PREINSPECTION OF THE SPECIAL PRESSURE VESSELS

General

The construction of pressure vessels (here special pressure vessels) which particularly have affect the safety of the nuclear power plants, may not be commenced before the relevant decision of the Institute of Radiation Physics (IRP), based on a preinspection performed by it. Associated with SFL-guide 1.00.73 the general requirements for documents needed for an inspection are outlined here. The preinspection will be performed by the IRP.

Scope

This guide has been worked out for special pressure vessels. As far as suitable, the same principles will also be applied in the acceptance procedure of other parts affecting the safety.

Types of special pressure vessels in a pressurized water reactor plant: reactor pressure vessel, primary circuit of heat transfer system with pertaining pressure vessels, connecting tubes and equipment, pressure retaining part of the control, protection and engineered safeguards system, pressure retaining containment of the reactor, pressure vessel containing remarkable amounts of radioactive substances, and any other apparatus under pressure, which due to its location or otherwise may affect the safety of the nuclear power plant, as judged by the IRP.

Documents

For preinspection the applicant shall provide the authorities in triplicate with following documents pertaining to the pressure vessel in question. Measuring units of the SI-system are recommended to be used in the documents.

The document shall have a front flyleaf which shall show the compiler of the document (signature with clarifications), all persons who have audited the document, and other relevant facts.

Reference literature hard to attain shall be made available to the IRP.

1	Organizational description
2	Material specification
3	Motivation of constructional solution
4	Manufacturing description
5	Quality assurance programme
6	Procedure test programme
7	Basic dimensions
8	Stress analysis
9	Drawings
10	Inservice surveillance programme
11	Any other possible document

Abbreviations

SFS	Finnish standard
ANSI	American standard (American National Standards Institute)
ASME	American standard (The American Society of Mechanical Engineers)
BS	British standard
DIN	German standard
GOST	Russian standard

INSKO	The Post-graduate Education Centre of the Engineering Societies in Finland
NGS	Northern recommendation (Nordiska gruppen för stålbestämmelser)
PK	Russian standard (PK 1514-70 guidelines for welding joints and on- weldings of energy producing apparatus of nuclear power plants)
SIS	Swedish standard
USAEC	United States Atomic Energy Comission

ORGANIZATIONAL DESCRIPTION

Purpose

The primary purpose of the organizational description is to depict the quality assurance performance within the organizations of the applicant, the plant supplier, the manufacturer of the main parts, and any other relevant parties.

Content

The organizational description comprises the organization confirmed by the company management, indicating definitions of duties, areas of responsibility, competences and arrangement of quality assurance.

The description may principally be founded upon the quality assurance manual possessed by the company.

Requirements

The whole organization shall be sufficient in numbers and competence, appropriate in regard to activity, and clear-cut in responsibility sharing. The actions and the arrangement of quality assurance are in detail stated in the quality assurance manual of the company.

It is important that the quality assurance is sufficiently independent of other activities, above all designing and production.

The chief designer of each main part and the persons responsible for manufacture and quality assurance shall be denominated.

Laws, standards, and recommendations

ANSI N 45.2-1971
ASME Code Section III NA-3000, NA-4000
VnP (232/71) on the welding of pressure vessels
Statute on pressure vessels (549/73)

Literature

Qualification requirements for an inspector in Finland (a proposition made for the Ministry of Commerce and Industry)
INSKO 49-73 Quality assurance of the nuclear power plants

MATERIAL SPECIFICATION

Purpose

The purpose of the material specification is to describe the applicability of materials (basic and welding materials) to the intended purpose and to unambiguously set forth data defining the principles and limits for their acceptance.

Content

The document comprises materials for different parts. The amount and quality of information set forth about them depends on the purpose of use and the extent to which reference to standards may be made. Besides data about basic and welding materials it includes the classification of pressure vessels and a concise summary of the environmental and loading conditions.

Requirements

The quide "Quality requirements laid down for materials used in special pressure vessels of nuclear power plants" (Ydinvoimalaitoksen erityispaineastioissa käytettäville materiaaleille asetettavat laatuvaatimukset) is used as the level of requirements. Depending on the use the IRP may allow exceptions regarding the quantity and quality of information set forth.

The information on basic and welding materials shall give references to standards. Specified properties shall fulfill the requirement limits of those standards which the material is stated to be consistent with. Regarding other properties the materials shall fulfill the requirements of those standards (standards of manufacturing country or manufacturer) according to which they have been named in the specification. All deviations shall be mentioned and justified in the document.

Laws, standards, and recommendations

SFS
ASME Code Section II
DIN
GOST
NGS documentation requirements (dokumentationskrav)
SIS

Literature INSKO 82-73 Nuclear power plant materials

MOTIVATION OF CONSTRUCTIONAL SOLUTION

Purpose

The purpose of the motivation of constructional solution is to set forth bases that have led to the solution in question. Particularly in case of a completely or partly new application or mode of solution, the chosen solution shall be well justified.

Content

The document includes a short explanation about bases that have led to the choice of solution. References, prototypes, main deviations from previous structures, and other factors possibly having effect on the approval, shall be stated.

Requirements

The design shall be based on

- a proved and wellfound solution
- a sufficiently proved prototype, or
- some other appropriate solution designed by interpreting standards correctly

When judging the appropriateness of the design the following shall be taken into account

- selection and use of material
- effect of manufacturing aspects on constructional properties
- possibilities to carry out quality assurance
- requirements of standards

Laws, standards, and recommendations

ASME Code Section III

Literature

INSKO 5-72 Design, manufacture, and inspection of nuclear power plant components

MANUFACTURING DESCRIPTION

Purpose

The manufacturing description shall be given considering the accomplishment of quality assurance and the appropriateness of manufacturing methods.

Content

The document contains the description of the manufactur of both the pressure vessel itself and the parts and ingots used for it. The description comprises following matters

- reference list
- method of production (rolling, forging, casting, etc.) of the parts and ingots bearing pressure or being otherwise subject to great loads, as well as the direction and quality of reduction
- possible machinings and their execution dates
- joining of parts together, especially welding joints with methods, work phases, and performance order
- execution manner and date of heat treatments as well as heat treatment period with temperature data
- cleaning, finishing, and protecting procedures

Requirements

The method of production of pressure bearing parts shall be explained such that on the basis of given information questions associated with the strength and qualtiy assurance of the construction may be judged.

QUALITY ASSURANCE

Purpose

The purpose of the quality assurance programme is to systematically set forth all requirements and inspection procedures concerning the quality of pressure vessels

Content

The document contains

- definitions
- a list of procedures
- procedures
- inspection planning charts separately for at least materials, production, and procedure tests [1)]

The document shall show the duties of different parties in the quality assurance measures.

Requirements

The quality assurance programme shall be consistent with
ANSI N 45.2-1971, and fulfill the
ASME Code Section III requirement level and Finnish regulations.

Laws, standards, and recommendations

PK 1514-70
USAEC Regulatory Guides 1.19, 1.28, 1.31, 1.34, 1.37, 1.38, 1.43, 1.44, 1.50, 1.54

Literature

INSKO 5-72 Design, manufacture, and inspection of nuclear power plant components, lecture XIII

INSKO 25-73 Quality control of pressure vessel manufacturing

INSKO 49-73 Quality assurance of nuclear power plants, lecture VIII

1) Unless a separate procedure test programme is set forth (See SFL-Guide 2.06.73)

PROCEDURE TEST PROGRAMME

Purpose

The procedure test programme has the purpose to set forth for every work method a necessary test and inspection programme that is fulfilled by means of special test tasks, before the manufacturing method in question is applied to production.

The procedure test programme may also be set forth in connection with the actual quality assurance programme.

The procedure test programme shall be approved before the beginning of manufacturing by aforesaid method.

Content

The document contains

- definitions
- procedures
- inspection planning charts
- drawings for test pieces, if they are not similiar to the actual production pieces.

The document reveals the duties of various parties in test and inspection measures.

Requirements

The programme shall meet the requirement level of ASME Code Section III and IX, and Finnish regulations.

Laws, standards, and recommendations

SFS 2224, SFS 2225
SFS 2610
PK 1514-70

Literature

INSKO 5-72 Design, manufacture and inspection of nuclear power plant components, lectures IX,X,XI

INSKO 25-73 Quality assurance of pressure vessel manufacturing, lecture II

BASIC DIMENSIONS

Purpose

The purpose of the documents for basic dimensions is to set forth the strength analytical derivation of the principal dimensions of pressure bearing parts.

Content

Instructions for the appearance and contents of the document are given in those parts concerning basic dimensions in the guide "Recommendation for the presentation form of strength calculations for special pressure vessels of nuclear power plants" (Suositus ydinvoimalaitosten erityispaineastiain lujuuslaskujen esitysmuodoksi). Dimensional calculations are furnished with drawing showing loads and necessary dimensions.

Requirements

The dimensioning of special pressure vessels shall meet the requirement level of ASME Code Section III. Basic dimensioning shall not be in contradiction to SFS standards.

In addition to dimensional calculations a stress analysis shall be presented for special pressure vessels. Depending on the structure and operational circumstances an examination concerning the stability of structure, vibration, fracture or other properties, shall also be presented when needed.

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

Laws, standards, and recommendations

SFS 2610
ASME Code Section III

Literature

Nicols R.W. (ed.), Pressure Vessel Ebgineering Technology, Elsevier, London 1971

STRESS ANALYSIS

Purpose	The document shall present stress conditions in various points of the structure due to different loads, and conclusions to be drawn there from.
Content	The content of the stress analysis document is presented in the guide "Recommendation for the presentation form of strength claculations for special pressure vessels of nuclear power plants".
Requirements	For preinspection the objects and methods of the intended stress analysis shall be presented. The actual analysis shall be submitted for approval before taking the pressure vessel into use.
Laws, standards, and recommendations	ASME Code Section III
Literature	Timoshenki & Woinowsky-Krieger, Theory of plates and shells, McCraw-Hill 1959 Savin, Stress concentration around holes, Pergamon, 1961 Zudans, Yen &Steigelmann, Thermal stress techniques in the nuclear industry, Elsevier, 1965 Publishing series: Welding research council bulletin (pressure vessel research committee) 1st and 2nd International Conference on Structural Mechanics in Reactor Technology, European Communities, Luxemburg

DRAWINGS

Purpose

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 apparatus are sufficiently shown in detail.

Content

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 subassambly data with parts lists
- position of various materials in the apparatus, and their mutual joining.

Requirements

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

INSERVICE SURVEILLANCE PROGRAMME

Purpose

The inservice surveillance programme is presented taking into account materials selection, standard solution, stress analyses, and operational circumstances.

Content

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

For preinspection a preliminary programme shall be presented. The final programme shall be presented for approval in connection with the application for operating license.

Requirements

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

Laws, standards. and recommendations

USAEC Regulatory Guide 1.33
USAEC Regulatory Guide 1.51
Recommended Practice for Surveillance Test for Nuclear Vessels, ASTM draft of standard
The report of a working group appointed by the Finnish Nuclear Safety Advisory Committee concerning the inservice surveillance of special pressure vessels and equivalent components, 1973-09-05

Literature

Analysis of reactor Vessel Radiation Effects Surveillance programs, L.E. Steele, C.Z. Serpan Jr. American Society for Testing and Materials, STP 481