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

PREINSPECTION OF NUCLEAR POWER PLANT PRESSURE VESSELS (SAFETY CLASSES 1 AND 2)

1 GENERAL

The construction of pressure vessels which particularly affect the safety of nuclear power plants shall not be commenced before the relevant decision of the Institute of Radiation Protection (IRP) is made, based on a preinspection performed by it. Associated with the guide YVL 1.1 general requirements for documents needed for an inspection are outlined here.

In this guide a pressure vessel means an apparatus, which is loaded with either an internal or external pressure (e.g. a pressure container, a steam boiler, a pump, a valve or a network of pipes).

2 SCOPE

This guide applies to pressure vessels classified in safety classes 1 and 2. Instructions for classification are given in the guide YVL 2.1.

Preinspection applies both to the manufacturing and the installation of the pressure vessel. When the preinspection documents of the manufacturing do not comprise equivalent data about the installation, a separate preinspection of the installation is performed by applying the document division of this guide. The installation plans shall be approved in the preinspection before the beginning of installation.

3 DOCUMENTS

For preinspection the applicant shall provide the authorities in triplicate with a document pertaining to the pressure vessel in question, and containing data mentioned later on.

The document shall have a front flyleaf in conformance with the guide YVL 1.1 and as its enclosure a list of the documents consistent with this guide as well as a mention when they have been delivered to the IRP.

Reference literature (or copies) hard to attain shall be made available to the IRP.

3.1 Explanation about the manufacturer

Purpose

The purpose of the explanation is to give a picture of the competence of the manufacturer. The explana-

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tion shall also comprise data about the subsuppliers and consultants, which participate in the design, manufacturing, or quality control of the pressure vessel. For the approval of a consultant for quality assurance activities is applied for in accordance with the guide YVL 1.3.

Contents

The explanation shall comprise a description of the organization confirmed by the management of the firm. The organizational explanation reveals definitions of duties, responsibility areas, and competences, as well as the arrangement of quality assurance. The description of the quality assurance may mainly be founded on the Quality Assurance Manual which is at the disposal of the firm.

The explanation shall further contain the data presupposed for the manufacture permit application in the Finnish Statute on pressure vessels (549/73) or a copy of the manufacture permit given by the Technical Inspectorate (formerly Inspectorate of Pressure Vessels), as far as this is valid, as well as copies of the certificates concerning the quality control rights of the manufacturer (as testing of materials, radiographical or ultrasonic testing).

If the document in essential parts is similar to the document earlier delivered to the IRP in connection of the preinspection of pressure vessels of the same nuclear power plant, a referance to the previous document together with announced changes is sufficient.

3.2
Design data

Purpose

The purpose of the design data is to present in brief the data concerning the operational circumstances and loadings, needed in the inspection of other preinspection explanations.

Contents

The design data shall comprise

- a description of the functioning of the pressure vessel and of its joining with the system, and the values of the process parameters
- design data as the pressure and temperature and their tolerances, and the number of load exchanges
- desirable data of chemical circumstances
- location plan in accordance with the Finnish Statute on pressure vessels

- an explanation of control and safety systems.

Requirements

The design data shall conform with process descriptions, and be sufficient for the inspection of the materials, quality control programmes, basic, dimensioning, drawings, stress analysis, and periodic inspection programmes.

3.3
Material report

Purpose

The purpose of the material report is to give a picture of the suitability of materials for their operational purpose, and to present data which unambiguously define the acceptance bases and limits of materials and their properties.

Contents

The material report contains the material data of the reception and work tests, which make valid both the manufacture and installation of all pressure bearing parts and parts fastened to the body. Matters are divided as follows:

1 A list of basic materials and welding additives for each apparatus giving the apparatus, the part numbers (reference to the welding drawing and inspection plans), the standard markings of basic materials and welding additives, and the numbers of material report leaves.

2 Essential design data for the material choice and control, or an unambiguous reference to a document wherein they are to be found.

3 Reports pertaining to the materials giving

- the standard marking and type of the basic material or welding additive
- an explanation of the acceptance of the basic material or welding additive for their operational purpose in Finland or in the manufacturing country
- the method of production, the delivering status, and the substance certificate type of the basic material

- significant manufacturing measures in regard to the material properties of the final product, or an unambiguous reference to a document wherein they are to be found

- material properties, testing procedures and testing scope of the final product, and information about, whether the verification of the properties takes place by testing, quaranteeing, or whether the data are informative, with the exception of radiographical, ultrasonic, magnetic powder, and penetrating liquid inspections

Requirements

All pressure bearing parts and parts fastened to the pressure body as well as the basic materials and welding additives of the test pieces making valid their production and installation shall be acceptable as construction materials of pressure vessels. The basic materials shall conform with the Finnish pressure vessel legislation and besides fulfil at least the requirements of those standars, which they have been called conformable with. The material report shall mention all deviations from the Finnish legislation on pressure vessels, standars, and other relevant instructions with justifications, and additional requirements for the material. References to standars shall be detailed.

The basic material, the weld, and the transformation zone of the final product shall at least fulfil the strength and toughness requirements set for the basic materials. The testing methods and scope as well as the confirmation manner of the presented properties shall be defined on the basis of the safety class, the material type and kind, the manufacturing method, the operational circumstances and dimensions, and conformity of the material standards.

Appendix

"Quality specifications for materials to be used for special pressure vessels of nuclear power plants"

3.4
Description of the manufacturing

Scope

The purpose of the description of the manufacturing is to present the manufacturing methods and the accomplishment of the quality assurance in separate manufacturing phases.

Contents

The description of the manufacturing comprises an explanation concerning both the pressure vessel itself and the manufacturing of parts and ingots used for it. The explanation comprises the following matters:

1 The manufacturing method (rolling, forging, casting, etc.) of parts and ingots submitted to pressure bearing or other great strains

2 The joining of parts together, especially welded joints with methods, work phases, and performance sequence

3 The timing of inspection procedures with regard to separate manufacturing phases

4 The performance manner and date of heat treatments, and the heat treating time with temperature data

5 Other manufacturing measures

6 The performance manner of work tests, giving welding and heat treatment data.

7 References to the procedural tests which make the welding valid and a mention when their results have been delivered to the IRP.

Requirements

The manufacturing method of pressure bearing parts has to be cleared up so that on the basis of given data questions related to the strength and quality control of the structure can be treated.

3.5
Quality control programme

Purpose

The purpose of the quality control programme is to systematically present quality control measures concerning the pressure vessel, and the inspection procedure to be applied herein.

Contents

The quality control programme contains

- definitions
- inspection instruction leaves and a list of them
- inspection plans for basic materials, welding joints, and final product

Requirements

Inspection instruction leaves shall be presented about inspection measures concerning the pressure vessel, which measures are related to the manufacture and installation as well as work tests representing them. The instruction leaf shall give the method, scope, requirements, and reporting of the inspection. In details reference to standards is made.
The most common quality control measures presented in the instruction leaves may be grouped as follows:

- identification, marking, and certificates of materials
- taking of test pieces
- destructive testing
- nondestructive testing
- surveillance of welding
- surveillance of heat treatments
- dimensional inspections of the structure
- tightness and pressure tests
- other inspections carried out by the manufacturer.

The inspection plans shall be presented in regard to the quality control measures of the basic material and work tests, and the product, separately for parts and welds.

The plan is compiled so that it indicates

- separate numbering for parts or welds in accordance with drawings
- name and number of the part
- standard marking for the basic material and the welding additive
- mention which procedure test makes each welding joint valid
- division in columns in accordance with the inspection instruction leaves

Each inspection measure in the plan shall reveal, whether it is carried out in the manufacturing factory of the material, in the work shop, or at the installation location, and which parties (e.g. manufacturer, accepted inspection body, control authority) carry out the inspection or supervise it.

3.6 Basic dimensioning

Purpose

The purpose of the basic dimensioning is to indicate that the dimensions and the design fulfil the requirements set forth in standards.

Contents

The basic dimensioning means the dimensioning of the pressure vessel in design circumstances which do not normally contain temperature gradients or repeatability of the load. Dimensioning calculations are provided with drawings, which reveal loads and necessary dimensions.

Requirements

Pressure vessels belonging to safety class 1 shall be dimensioned in accordance with ASME Boiler and Pressure Vessel Code, Section III (ASME Code Section III), NB-3000. Deviations may be accepted according to the consideration of the IRP, if they are based on a valid nuclear power plant standard in the manufacturing country.

Pressure vessels belonging to safety class 2 shall be dimensioned in accordance with ASME Code Section III, NC-3000, or some other nuclear power plant standard accepted by the IRP. Following standards may also be used in the dimensioning, if sufficient attention is paid to the quality control:

1 SFS 2610
2 ISO/TC11
3 AD-Merkblatt, Series B (except B5), supplemented with TRD 301 and DIN 25408 and DIN 25418

The steel containment shall be dimensioned according to ASME Code Section III, NE-3000.

In the dimensioning of other pressure bearing apparatus than pressure containers and steam boilers the aforementioned standards shall appropriately be used.

3.7 Drawings

Purpose

The purpose of the drawings is to describe the structure in regard to assembly and details so that the size, shape, and manufacture of the apparatus are sufficiently shown in detail.

Contents

The drawings shall be unambiguous and clear. They shall show

- measures and shapes used in or derived from strength calculations and stress or other analyses
- positioning, measures, and details of joints

- assembly and subassembly data with parts lists
- position of various materials in the apparatus, and their mutual joining.
- regarding each welding joint a reference to the welding instruction and a mention which procedure test makes it valid.

Requirements

The drawings shall meet the requirements of SFS standards (e.g. SFS 2223 and SFS 2610).

3.8
Stress analysis

Purpose

The stress analysis shall present the stress conditions caused by all loading states in various points of the structure, and conclusions to be drawn therefrom.

Contents

The stress analysis usually contains the definition of the temperature and stress distribution of the structure under circumstances defined in the design data, and the judgement of the acceptability of the stress states by using fatigue analysis. When the pressure vessel under accident conditions is submitted to the strain of a unique load greater than in general, the stress analysis is supplemented by a limit state analysis based on plasticity theory. Depending on the structure and loading conditions, an analysis concerning the stability, vibrational properties, brittle fracture, or other properties shall further be presented as needed.

Requirements

The objects and methods of the planned stress analysis shall be presented for the preinspection. The proper analysis shall be accepted before taking the pressure vessel in use.

The stress analysis shall indicate that the structure fulfils the requirements of ASME Code Section III.

3.9
Programme of periodic inspections

Purpose

The programme of the periodic inspections is presented by taking into consideration the choice of material, the structural solution, the operational circumstances and the accessibility of the objects to be inspected.

Contents

The programme contains the inspections planned to periodically be carried out during the use of the pressure vessel, the requirements concerning the performance of the inspections, and the criteria to be used in drawing conclusions.

For the preinspection of the reactor pressure vessel and containment a preliminary programme of periodic inspections shall be presented. The final programme shall be presented for approval when applying for the operation licence.

Requirements

The document shall meet the requirement level of ASME Code Section XI, and Finnish regulations.

3.10
Other possible explanation

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ABBREVIATIONS

AD-Merkblatt	Arbeitsgemeinschaft Druckbehälter, published by VdTÜV
ASME	The American Society of Mechanical Engineers
DIN	Deutsche Industrienormen, published by DNA
DNA	Deutscher Normenausschuss
ISO	International Organization for Standardization
SFS	Suomen Standardisoimisliitto r.y. (Finnish Standards Association)
TRD	Technische Regeln für Dampfkessel, published by VdTÜV
VdTÜV	Vereinigung der Technischen Überwachungs-Vereine e.V.