the inspections, a description of the manufacturing stages shall be submitted to STUK. The dates of the manufacturing stages shall be submitted to STUK for information early enough, prior to the commencement of each manufacturing stage.

4.2 Auditing of manufacturer quality system

STUK shall be reserved the possibility of auditing the manufacturer's quality system prior to the commencement of, and during, manufacturing. The objective of auditing is to evaluate the adequacy of measures described in the quality system and the organisation's ability to deliver

Table I. *The scope of STUK's control procedures by equipment group and safety class.*

Component	Auditing of manufacturer quality system	Materials[2)]	Qualification tests	Welding	Heat treatment
Pressure vessels	SC 1 and 2	SC 1 and 2	SC 1 and 2	SC 1 and 2	SC 1 and 2
Piping [1)]	SC 1 and 2	SC 1 and 2	SC 1 and 2	SC 1 and 2	SC 1 and 2
Valves and their actuators	SC 1 and 2	SC 1 and 2	SC 1 and 2	SC 1	SC 1
Pumps and their motors, diesel generators	SC 1 and 2	SC 1 and 2	SC 1 and 2	SC 1	SC 1
Steel containment	SC 2	SC 2	SC 2	SC 2	SC 2
Lifting and transfer equipment	SC 3	–	SC 3	SC 3	–
Steel structures	SC 2	–	SC 2	SC 2	–

1) Piping d ≥ 100 mm in Safety Class 2
2) Welding filler materials for components in Safety Class 1

products that are in compliance with requirements. The scope of STUK's manufacturer-specific quality systems audits is given in Table 1.

4.3 Construction materials

Construction materials, such as plates, pipes, bars, forgings and castings shall satisfy requirements presented in the material description of the construction plan or in the applicable standard. The scope of STUK's control of the inspection, sampling and testing of structural and welding filler materials is given in Table 1. To assess the acceptability of measures affecting the quality of materials and their testing, STUK conducts audits to the premises of companies that manufacture and test materials. STUK determines the scope of the inspections. The review and approval of material testing results and NDT records is part of the construction inspections in accordance with Guide YVL 1.15.

4.4 Qualification of manufacturing methods

STUK witnesses and controls the qualification tests of manufacturing instructions and methods according to Table 1. The tests include for example welding procedure and pre-production tests as well as procedure tests for heat treatment and hot forming. STUK's assessment of the qualification of manufacturing methods is manufacturer-specific. The regulatory control exerted by STUK encompasses also assessment of procedures pertaining to qualification tests. STUK reviews and approves the inspection and test results of qualification tests as part of the construction plan or in connection with the construction inspection. Manufacturing instructions shall be qualified in accordance with the standards presented in component-specific YVL guides or procedures approved by STUK.

4.5 Welding

The scope of STUK's assessment of welding work is given in Table 1. If necessary, STUK conducts audits to the manufacturer's premises during demanding welding work. The welding instructions of the construction plan shall be followed during welding. The welding conditions and the handling of welding filler materials shall be in accordance with instructions documented in the quality system. The performance of welding machines and equipment shall be tested.

4.6 Heat treatment

The scope of STUK's assessment of heat treatment procedures during manufacturing is given in Table 1. If necessary for the assessment, STUK conducts audits to the manufacturer's premises during demanding heat treatments. Heat treatments shall be carried out by trained personnel in accordance with the working instructions of the construction plan. The calibration of measuring instruments and the placement of detectors shall be according to the working instructions. As regards arrangements relating to heat treatment, post-heat treatment destructive examination shall be considered in case it is required for the demonstration of materials characteristics.

5 Records

Manufacturing control by the various parties shall be documented, describing the manufacturing, inspection or testing stage controlled. Any nonconformities or shortcomings relating to the construction plan, the applicable standards or quality system requirements shall be recorded. Their causes shall be clarified and any corrective actions reported.

6 References

1 Directive 97/23/EC on pressure equipment

2 SFS-EN ISO 9001: Quality systems. Model for quality assurance in design, development, production, installation and servicing.

3 SFS-EN 729-2: Quality Requirements for Welding. Fusion welding of metallic materials. Part 2: Comprehensive quality requirements.