INSTITUTE OF RADIATION PROTECTION GUIDE YVL 3.2

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In the event of any differences in interpretation of this guide the Finnish version shall take precedence over this translation

# NUCLEAR POWER PLANT PRESSURE VESSELS CONSTRUCTION PLAN. SAFETY CLASS 3 AND CLASS EYT

CONTENTS



## 1. GENERAL

A construction plan, which is approved by the IRP prior to commencement of manufacture, shall be prepared for nuclear power plant pressure vessels. This guide sets forth requirements for the contents of the construction plan for pressure vessels [1] in safety class 3 and in class EYT. Guide YVL 3.0 presents the general licensing procedures and inspections relative to the supervision of pressure vessels.

The construction plan shall include the designs concerning the manufacture and, if need be, the installation of the pressure vessel or part of it. The procedure given in Standard SFS 2610 can be applied in the design of pressure vessels

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[1] Pressure vessel, as defined in this guide, means all pressure vessels except boilers and piping.

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described in this guide unless otherwise stipulated here or in other YVL Guides concerning pressure vessels.

Parts outside the design limit of the pressure vessel (YVL 3.0, sub-section 1.4), such as piping, valves, pumps and equipment, shall be designed and approved in accordance with pertinent YVL Guides.

For the approval of the construction plan, the Institute of Radiation Protection may ask for an account of a study made of the structure and operational safety of a pressure vessel that is produced in series for laboratory use.

If, due to radioactive contents or for some other reason, the required periodic inspections for the pressure vessel cannot be carried out during operation, this shall be taken into consideration in design (e.g. choice of materials) and the reliability of the component in operation shall be shown in some other way.

A separate account of this issue shall be attached to the construction plan.

The construction plan shall be provided with a front leaf in accordance with Guide YVL 1.2 and, as an appendix, a list of the documents that are mentioned in this guide, If these documents are not included in the material, reference shall be made indicating when they have been submitted to the IRP. When necessary, the reference literature used in the documents shall be submitted to the IRP.

## 2. MANUFACTURER

The construction plan shall contain the following manufacturing information: manufacturer of the pressure vessel, description of the manufacturing license issued by the IRP or the Technical Inspectorate, accepted supervisor of manufacture, and inspection rights of the quality control. Procedures relative to the manufacturing license and inspection rights are presented in Guides YVL 3.4 and YVL 1.3.

## 3. DESING BASES

The design bases contain the data on the function, operation and loading of the pressure vessel that are needed in the design and inspection of a pressure vessel.

The design bases shall include:

1. An account of the function of the pressure vessel and its relation to the system; design values such as design pressure and temperature, planned operating time, etc.

2. Operating values (highest allowable operating pressure, highest and lowest allowable temperature of the contents) and data on contents and external conditions.

3. Loads that are continuous or temporary in operating or test conditions and have bearing on the dimensioning of structures (SFS 2610, sub-section 3.2).

## 4. CONSTRUCTION MATERIAL DATA

The construction plan shall present all the data on construction materials and welding filler materials that relate to the structure of the pressure vessel. Also the pertinent standards specific to each pressure vessel, structural part and welded joint shall be presented. Any additional requirements deviating from the standards set for construction and welding materials shall be set forth. The requirements concerning material testing as well as marking and identification of construction materials are given in Guide YVL 3.9. The guality control of construction materials for pressure vessels in safety class 3 is presented in connection with the quality control programme.

Only approved construction materials and welding filler materials may be used for the manufacture of pressure vessels. A prerequisite for a component-specific approval is a valid general approval which has been granted in accordance with Guide YVL 3.9, section 2 or 3 and which shall be referred to in the construction plan.

The base material, weld and transition zone of the final product shall fulfil the chemical and mechanical requirements set for the construction materials. The methods and scope of testing shall be determined on the basis of safety class, type and quality of material, manufacturing method, operating conditions, measurements, and conformity of materials to standards.

## 5. MANUFACTURE

The construction plan shall give a description of the manufacture of the pressure vessel including, when necessary, the parts and ingots used for it. The description shall comprise the following items:

1. Measurements and manufacturing method of the structural part joints. The welding of a pressure vessel shall take place in accordance with the manufacturing instructions presented in Standard SFS 2223. The information required by the above-mentioned standard shall be given in a drawing prepared of the welded joints.

2. Work phases affecting the strength of the structural parts, such as moulding.

3. Heat treatment procedure and its timing in the manufacture, containing the allowable and used heat treatment times, temperatures and rates of temperature change.

4. Timing of inspection measures during manufacture and in the various stages of manufacture.

5. Manufacture of potential work samples, including data on heat treatments and welding and a testing plan.

The manufacturing and inspection methods of pressure-bearing parts shall be described in sufficient detail so as to make possible the assessment of the final properties of the structure. Some data on manufacture can also be included in the quality control programme.

## 6 QUALITY CONTROL

The construction plan of pressure vessels in safety class 3 shall include a quality control programme which gives a systematic description of the scope of the quality control measures that are applied to the pressure vessel and of the instructions that are observed in inspections.

Inspection plans for the quality control measures concerning the manufacture and inspection of the material, welding, work samples and the fin-

ished product shall be presented in the quality control programme for each part and welded joint.

The instructions for inspection shall primarily define the scope of inspections related to the pressure vessel, requirement level, and reporting procedure. As far as the inspection techniques are concerned, reference to acceptable standards is usually sufficient.

In class EYT, the realization of quality control can also be presented in accordance with the principles in Standard SFS 2610. In that case the construction plan must contain the necessary information about the scope and procedures of inspections performed for welded joints as well as the data on pressure tests.

The most common inspections to be presented in the quality control programme are.

- identification, marking and certificates of materials
- supervision of heat treatments
- sampling for material testing
- destructive testing
- checking of the welders' competence according to Standard SFS 2218 or by some other means
- supervision of welding
- non-destructive testing
- leak and pressure tests
- eventual final inspections.

As the technical requirement level of quality control for pressure vessels in safety class 3 does not become fully evident on the basis of the YVL Guides and SFS Standards, the general document on quality requirements, which is specific to the power plant unit (Guide YVL 3.0, subsection 4.1), shall be submitted to the IRP for approval before component-specific construction plans.

## 7. DIMENSIONING

The construction plan shall include dimensioning calculations, which show that the measures and design of the pressure vessel fulfil the requirements set forth in the standards.

The dimensioning is carried out on the basis of the design conditions of the pressure vessel. The dimensioning calculations are based on the

drawings of the pressure vessel, which reveal the necessary measures and shape of the structure.

Calculation methods presented in Standard SFS 2610 and other related dimensioning standards are used in the dimensioning of pressure vessels referred to in this guide. Besides these, also other design guides approved by the IRP may be utilized, provided that the general principles of the above-mentioned guide are adhered to.

If the pressure tank contains some radioactive substance, the raising of the safety factor implied in Standard SFS 2610 is not applied. Instead, the importance of the radioactive contents in nuclear power plant pressure vessels is taken into consideration when the safety class of the vessel is defined in accordance with Guide YVL 2.1. In case of the other dangerous substances described in the standard, the safety factors shall be raised by 20 % or, alternatively, the inspection scope of welded joints, as defined in standards, shall be increased and extra requirements shall be made for the material certificates of construction materials.

Any investigations that are similar to stress analyses are made in accordance with Standard SFS 3292.

## 8. DRAWINGS

The purpose of the drawings is to describe the structure in regard to assembly and details such that the size, shape and manufacture of the component with allowed tolerances are presented in sufficient detail.

The drawings shall describe:

- assembly and part assembly data with part lists
- measures and shapes used in or derived from the computation of strength calculations and other analyses
- type of construction material and filler material used in pressure-bearing parts and parts welded to the pressure body, and applicable standards or references to other documents

- locations and sizes of inspection and cleaning openings
- references from the quality control and inspection instructions relative to the pressure vessel
- finishing
- other data required for the welding drawing (SFS 2223)

## 9. REFERENCE LITERATURE


YVL 1.2 Formal requirements for the documents to be submitted to the Institute of Radiation Protection, Dec. 1, 1976

YVL 1.3 Acceptance of separate inspecting bodies to carry out inspections of main components and systems of nuclear power plants, July 25, 1975

YVL 3.0 Nuclear power plant pressure vessels. General guidelines on inspection, Feb. 7, 1978

YVL 3.3 Supervision of nuclear power plant piping. General guide

YVL 3.4 Nuclear power plant pressure vessels. Manufacturing license, April 15, 1981

YVL 3.9 Nuclear power plant pressure vessels. Materials and filler metals, Nov. 6, 1978

YVL 5.3 Inspection of nuclear power plant valves, Nov. 26, 1979

YVL 5.7 Inspection of nuclear power plant pumps, Dec. 14, 1977

SFS 2218 Welding. Qualification of welders (2nd ed.)

SFS 2223 Welding of pressure vessels. General rules for fabrication (2nd ed.)

SFS 2610 Design of pressure vessels. Basic requirements (3rd ed.)

SFS 3292 Design of pressure vessels. Stress analysis.