STP-NU-051

CODE COMPARISON REPORT for Class 1 Nuclear Power Plant Components

ASME STANDARDS TECHNOLOGY, LLC

STP-NU-051

CODE COMPARISON REPORT

for

Class 1 Nuclear Power Plant Components

Prepared for:

Multinational Design Evaluation Programme

Codes and Standards Working Group

ASME STANDARDS TECHNOLOGY, LLC

Date of Issuance: January 27, 2012

This report is the result of a multi-national effort by Standards Development Organizations (SDOs) from the United States of America, France, Japan, Korea and Canada.

ASME Standards Technology, LLC
Three Park Avenue, New York, NY 10016-5990

ISBN No. 978-0-7918-3419-0

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FOREWORD

ASME Standards Technology, LLC (ASME ST-LLC) appreciates the collaborative effort put forth by all those involved in the development of this report. The report is the result of a multi-national effort by Standards Development Organizations (SDOs) from the United States of America, France, Japan, Korea and Canada. We also acknowledge the nuclear regulatory authorities who supported this work, which was initiated with a global vision of codes and standards consistency.

Established in 1880, the American Society of Mechanical Engineers (ASME) is a professional not-for-profit organization with more than 127,000 members promoting the art, science and practice of mechanical and multidisciplinary engineering and allied sciences. ASME develops codes and standards that enhance public safety, and provides lifelong learning and technical exchange opportunities benefiting the engineering and technology community. Visit **www.asme.org** for more information.

The ASME Standards Technology, LLC (ASME ST-LLC) is a not-for-profit Limited Liability Company, with ASME as the sole member, formed in 2004 to carry out work related to newly commercialized technology. The ASME ST-LLC mission includes meeting the needs of industry and government by providing new standards-related products and services, which advance the application of emerging and newly commercialized science and technology and providing the research and technology development needed to establish and maintain the technical relevance of codes and standards. Visit **www.stllc.asme.org** for more information.

ABSTRACT

The Multinational Design Evaluation Programme (MDEP) Code Comparison Project was initiated in late 2006 in response to a request by the MDEP Codes and Standards Working Group (CSWG) formerly known as the Working Group on Component Manufacturing Oversight (WGCMO). The CSWG invited the organizations responsible for development of major nuclear component construction codes and standards, Standards Development Organizations (SDOs), to make presentations regarding the requirements of their respective codes and standards pertaining to light water cooled nuclear power plants along with comparisons between those respective codes and standards.

In an effort to facilitate consistent design and manufacturing processes for Nuclear Power Plant Class 1 components among the ten MDEP countries, the CSWG requested the various SDOs to develop a comparison of the requirements of their respective codes and standards and those of the others.

The SDOs from the USA, France, Japan, Korea and Canada (ASME, AFCEN, JSME, KEA, and CSA, respectively) agreed to participate in this code comparison project and develop comparisons of the requirements for Class 1 vessels, piping, pumps and valves.

The objective of this report is to identify and summarize the differences between major international nuclear codes and standards for Class 1 equipment; namely those of AFCEN (RCC-M), ASME (Section III), CSA (N-285), JSME (S NC1) and KEA (KEPIC-MN).

The reader is reminded that each of the codes is a set of consistent rules. The requirements of one area may be, and often are, dependent on the requirements in other sections. Since a line-by-line comparison has been done, it may be tempting to judge the entire code based on the differences between these individual points, but this may not lead to a correct conclusion. This exercise identifies the different requirements of the different codes. It was not within the scope of this report to provide conclusions relative to the full implementation of the various Codes.

1 INTRODUCTION

1.1 Background and Scope

The Multinational Design Evaluation Programme (MDEP) Code Comparison Project was initiated in late 2006 in response to a request by the MDEP Codes and Standards Working Group (CSWG) formerly known as the Working Group on Component Manufacturing Oversight (WGCMO). The CSWG invited the organizations responsible for development of major nuclear component construction codes and standards, Standards Development Organizations (SDOs), to make presentations regarding the requirements of their respective codes and standards pertaining to light water cooled nuclear power plants along with comparisons between those respective codes and standards.

In an effort to facilitate consistent design and manufacturing processes among the 10 MDEP countries for Class 1 Nuclear Power Plant components, the CSWG requested the various SDOs to develop a comparison of the requirements of their respective codes and standards and those of the others.

The SDOs from the USA, France, Japan, Korea and Canada (ASME, AFCEN, JSME, KEA, and CSA, respectively) agreed to participate in this code comparison project and develop comparisons of the requirements for Class 1 vessels, piping, pumps and valves. The SDO from Russia (NIKIET) has since also joined in this effort, and is developing comparisons of the NIKIET PNAE-G-7 requirements to those of ASME Section III for Class 1 components.

As the project was initiated, the SDOs determined that development of comparisons between every code and each of the others would be very complicated. Recognizing that the CSA, JSME, KEA and AFCEN Codes were all originally developed based on ASME Section III, the SDOs agreed to define ASME Section III as the baseline for the comparison and compare each of the other Codes to ASME Section III and also to base the comparisons on the 2007 editions of each of the Codes.

1.2 Objectives

The objective of this report is to identify and summarize the differences between major international nuclear codes and standards for Class 1 equipment; namely those of AFCEN (RCC-M), ASME (Section III), CSA (N-285), JSME (S NC1) and KEA (KEPIC-MN).

The results of this work are intended for use by regulatory bodies, component designers and component manufacturers.

The reader is reminded that each of the codes is a set of consistent rules. The requirements of one area may be, and often are, dependent on the requirements in other sections. Since a line-by-line comparison has been done, it may be tempting to judge the entire code based on the differences between these individual points; but, this may not lead to a correct conclusion.

This exercise in summarizing the differences between major international nuclear codes and standards for Class 1 equipment identifies the different requirements of the different codes. It was not within the scope of this report to provide conclusions relative to the full implementation of the various Codes.

1.3 Contents of the Report

The report is organized into 8 sections. Section 1 provides a general Introduction. The main body of the report begins with Section 2, which provides a general presentation of the background for each code along with a description of the organizations responsible for administering the Codes. A summary list of the standards applied within each respective code is also provided. Section 3 provides a comparison of the general layout for each of the Codes relative to ASME Section III.

Sections 4 through 7 summarize the individual code comparisons for the AFCEN RCC-M, JSME S NC-1, KEA KEPIC-MN and CSA N-285 Codes, each compared relative to ASME Section III. Section 8 provides the applicable References. The detailed Code Comparisons prepared by each of the respective SDOs are provided in the Appendices.

Sections 4 through 7 are organized in a similar fashion and provide a comparison between the codes consistent with the order of the paragraphs in ASME Section III Division 1. The first subsection after the Introduction compares the NB-1000 preliminary paragraphs from the ASME Boiler & Pressure Vessel Code (BPVC) to their equivalents from the others codes. The second subsection addresses the NB-2000 paragraphs related to materials and the third deals with the NB-3000 paragraphs related to design. The NB-4000 requirements associated with fabrication and installation are discussed in the subsection entitled Fabrication and Welding. Examination requirements from NB-5000 are dealt with in the same subsection. The NB-6000 paragraphs related to testing are partially covered in the Pressure Tests subsection. NB-7000, which deals with overpressure protection, is addressed in the last subsection before a short overview on Quality aspects of the codes and the Conclusion.

The code comparison is organized in three levels. First, in each of the subsections mentioned in the previous paragraph, the structure is very similar: they all start with highlights. These highlights summarize the main warnings that need to be communicated. They represent major differences that exist between the ASME BPVC and the other codes. The second level is the text after these highlights: it develops the ideas given by providing comments and background information but it also lists additional differences between the codes. Finally, the third and more detailed level of comparison can be found in the Appendices: the reader will find detailed tables comparing the ASME Section III Division 1 line by line to the other codes.

Sections 4 thru 7 each include tables that present the general layouts of the codes from the ASME point of view as well as from the perspective of the code being compared to the ASME Code.

1.4 Comparison Scale

The following comparison scale is used in this report, specifically in the Appendices:

(a) A1 = Same
(b) A2 = Equivalent
(c) B1 = Different – Not Specified
(d) B2 = Technically Different

These categories of the comparison scale are defined in the following paragraphs.

(a) A1 = Same

Requirements classified as category A1 are considered to be technically identical. Requirements are classified as category A1 and considered to be the same even if there are inconsequential differences in wording, such as might result due to translation from one language to another, as long as the wording does not change the meaning or interpretation of the requirement. Likewise, differences in paragraph numbering are not considered when classifying requirements as long as the same requirement exists in both codes being compared.

(b) A2 = Equivalent

Requirements are considered to be equivalent when applying either code or standard, if compliance with the applied code or standard will also meet the requirements of the other code or standard. Equivalence is not affected by differences in level of precision of unit conversions.

(c) B1 = Different – Not specified

Requirements are considered to be different – not specified, if one code or standard includes requirements that the compared code or standard does not specify. This classification may result because of differences in the scope of equipment covered by a respective code, the scope of industrial practices applied in context of the respective code, differences in regulatory requirements applicable in conjunction with application of a particular code or simply as a result of differences in requirements addressed in one code versus those of another.

(d) B2 = Technically Different

Requirements are considered to be technically different if either code requires something more or less than, or otherwise technically different from, the requirements imposed by the other. These differences might be due to different technical approaches applied by a code or imposition of regulatory requirements within the country from which a code originates.

2 GENERAL PRESENTATION OF CODES

2.1 Background Information on ASME

The present ASME Section III organization is provided in Figure 1; a list of the standards used in the ASME BPVC is provided in Figure 2.

In the second half of the 19th century, an important establishment of schools and institutions in engineering was witnessed in the USA. As an example, in 1880 there were no less than 85 engineering colleges throughout the country. At that time, many groups in different fields of engineering were seeking to create organizations of specialized professional standing. The Institution of Chartered Mechanical Engineers had been successfully established in England, 33 years earlier in 1847. In the United States, the American Society of Civil Engineers had been active since 1852, and the American Institute of Mining Engineers had been organized in 1871. But in the USA, for mechanical engineers, none were devoted to machine design, power generation, and industrial processes, to a degree that was capable of projecting a broader national or international role to advance technical knowledge and systematically facilitate a flow of information from research to practical application. Finally, in 1880, the ASME was founded to bridge the gap.

ASME then acted in various domains: it formed its research activities in 1909 and has led in the development of technical standards; for instance, for the screw thread in 1901. But the Society is best known for improving the safety of equipment, especially boilers. From 1870 to 1910, at least 10,000 boiler explosions in North America were recorded. By 1910, the rate jumped to 1300 to 1400 a year. A Boiler Code Committee was formed in 1911 that led to the Boiler Code being published in 1914-15 and was later incorporated in laws of most U.S. states and territories and Canadian provinces.

By 1930, 50 years after ASME was founded, the Society had grown to 20,000 members, though its influence on American workers is far greater. New standards and codes were published in various domains of mechanical engineering to ensure safely designed components. In 1921, the first elevator code was issued; in 1939, standards for turbine generators were laid down.

Today, ASME is a worldwide engineering society with 125,000 members focused on technical, educational and research issues. Its diversity in the mechanical engineering field can be seen in ASME's 36 Technical Divisions (plus one subdivision) and 3 Institutes. Today’s structure of Technical Divisions was established in 1920, when eight were founded: Aerospace, Fuels, Management, Materials, Materials Handling Engineering, Power, Production Engineering and Rail Transportation. Two more were formed the next year: Internal Combustion Engine and Textile Industries. The most recent addition is the Information Storage and Processing Systems Division (June 1996). The organization chart can be seen Figure 1.

Now, focusing more specifically on the nuclear industry, ASME first established in 1956 a committee in charge of writing a new code that would be named the “ASME Boiler and Pressure Vessel Code for Nuclear Age.” A few years later, in 1963, this committee finally proposed to add a new section to the ASME BPVC to cover the rules and good practices to be followed in the newborn civil nuclear industry. This section was Section III and still is the section to refer to in the code for the nuclear industry. Further, the ASME committees that formulate the Sections and Subsections of the Boiler and Pressure Vessel Code are made up of technical experts from many countries and there are no limitations or membership requirements for participation in the committees.

The nuclear sections of the Boiler and Pressure Vessel Code are currently available in English, Korean and Chinese. In addition to the ASME Code for Class 1 components, which is the code discussed in this report and focuses on construction rules for mechanical components of nuclear reactor pressure boundary, ASME has published multiple other Sections and Subsections for nuclear application:

- Rules for Constructions of Nuclear Facility Components, Subsection NCA – General Requirements for Division 1 and Division 2
- Rules for Construction of Nuclear Facility Components, Division 1 – Class 2 Components
- Rules for Constructions of Nuclear Facility Components, Division 1 – Class 3 Components
- Rules for Construction of Nuclear Facility Components, Division 1 – Class MC Components (Steel Containments)
- Rules for Construction of Nuclear Facility Components, Division 2 – Code for Concrete Containments
- Rules for Construction of Nuclear Facility Components, Division 1 – Supports
- Rules for Construction of Nuclear Facility Components, Division 1 – Core Support Structures
- Rules for Construction of Nuclear Facility Components, Division 1 – Class 1 Components in Elevated Temperature Service
- Rules for In-Service Inspection of Nuclear Power Plant Components.

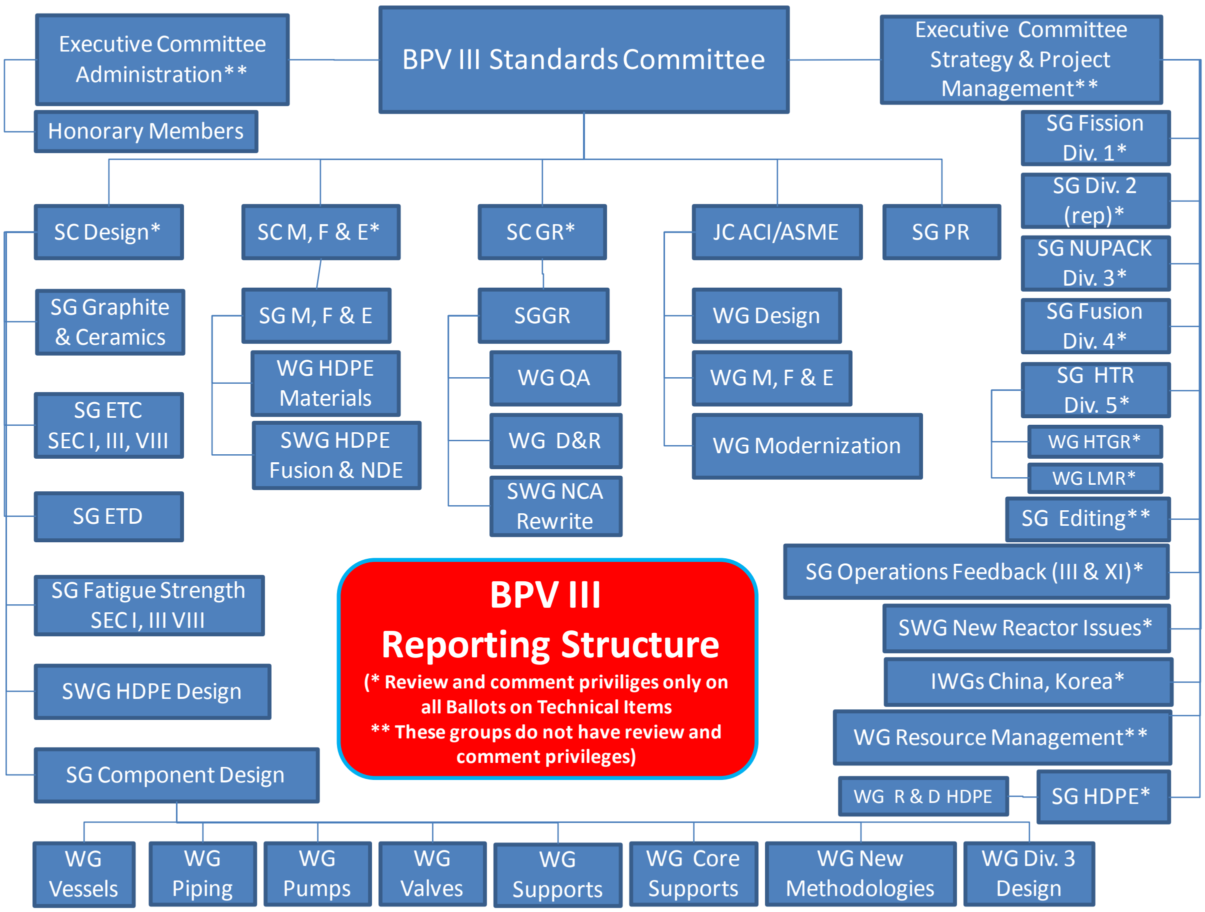


Figure 1—ASME Section III Organization Chart

Standard ID	Standard ID	Standard ID
Pipes and Tubes	Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)	American Society for Testing and Materials (ASTM)
ASME B36.10	MSS SP-43	ASTM C 231
ASME B36.19	MSS SP-44	ASTM C 260
Fittings, Flanges and Gaskets	MSS SP-87	ASTM C 266
ASME B16.5	U.S. Army Corps of Engineers	ASTM C 289
ASME B16.9	CRD-C 36	ASTM C 295
ASME B16.11	CRD-C 39	ASTM C 311
ANSI B16.18	CRD-C 44	ASTM C 342
ASME B16.20	CRD-C 119	ASTM C 441
Wound and Jacketed	CRD-C 621	ASTM C 469
ASME B16.21	American Concrete Institute (ACI)	ASTM C 494
ASME B16.22	ACI 211.1	ASTM C 496
Fittings	ACI 214	ASTM C 512
ASME B16.25	ACI 304R	ASTM C 535
ASME B16.28	ACI 305R	ASTM C 586
ASME B16.47	ACI 306R	ASTM C 595
SAE J513	ACI 309R	ASTM C 618
MSS SP-43	ACI 347R	ASTM C 637
MSS-SP-44	American Institute of Steel Construction (AISC)	ASTM C 642
MSS SP-87	…	ASTM C 937
Piping Applications	…	ASTM C 939
MSS SP-97	American Public Health Association (APHA)	ASTM C 940
Socket Welding, Threaded and Buttwelding Ends	APHA-4500-5	ASTM C 943
ANSI/AWWA C207	American Society for Nondestructive Testing (ASNT)	ASTM C 953
API 605	SNT-TC-1A & Supplements	ASTM C 1017
Bolting	American Society for Testing and Materials (ASTM)	ASTM C 1077
ASME B18.2.1	ASTM A 108	ASTM D 92

Figure 2—List of Standards Used in the ASME BPVC

Standard ID	Standard ID	Standard ID
ASME/ANSI B18.2.2	ASTM A 416	ASTM D 512
ASME B18.3	ASTM A 421	ASTM D 609
Threads	ASTM A 490	ASTM D 610
ASME B1.1	ASTM A 513	ASTM D 937
ANSI/ASME B1.20.1	ASTM A 519	ASTM D 938
ANSI B1.20.3	ASTM A 576	ASTM D 974
Standards Supports	ASTM A 615	ASTM D 1411
MSS SP-89	ASTM A 673	ASTM D 1888
Valves	ASTM A 687	ASTM E 23
ASME B16.34	ASTM A 706	ASTM E 94
MSS SP-100	ASTM A 722	ASTM E 142
The American Society of Mechanical Engineers (ASME)	ASTM A 779	ASTM E 165
ASME NQA-1	ASTM B 117	ASTM E 186
ASME QAI-1	ASTM C 31	ASTM E 208
American Society for Nondestructive Testing (ASNT)	ASTM C 33	ASTM E 280
SNT-TC-1A	ASTM C 39	ASTM E 328
American Society for Testing and Materials (ASTM)	ASTM C 40	ASTM E 446
ASTM A 275	ASTM C 42	ASTM F 436
ASTM A 673	ASTM C 78	
ASTM E 8	ASTM C 94	
ASTM E 23	ASTM C 109	
ASTM E 94	ASTM C 114	
ASTM E 142	ASTM C 115	
ASTM E 185	ASTM C 117	
Power Reactor Vessels	ASTM C 123	
ASTM E 186	ASTM C 127	
ASTM E 208	ASTM C 128	
ASTM E 213	ASTM C 131	
ASTM E 280	ASTM C 136	

Figure 2—List of Standards Used in the ASME BPVC (cont.)

Standard ID	Standard ID	Standard ID
ASTM E 446	ASTM C 138	
ASTM E 606	ASTM C 142	
ASTM E 883	ASTM C 143	
American Welding Society (AWS)	ASTM C 150	
AWS A4.2	ASTM C 151	
American Welding Society (AWS)	ASTM C 157	
AWS A4.2	ASTM C 172	
AWS A5.1	ASTM C 173	
AWS A5.5	ASTM C 183	
AWS A5.18	ASTM C 191 Standard Test Method for Time of Setting Hydraulic Cement by Vicat Needle 1999	
AWS A5.20	ASTM C 192	
AWS A5.28	ASTM C 204	
AWS D1.1	ASTM C 227	

Figure 2—List of Standards Used in the ASME BPVC (cont.)

2.2 Background Information on AFCEN

AFCEN is an association that was founded in October 1980 by Electricité de France (EDF) and Framatome. The first RCC-M Specification was issued in 1980 and the first official and complete issue was released in 1984. At that time, it was based on a combination of the ASME Section III Code, Westinghouse pressurized water reactor (PWR) Design Specifications and French construction practices. Over time, it evolved to adopt provisions and experience feedback from the French regulatory requirements; later from the German and French cooperation and even later from the European standard practices. The recent modifications of this code now integrate any international regulation.

AFCEN's purpose is:

- To establish detailed and practical rules for the design, manufacture, installation, commissioning and in-service inspection of components for nuclear islands used for power generation stations
- To publish, under code form, the texts corresponding to these rules, after approval by expert groups
- To revise and update these rules on the basis of, in particular:
  - Experience
  - Technological advancements
  - Changes in regulatory requirements
  - Operational feedback.

In 2008, AFCEN integrated associate members: APAVE Group, Bureau VERITAS, AIB-VINCOTTE (Belgian), all three being notified inspection bodies recognized by the French Nuclear Safety Authority. Later in 2009, the Commissariat à l'Energie Atomique Français (CEA) and other services such as AREVA-TA or the French DCN (known as DCNS since 2007), both involved in PWR activities related to nuclear boilers, submarines and ships, were also integrated as associate members of AFCEN.

In 2010, AFCEN expanded membership to allow any nuclear organization to become a member and participate in AFCEN activities.

The AFCEN working methods are similar to ASME Section III working organization, through Board, Committees, Subcommittees, Working Groups, Task Groups, etc., that meet periodically to answer Code Interpretation Sheets and work on Code Modification Sheets in support of modification review/approval and incorporation into addenda or new editions. The AFCEN Organization Chart is provided in Figure 3.

AFCEN publications are currently available in French, English and Chinese. In addition to the RCC-M Code, which is the code discussed here in this report and focuses on Design and Conception Rules for Mechanical Components of PWRs, AFCEN has published multiple other RCC and RSE, which are mentioned in Figure 4.

A list of the standards referenced in the RCC-M is provided in Figure 5.

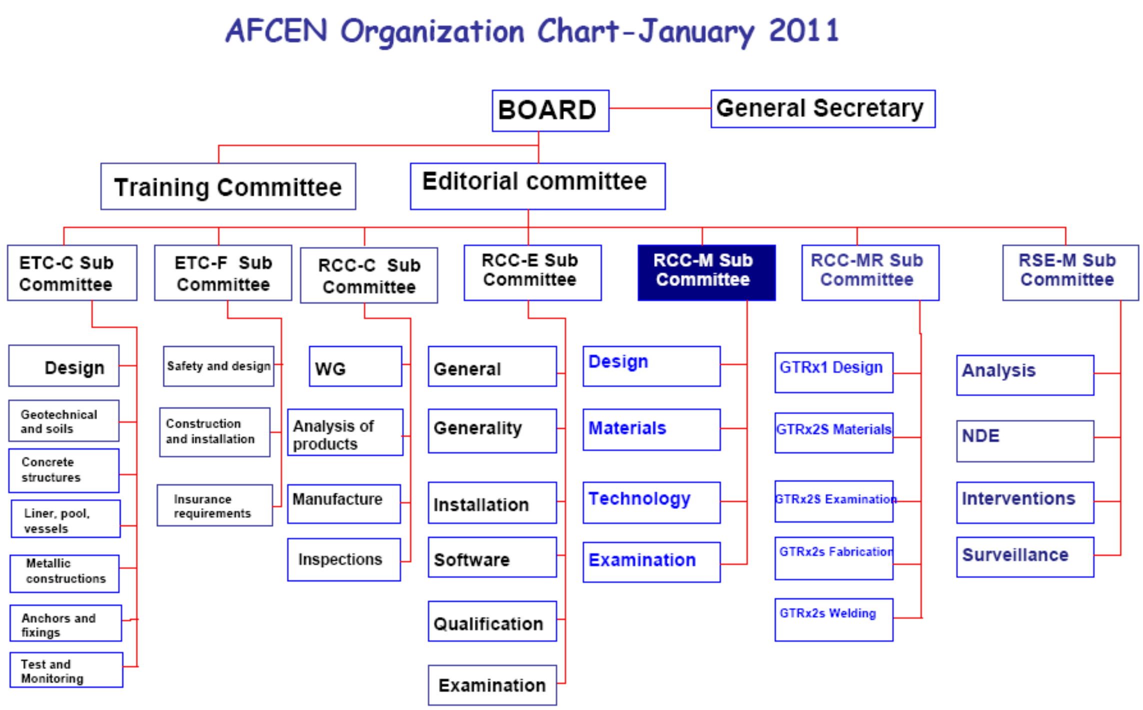


Figure 3—AFCEN Organization Chart

The AFCEN Codes

AFCEN PWR reactors codes:

- RCC-M Mechanical components
- RCC-C Nuclear Fuel
- RCC-E Electrical Equipment
- ETC-C Civil Works
- RSE-M In-service surveillance of mechanical components
- ETC-F Fire protection

AFCEN FBR and experimental reactors codes:

- RCC-MR Mechanical components of FBR reactors (2007)

  To be replaced by:
- RCC-MRx Mechanical components for Experimental Reactors

PWR: Pressurized Water Reactor
FBR: Feed Breeder Reactor
RCC: **R**ules for Design and **C**onstruction of **C**omponents of PWR Nuclear Islands
ETC: **E**PR™ **T**echnical **C**ode

Figure 4—AFCEN Codes

Standard ID	Standard ID	Standard ID	Standard ID
NF A 03-652	NF EN 1713 + Amendment A1 + Amendment A2	NF EN 10283	NF EN ISO 15614-8
NF A 04-308	NF EN 1779	NF EN 10307	NF ISO 68-1
NF A 05-150	NF EN 10002-1	NF EN 12072	NF ISO 262
NF A 05-152	NF EN 10002-2	NF EN 12223	NF ISO 965-2
NF A 05-165	NF EN 10002-4	NF EN 12330	NF T 30-900
NF A 32-054	NF EN 10002-5	NF EN 12668-1 + Amendment A1	NF T 30-901
NF A 35-557	NF EN 10021		NF T 30-903
NF A 36-200	NF EN 10025-1	NF EN 12668-2 + Amendment A1	ASME/ANSI B16.5
NF A 36-210	NF EN 10025-2		ASME/ANSI B16.9
NF A 36-250	NF EN 10027-2	NF EN 12668-3 + Amendment A1	ASME/ANSI B16.11
NF A 36-605	NF EN 10028-1 + Amendment A1	NF EN 12681	ASME/ANSI B16.25
NF A 36-606	NF EN 10028-2	NF EN 13184	ASME/ANSI B16.28
NF A 45-201	NF EN 10028-3	NF EN 13185	ASME/ANSI B16.34
NF A 45-202	NE EN 10028-7	NF EN 20273	ANSI/ASME B36.10M
NF A 45-205	NF EN 10045-1	NF EN 20898-2	ANSI/ASME B36.19M
NF A 45-209	NF EN 10045-2	NF EN 24497	ASTM A 370
NF A 45-255	NF EN 10052	NF EN 25580	ASTM E 83
NF A 49-213	NF EN 10083-1	NF EN 45014	ASTM E 186
NF A 49-214	NF EN 10083-2	NF EN ISO 544	ASTM E 192
NF A 49-281	NF EN 10083-2	NF EN ISO 643	ASTM E 208
NF A 49-285	NF EN 10084	NF EN ISO 683-17	ASTM E 272
NF A 49-871	NF EN 10088-2	NF EN ISO 898-1	ASTM E 280
NF A 49-872	NF EN 10088-3	NF EN ISO 945	ASTM E 446
NF A 91-101	NF EN 10160	NF EN ISO 2162-2	ASTM E 813
NF E 05-017*	NF EN 10164	NF EN ISO 3452-2	ASTM G 36
NF E 05-051	NF EN 10204	NF EN ISO 3452-3	ASTM G 38
NF E 25-403	NF EN 10213-2	NF EN ISO 3506-1	AWS A 5.1

Figure 5—List of Standards Used in the RCC-M Code

Standard ID	Standard ID	Standard ID	Standard ID
NF E 25-404	NF EN 10213-3	NF EN ISO 3506-2	AWS A 5.4
NF E 29-005	NF EN 10213-4	NF EN ISO 3887	AWS A 5.5
NF E 29-031	NF EN 10216-1 + Amendment A1		AWS A 5.9
NF E 29-851		NF EN ISO 4032	AWS A 5.17
NF E 29-882		NF EN ISO 4034	AWS A 5.18
NF E 29-883		NF EN ISO 4063	AWS A 5.20
NF E 29-884	NF EN 10216-2 +	NF EN 10269 + Amendment A1	NF EN ISO 9606-4
NF E 32-103	Amendment A1	NF EN ISO 4126-1	NF EN ISO 8493
NF E 44-001	NF EN 10216-3 +	NF EN ISO 4126-2	NF EN ISO 14344
NF E 44-002	Amendment A1	NF EN ISO 4126-3	NF EN ISO 15609-1
NF EN 287-1 +	NF EN 10216-5	NF EN ISO 4126-4	NF EN ISO 15614-1
Amendment A2	NF EN 10217-1 +	NF EN ISO 4126-5	AWS A 5.23
NF EN 462-1	Amendment A1	NF EN ISO 4126-6	ISO 1027
NF EN 462-2	NF EN 10217-2 + Amendment A1	NF EN ISO 4126-7	ISO 4628/3
NF EN 473 + Amendment A1	NF EN 10217-7	NF EN ISO 4759-1	ISO 9001
NF EN 499	NF EN 10222-1 + Amendment A1	NF EN ISO 6506-1	ISO 9002
NF EN 571-1	NF EN 10222-2	NF EN ISO 6506-2	ISO 9717
NF EN 583-1 + Amendment A1	NF EN 10222-5	NF EN ISO 6506-3	IS US 319-21
NF EN 583-2	NF EN 10246-5	NF EN ISO 6506-4	MSS SP 43
NF EN 583-5 + Amendment A1	NF EN 10246-6	NF EN ISO 6507-1	Specifications for blasting by abrasives (O.N.H.G.P.I.)
NF EN 584-1	NF EN 10246-7	NF EN ISO 6507-2	Rules for fire protection
NF EN 764-7	NF EN 10250-1	NF EN ISO 6507-3	Recommendation 543.77 of I.I.S. Commission XII
NF EN 895	NF EN 10250-2	NF EN ISO 6507-4	A.I.E.A. no. 50 C SG Q

Figure 5—List of Standards Used in the RCC-M Code (cont.)

Standard ID	Standard ID	Standard ID	Standard ID
NF EN 910	NF EN 10250-3	NF EN ISO 6508-1	IIS/IIW 146.64
NF EN 1043-1	NF EN 10250-4	NF EN ISO 6508-2	ISC 319.20
NF EN 1369	NF EN 10263-1	NF EN ISO 6508-3	ISM 319.30
NF EN 1371-1	NF EN 10263-2	NF EN ISO 6520-1	Standard TEMA
NF EN 1418	NF EN 10263-3	NF EN ISO 6847	
NF EN 1593	NF EN 10263-4	NF EN ISO 7438	
NF EN 1597-1	NF EN 10263-5	NF EN ISO 7500-1	
NF EN 1600	NF EN 10269 + Amendment A1	NF EN ISO 8492	

Figure 5—List of Standards Used in the RCC-M Code (cont.)

2.3 Background Information on JSME

Historically, detailed technical rules and requirements on the design and construction activities for nuclear power plants in Japan were provided by the government as part of the government regulation system such as MITI Ordinance No. 62 and Notification No. 501. During the period of late 1990s, which was right after the WTO/TBT agreement was in effect in 1994, there evolved discussions that the government regulation should be performance-based and that Standards Development Organization's (SDO's) codes and standards should be applied as detailed technical codes (Reference [4]).

The Committee on Power Generation Facility Code was established within the Japan Society of Mechanical Engineers (JSME) in October 1997 to provide technically sound codes and standards to protect people's safety from industrial hazards and to promote industry development and competitiveness. Behind the scene, a consensus was reached between the regulator and the industry that the regulatory body endorsed and applies SDO codes and standards for their regulation of nuclear power plants in Japan.

Under the main committee, there are four subcommittees that include thermal power, nuclear power, fusion power and materials, as are shown in Figure 6. The subcommittee on nuclear power is responsible for developing, maintaining and revising JSME nuclear codes and standards, and has in its under-tier 12 subgroups such as design and construction, materials, fitness for service and so on. The organization of the subcommittee on nuclear power is shown in Figure 7. Each of these subgroups is responsible for a code book and many of these subgroups have several working groups.

As of today, total of about 350 volunteers are actively committed to the JSME Codes and standards development and maintenance activities. These volunteers come from various sectors. These include industry (utilities, nuclear systems and component suppliers and steel makers), laboratories and research institutes, university academia, government organizations and regulatory agencies.

Since its foundation in 1997, the committee has issued a number of codes in the fields of thermal power, nuclear power and fusion power. The latest editions of the JSME nuclear codes are listed in Figure 8 and the standards referenced in the JSME Code are listed in Figure 9. Note that the codes for spent fuel transport/storage casks and for spent fuel reprocessing facilities are included in JSME nuclear codes. Beside these code books, a number of code cases have been issued.

The first nuclear code published by JSME was JSME S NA1-2000, Rules on Fitness-for-Service for NPPs, which was a counterpart of ASME Section XI. The first edition of Rules on Design and Construction for NPPs, which is a counterpart of ASME Section III, was published in 2001. Since then, the JSME nuclear code editions have basically been published in every three to five years. Between these editions addenda have been issued generally on a yearly basis.

As was mentioned earlier, these JSME nuclear codes are subjected to technical evaluation conducted by the Japan Nuclear Energy Organization (JNES)[1], and then endorsed by the Nuclear and Industry Safety Agency (NISA).

Among these nuclear codes, JSME S NA1-2008, Rules on Fitness-for-Service for NPPs, JSME S NB1-2007, Rules on Welding for NPPs and JSME S NC1-2007, Rules on Design and Construction for NPPs, Div. 1 LWRs, have been endorsed by NISA, the government regulatory body, and applied to the regulation of LWR nuclear activities of design, construction, maintenance and repair.

[1]JNES is a Technical Support Organization (TSO) for NISA.

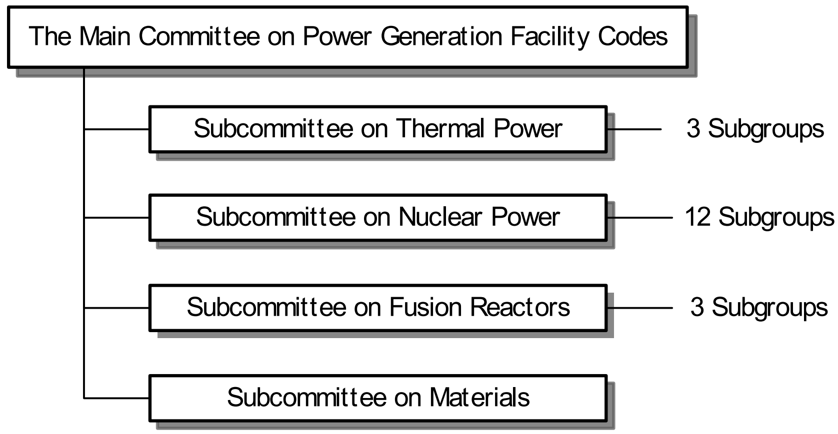


Figure 6—Organization of JSME Main Committee

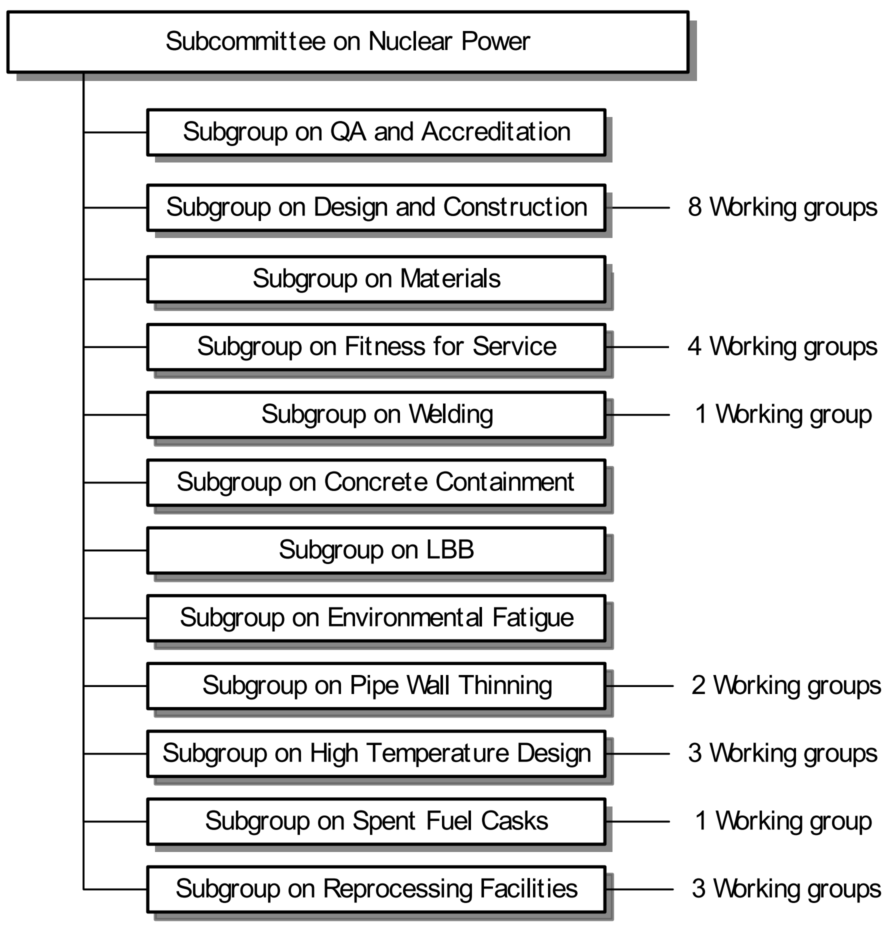


Figure 7—Organization of JSME Subcommittee on Nuclear Power

Code No.	Title of Code	ASME BP&V Code Counterpart
JSME S NA1-2008	Rules on Fitness-for-Service for NPPs	Section XI
JSME S NB1-2007	Rules on Welding for NPPs	Section V
JSME S NC1-2008	Rules on Design and Construction for NPPs, Div. 1 LWRs	Section III, Div.1
JSME S NC2-2009	Rules on Design and Construction for NPPs, Div. 2 FBRs	Section III, Div. 1, Subsection NH
JSME S ND1-2002	Rules on Protection Design against Postulated Pipe Rupture for NPPs (LBB)	
JSME S NE1-2003	Rules on Concrete Containment Vessels for NPPs	Section III, Div. 2
JSME S NF1-2009*	Environmental Fatigue Evaluation Method for Nuclear Power Plants	
JSME S NG1-2006	Rules on Pipe Wall Thinning Management for PWR Power Plants	
JSME S NH1-2006	Rules on Pipe Wall Thinning Management for BWR Power Plants	
JSME S NJ1-2011	Rules on Materials for Nuclear Facilities (to be published)	Section II
JSME S RA1-2010	Rules on Design for Reprocessing Facilities of Spent Nuclear Fuel	
JSME S FA1-2007	Rules on Transport/Storage Packagings for Spent Nuclear Fuel	
JSME S FB1-2003	Rules on Concrete Casks, Canister Transfer Machines and Canister Transport Casks for Spent Nuclear Fuel	
JSME S KA1-2008*	Rules on Superconducting Magnet Structure	

* English translation version available.

Figure 8—List of Latest JSME Nuclear Codes and Standards

JSME Rules on Design and Construction for NPP, Div.1		Used Codes & Standards
Subsection	**No.**	**Number and Title of Codes and Standards**
Subsection 1 General Requirements	GNR-1110	JSME S NE1-2003 :Rules on Concrete Containment Vessels for Nuclear Power Plant
	GNR-1122	JSME S NB1-2007: Rules on Welding for Nuclear Power Plant
	GNR-1122	JSME S NJ1-2008: Rules on Materials for Nuclear Power Facilities
	GNR-1122	JEAG 4601-Supplement-1984: Technical Guidelines for Aseismic Design of Nuclear Power Plant Part of Classification and Allowable Stress
	GNR-1122	JEAG 4601-1987: Technical Guidelines for Aseismic Design of Nuclear Power Plant
	GNR-1122	JEAG 4601-Supplement-1991: Technical Guidelines for Aseismic Design of Nuclear Power Plant
	GNR-1260	JIS Z 8203: SI Units and Recommendations for the Use of Their Multiples and of Certain Other Units
Subsection 2 Mechanical Testing	GTM-1120	JIS G 0202: Glossary of Terms Used in Iron and Steel (Testing)
	GTM-1120	JIS G 0201:Glossary of Terms Used in Iron and Steel (Heat Treatment)
	GTM-1130	JIS Z 2241: Method of Tensile Test for Metallic Materials
	GTM-1130	JIS Z 2242: Method of Charpy Pendulum Impact Test of Metallic Materials
	GTM-2120	JIS Z 2201: Test Pieces for Tensile Test for Metallic Materials
	GTM-3220	JIS Z 2242: Method of Charpy Pendulum Impact Test of Metallic Materials
Subsection 3 Non-destructive Testing	GTN-1120	JIS Z 2300: Terms and Definitions of Nondestructive Testing
	GTN-2212	JIS Z 2352: Method for Assessing the Overall Performance Characteristics of Ultrasonic Pulse Echo Testing Instrument
	GTN-4141	JIS Z 4606: Industrial X-ray Apparatus for Radiographic Testing

Figure 9—List of Standards Used in the JSME Code

JSME Rules on Design and Construction for NPP, Div.1		Used Codes & Standards
Subsection	**No.**	**Number and Title of Codes and Standards**
	GTN-4141	JIS Z 4560: Industrial γ-ray Apparatus for Radiography
	GTN-4143	JIS Z 2306: Radiographic Image Quality Indicators for Non-destructive Testing
	GTN-4145	JIS Z 4561: Viewing Illuminators for Industrial Radiograph
Subsection 3 Non-destructive Testing	GTN-4231	JIS G 0581: Methods of Radiographic Examination for Steel Castings
	GTN-6210	JIS G 0565: Method for Magnetic Particle Testing of Ferromagnetic Materials and Classification of Magnetic Particle Indication
	GTN-7210	JIS Z 2343-1: Non-destructive Testing-Penetrant Testing-Part 1: General Principles-Method for Liquid Penetrant Testing and Classification of the Penetrant Indication
	GTN-7260	JIS Z 2343-3: Non-destructive Testing-Penetrant Testing-Part 3: Reference Test Blocks
Subsection 4 Vessels	Appendix 4-1	JEAC 4206: Method of Verification Tests of the Fracture Toughness for Nuclear Power Plant Components
Subsection 5 Pipes	PPB-3414	JIS B 2238: General Rules for Steel Pipe Flange
	PPB-3414	JIS B 2239: General Rules for Cast Iron Pipe Flange
	PPB-3414	JIS B 8265: Construction of Pressure Vessel-General Principles (Amendment-1)
	PPB-3415	JIS B 2312: Steel Butt-welding Pipe Fittings (Amendment-1)
	PPB-3415	JIS B 2313: Steel Plate Butt-welding Pipe Fittings (Amendment-1)
	PPB-3415	JIS B 2316: Steel Socket-welding Pipe Fittings
	PPD-3415	JIS B 2301: Screwed Type Malleable Cast Iron Pipe Fittings
	PPD-3415	JIS B 2302: Screwed Type Steel Pipe Fittings
	PPD-3415	JIS B 2303: Screwed Drainage Fittings

Figure 9 (cont.) —List of Standards Used in the JSME Code

JSME Rules on Design and Construction for NPP, Div.1		Used Codes & Standards
Subsection	**No.**	**Number and Title of Codes and Standards**
	PPD-3415	JIS B 2311: Steel Butt-welding Pipe Fittings for Ordinary Use (Amendment-1)
	PPD-3415	JIS G 3443-2: Coated Steel Pipes for Water Service-Part 2: Fittings
	PPD-3415	JIS G 5527: Ductile Iron Fittings
	PPH-3040	JIS B 2240: Copper Alloy Pipe Flanges
	Appendix 5-A	JSME S 012-1998: Guide Line for Evaluation of Flow-induced Vibration of a Cylindrical Structure in a Pipe
Subsection 5 Pipes	Appendix 5-B	JSME S 017-2003: Guide Line for Evaluation of High-cycle Thermal Fatigue of a Pipe
Subsection 10 Safety Valves	SRV-1120	JIS B 8210: Steam Boilers and Pressure Vessels-Spring Loaded Safety Valves
	SRV-1120	JIS B 0100: Glossary of Terms for Valves
	SRV-3113	JIS B 8226: Bursting Discs and Bursting Disc Assemblies
Explanation Subsection 1 General Requirements	Table GNR-1220-1	JEAC 4602-2004: Code for Defining Range of Reactor Coolant Pressure Boundary and Reactor Containment Vessel Boundary
	Table GNR-1220-2	JEAC 4605-2004: Definition Code of Engineered Safety Features and Related Features for Nuclear Power Plants
Explanation Subsection 2 Mechanical Testing	GTM-3320	JEAC 4202-1991: Drop-weight Test Method of Ferritic Steels
Explanation Subsection 3 Non-destructive Testing	GTN-2130	JIS Z 2305: Non-destructive Testing-Qualification and Certification of Personnel
	GTN-2141	JEAG 4207-1996: Ultrasonic Examination for Inservice Inspection of Light Water Cooled Nuclear Power Plant Components
	GTN-2142	JEAC 4111-2003: Quality Assurance Code for Safety in Nuclear Power Plant
	GTN-3222	JIS G 0582: Ultrasonic Examination for Steel Pipes and Tubes

Figure 9 (cont.) —List of Standards Used in the JSME Code

JSME Rules on Design and Construction for NPP, Div.1		**Used Codes & Standards**
Subsection	**No.**	**Number and Title of Codes and Standards**
	GTN-5151	JIS G 0568: Eddy Current Testing Method for Steel Products by Encircling Coil Technique
	GTN-5151	JIS G 0583: Eddy Current Examination of Steel Pipes and Tubes
	GTN-7141	JIS Z 2343: Method for Liquid Penetrant Testing and Classification of the Indication
	GTN-8151	NDIS 3414-1989: General Rules for Visual Testing Method
Explanation Subsection 4 Vessel	PVB-2221	JIS G 0307: Steel Castings-General Technical Delivery Requirements
	PVC-3920	JIS B 8501: Welded Steel Tanks for Oil Storage
	PVE-3710	JIS B 8265: Construction of Pressure Vessel-General Principles (Amendment-1)
Explanation Subsection 5 Pipes	PPH-3020	JIS A 4009: Components of Air Duct
Explanation Subsection 6 Pumps	PMB-3110	JIS B 0131: Glossary of Terms for Turbopumps
Explanation Subsection 8 Support Structures	Figure SSB-3131-1	Architectural Institute of Japan Design Standard for Steel Structures
Explanation Subsection 12 Surveillance Test	RST-1130	JEAC 4201-2004: Method of Surveillance Tests for Structural Materials of Nuclear Reactors
	RST-1230	JIS B 7722: Charpy Pendulum Impact Test-Verification of Testing Machines

Figure 9 (cont.) —List of Standards Used in the JSME Code

2.4 Background Information on KEA

The Korea Electric Association is the sole organization in Korea that maintains and develops the technical standards in the power industry field. In 2001, KEA was registered as a private collective standards development organization at the ISO/IEC information center. The association pursues improved domestic technical power in Korea's power industry, continuously reflects power plant construction and operation experience and advances the standardization technology by continuously maintaining and managing KEPIC.

KEPIC is an organization standard that was developed by industry bodies with the support of the government to secure the stability/reliability and quality of electric power industry facilities and equipment. It is the industry technology standard that comprehensively provides the technological guidelines for the overall stages from design, fabrication and installation to construction, testing, inspections, operation, etc.

KEPIC was developed by the KEPCO since 1992, after the feasibility study of 1987 as part of the government's policy of self-reliant nuclear power technology, and the related works have been transferred to the nonprofit organization, the Korea Electric Association, in accordance with government policy of 1995. KEPIC committees were formed and KEPIC 1995 edition was issued in the same year.

The KEPIC Technical Committee has been expanded and reorganized many times to form the current organization (Figure 10) with one Policy Committee, 8 Technical committees and 33 subcommittees, and approximately 400 specialists in related fields are now working, including the Regulatory Agency, Utilities, Industries, Academies, Research Institutes, Authorized Inspection Agencies, etc.

Originally, KEPIC was developed with a focus on the standards of nuclear power safety as related with pressurized light water reactors. However, it has been expanded through the 2000 edition, 2005 edition and 2010 edition (338 types). Currently, as shown in Figure 11, standards related with nuclear and thermal power generation have been maintained and developed by each technical field.

KEPIC has been endorsed with the application of nuclear power plants in Korea through the government's public announcement, as shown in Figure 12, since the 1995 edition. To note, in July 2010, KEPIC was endorsed by the UAE regulatory organization (FANR), for the application codes for nuclear power plants constructed in the UAE.

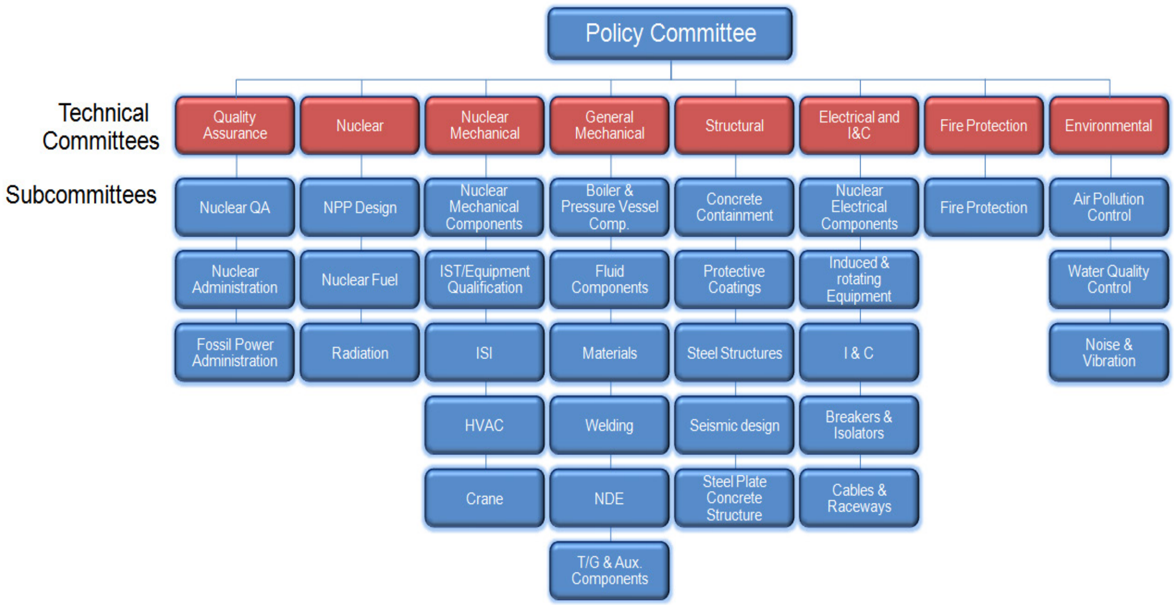


Figure 10—KEPIC Committee Organization Chart

Part	Subpart	Reference Codes & Standards
Quality Assurance (KEPIC-Q)	QAP : Nuclear Quality Assurance	ASME NQA-1
	QAI : Authorized Inspection	ASME QAI-1
	QAR : Registered Professional Engineer	ASME Sec.III App.XXIII
Mechanical (KEPIC-M)	MN : Nuclear Mechanical Components	ASME Sec.III Div.1&3
	MG : Non-nuclear Mechanical Components	ASME Sec.VIII, HEI, API
	MC : Cranes	ASME NOG-1, CMAA 70
	MH : HVAC	ASME AG-1
	MD : Materials	ASME Sec.II
	ME : Non-destructive Examination	ASME Sec.V
	MQ : Welding &Brazing Qualification	ASME Sec.IX
	MI : In-service Inspection	ASME Sec.XI
	MO : In-service Testing	ASME OM
	MF : Qualification of Mechanical Equipment	ASME QME-1
	MB : Power Boilers	ASME Sec.I
	MT : Turbine &Generators	Manufacturer's Spec.
	MP: Performance Tests	ASME PTC Series
Electrical (KEPIC-E)	EN : Class 1E Equipment	IEEE, ANSI, ISA, etc.
	EM: Measuring &Control Equipment	IEEE, ISA, IEC, etc.
	EE : Electric Equipment	NEMA, IEC, ANSI, etc.
	EC : Cables &Raceways	ASTM, NEMA, IEEE, etc.
	ET : Transmission, Transformation and Distribution	IEC, IEEE, etc.
Structural (KEPIC-S)	SN : Nuclear Structures	ASME Sec.III Div.2, ACI 349, etc.
	SG : Non-nuclear Structures	ACI 318, AISC, etc.
	ST : Extra-provisions for Structures	ASCE 4/7
	SW: Structural Welding	AWS D1.1/D1.3
Nuclear (KEPIC-N)	NF : Nuclear Fuels	ASTM, Manufacturer's Spec.
	ND : Design of Nuclear Power Plants	ANS 51.1 etc.
	NR : Radiation Protection Facilities	ANS 6.4, 18.1 etc.
	NW : Radioactive Waste Processing System	ANS 55.1, 55.4, 40.35 etc.

Figure 11—KEPIC Codes and Standards List (based on 2010 Edition)

Part	Subpart	Reference Codes & Standards
Fire Protection (KEPIC-F)	FP : Fire Protection for Nuclear &Fossil Power Plants	NFPA 803/804/805, etc.
Environmental (KEPIC-G)	GG : Air Pollution Control GS : Noise & Vibration GW : Water Treatment	- - -

Figure 11 (cont.) —KEPIC Codes and Standards List (based on 2010 Edition)

Regulatory Body	Regulation No. (Notice)	Scope	Related KEPIC
MEST (Ministry of Education, Science and Technology)	2010-28	General Application of KEPIC for Nuclear Power Plants (2005 Ed. Thru. 2006 2nd Add.)	QA, MN/MI/MO/MF, MH/MCN, EN/EM, SN/ST, FPN
	2009-37	Safety Valves and Relief Valves of Nuclear Reactor Facilities (Formerly 2008-15)	MD, MN
		Detailed Requirements for Quality Assurance (Formerly 2008-11)	QAP
		Safety Classification and Applicable Codes and Standards (Formerly 2008-13)	MN, EN, SN
		In-service Inspection (Formerly 2009-23)	MI
		In-service Testing (Formerly 2008-24)	MO
MKE (Ministry of Knowledge Economy)	2009-35	Substitutive Application of KEPIC for Fossil Power Plants	MB, MG, MT, MD, ME, MQ

Figure 12—KEPIC Endorsement Status by Korea Ministries

2.5 Background Information on CSA

CSA is organized under an Executive Management Group known as the CSA Group: The Group has oversight over three major areas: CSA Standards, OnSpex and CSA International.

The role of CSA Group is to foster operational excellence. The CSA Group harnesses the talents of people and the power of technology to create new products and services that respond to the needs of stakeholders and society at large. These efforts are supported by the effective management of financial and technological resources, risk and organizational change; legal and investigative support services; human resource recruitment and development; and a wide range of marketing activities designed to establish top of mind awareness of CSA among members, current and potential customers and other key stakeholders.

If no standard exists, CSA provides a structure and a forum for developing the standard. A committee is created using a "balanced matrix" approach, which means that each committee is structured to capitalize on the combined strengths and expertise of its members — with no single group or matrix category dominating. The committee considers the views of all participants and develops the details of the standard by consensus process. Substantial agreement among committee members, rather than a simple majority of votes, is necessary. When a draft standard has been agreed upon, it is submitted for public review, and amended if necessary. All CSA standards are regularly reviewed by committee members and updated to reflect current requirements. This inclusive approach results in standards that meet the needs and practical realities faced by diverse stakeholders. And because they have been developed by members from particular areas of expertise, they are readily accepted and applied by business, consumers and regulators. By representing the interests of diverse members, CSA builds integrity into every standard published.

Many CSA standards are cited in legislation at federal, provincial, state and municipal levels across North America. Many are internationally or regionally harmonized. All are the result of the expertise and experiences of some 9000 members who develop the standards. CSA may take the initiative to develop a document, but more often the organization responds to requests from government, industry or consumers. If a standard is needed, CSA looks to its international counterparts to see whether an existing standard can be adopted.

CSA International offers testing and certification programs that correspond to about 40 percent of CSA standards. Sometimes, industry seeks certification because laws and regulations stipulate that certain products meet a standard before they are put on the market. Sometimes, an industry group or association requires its members to follow a certain standard. And sometimes, a company voluntarily seeks the mark because it conveys a meaningful message to consumers. The CSA mark, which appears on everything from DVD players to plumbing products…gas appliances to windows and doors… electrical goods to computer hardware, indicates that the product meets the requirements of the applicable standards. CSA marks are accepted by regulatory authorities in the occupational health and safety, electrical, gas, building, plumbing and many other fields in the U.S. and Canada.

CSA Group's newest division, OnSpeX, provides a full range of product verification, testing, evaluation, inspection and advisory services specifically designed to help clients accelerate supply chains, increase product sales, build customer satisfaction and lower product return rates. At the product design stage, OnSpeX can help determine what relevant safety standards, regulations and codes may be applicable — and evaluate compliance-critical factors. It can also provide detailed written specifications for existing products based on materials, physical characteristics, features, packaging attributes and safety and regulatory requirements.

The Canadian Standards Association functions as a neutral third party, providing a structure and a forum for developing the standard. Its committees are created using a "balanced matrix" approach, which means that each committee is structured to capitalize on the combined strengths and expertise of its members — with no single group dominating.

The committee considers the views of all participants and develops the details of the standard by a consensus process, which includes the principles of inclusive participation, and respect for diverse interest and transparency. Substantial agreement among committee members, rather than a simple majority of votes, is necessary. When a draft standard has been agreed upon, it is submitted for public review, and amended if necessary.

The committee's standards are living documents, continually revised and refreshed to address changing requirements and emerging technologies. Each standard is reviewed at least every five years as part of the process of continual improvement.

The governance of the CSA Standards development process is depicted Figure 13.

The standards development process under which CSA and other Standards Development Organizations operate is well developed and formally documented and controlled. This process includes eight distinct stages:

- Preliminary Stage: On receipt of a request for the development of a standard, an evaluation is conducted and the project is submitted for authorization.
- Proposal Stage: Public notice of intent to proceed is published and a Technical Committee is formed — or the project is assigned to an existing Technical Committee.
- Preparatory Stage: A working draft is prepared and a project schedule is established.
- Committee Stage: The Technical Committee or Technical Subcommittee — facilitated by CSA staff — develops the draft through an iterative process that typically involves a number of committee meetings.
- Enquiry Stage: The draft is offered to the public for review and comment, the Technical Committee reaches consensus, CSA staff conduct a quality review and a pre-approval edit is completed.
- Approval Stage: The Technical Committee approves the technical content by letter ballot or recorded vote. A second-level review verifies that standards development procedures were followed.
- Publication Stage: CSA staff conducts a final edit to verify conformity with the applicable editorial and procedural requirements and then publishes and disseminates the standard.
- Maintenance Stage: The standard is maintained with the objective of keeping it up to date and technically valid. This may include the publication of amendments, the interpretation of a standard or clause and the systematic (five-year) review of all standards.

Figure 14 delineates the Standards development flow from the initial request to final publication and its ongoing maintenance.

The CSA Nuclear Standards Program promotes safe and reliable nuclear power industry in Canada and has a positive influence on the international nuclear power industry. While focusing on nuclear power plants, the program area provides guidance for other types of nuclear facilities for selected topics, such as radioactive waste management and environmental releases.

Specifically, the program is designed to:

- Address industry knowledge management challenges by embedding key historical knowledge in documents and exposing young technical personnel to seasoned experts.

- Provide an alternative to Regulatory Documents with consistent guidance to the industry.
- Provide a structure for interpretations of Standards by an "expert panel."
- Meet identified stakeholder needs for Standards on which to base future work.
- Provide standards and forums to support licensing and regulation.

Users of the Nuclear Standard are reminded that the design, fabrication, installation, commissioning and operation of nuclear facilities in Canada are subject to the provisions of the Act and its Regulations. The Canadian Nuclear Safety Commission (CNSC) specifies regulatory and administrative requirements for pressure-retaining systems in their Regulations and regulatory documents. Where CNSC documents conflict with the requirements of this Standard, the CNSC documents take precedence. In this Standard, the CNSC is referred to as the regulatory authority.

The CSA Nuclear Strategic Steering Committee (NSSC) consists largely of senior executives and managers from the industry and regulators; it operates under the auspices of the CSA and its Board of Directors and Standards Policy Board. The NSSC's primary role is to set the long-term strategic direction for Canadian nuclear standards, and to provide guidance and support to the TC structure.

There are 10 TCs reporting to the NSSC, each covering distinct functional areas. Each TC is headed by a chair and consists of technical experts drawn from across the industry and relevant public interest groups. The TCs generate standards in the areas seen in Figure 15.

The various standards used can be found Figure 16.

The CSA N285 series consists of the following Standards:

- CSA N285.0 – General requirements for pressure-retaining systems and components in CANDU nuclear power plants.
- CAN/CSA-N285.1 – This Standard no longer exists as a separate publication; it was incorporated into CAN/CSA-N285.0-95.
- CAN/CSA-N285.2 – This Standard no longer exists as a separate publication; it is incorporated as Annex I of CSA N285.0-08.
- CAN/CSA-N285.3 – This Standard no longer exists as a separate publication; it is incorporated as Annex J of CSA N285.0-08.
- CSA N285.4 – Periodic inspection of CANDU nuclear power plant components.
- CAN/CSA-N285.5 – Periodic Inspection of CANDU Nuclear Power Plant Containment Components.
- CSA N285.6 Series – Material Standards for reactor components for CANDU nuclear power plants (published with CSA N285.0).
- CSA N285.8 – Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors.

The first edition of CSA Standard CAN3-N285.0, General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants, was issued in March 1981, which superseded the preliminary Standard N285.1 developed in the mid-1970s.

The second edition CSA Standard CAN/CSA-N285.0, General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants, supersedes the edition published in March 1981 and its amendments.

The third edition of the Standards was issued in November 2005, which also incorporated the CSA Standard CAN/CSA-N285.1-M91. Additionally, the fourth edition of CSA Standard CSA-N285.0-06, General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants, supersedes previous editions published in 1995, 1991 and 1981.

The latest edition of the CSA-N285.0 series of Standards was issued in June 2008. This is the first edition of CSA N285.0/N285.6 Series, General requirements for pressure-retaining systems and components in CANDU nuclear power plants/Material Standards for reactor components for CANDU nuclear power plants. It supersedes the previous editions of CSA N285.0 published in 2006, 1995, 1991 and 1981, and the previous editions of the CSA N285.6 Series published in 2005 and 1988.

The CSA N285 series of Standards specifies requirements applicable to nuclear power plants in Canada and references the applicable requirements of the ASME Boiler and Pressure Vessel Code (BPVC). The specific objectives of these Standards are as follows.

- To establish technical requirements for pressure boundary items of CANDU power reactors, in a format that regulatory authorities can reference.
- To establish requirements for each class of system, component or support, consistent with the Nuclear Safety and Control Act (Act) and its Regulations.
- To reference applicable requirements of the ASME BPVC where they are appropriate to CANDU power reactors.
- To specify rules and material requirements for the design, fabrication, installation, quality assurance and inspection of those pressure-retaining components and supports for which the ASME BPVC does not specify requirements.
- To establish rules for the periodic inspection of pressure-retaining components in CANDU nuclear power plants.

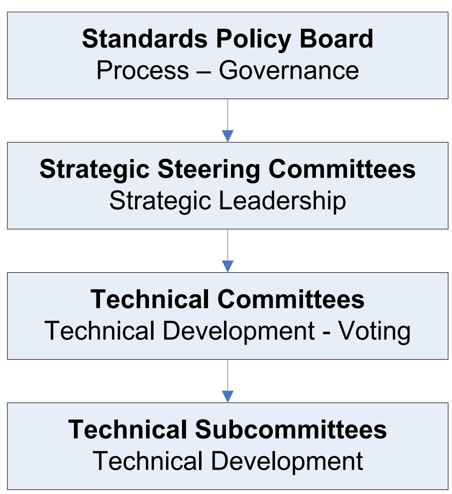


Figure 13—Governance of the CSA Standards

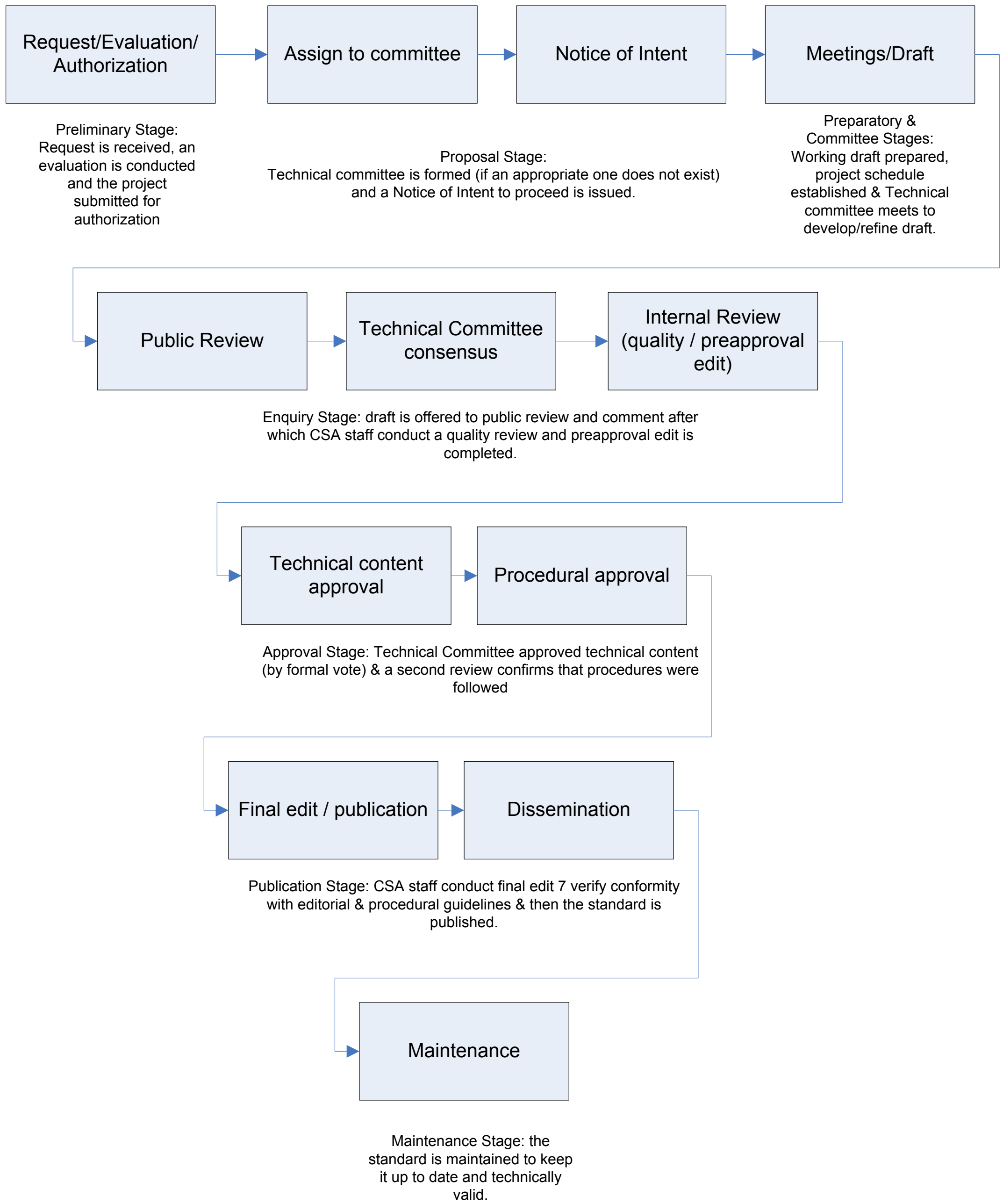


Figure 14—CSA Standards Development Process

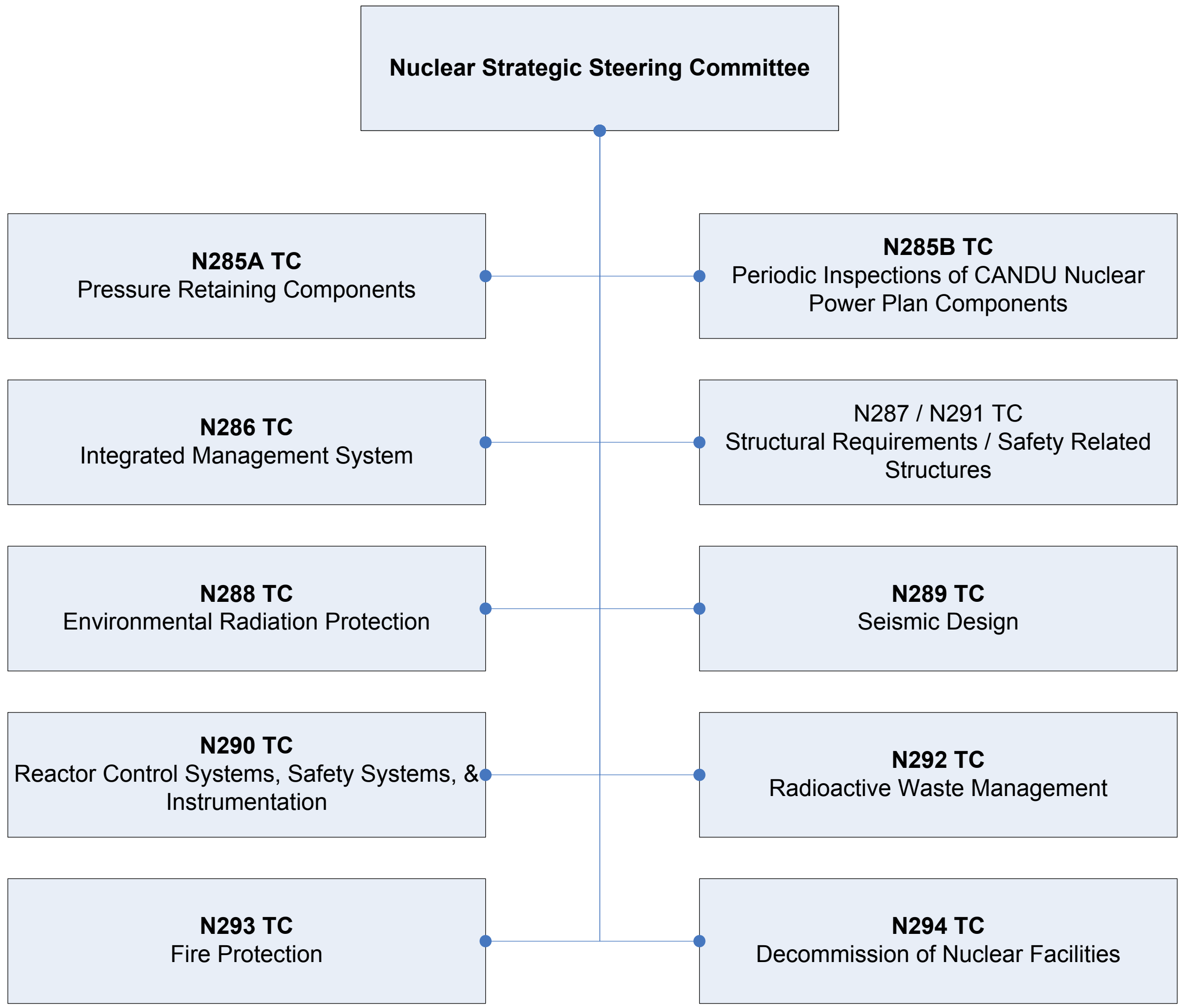


Figure 15—NSSC and TC Organization Chart

Standard	Title of the Standard
N285.0/N285.6	SERIES General Requirements for pressure-retaining systems and components in CANDU nuclear power plants/Material Standards for reactor components for CANDU nuclear power plants
N285.2	Requirements for Class 1C, 2C, and 3C Pressure-Retaining Components and Supports in CANDU Nuclear Power Plants
N285.3	Requirements for Containment System Components in CANDU Nuclear Power Plants
N285.4	Periodic inspection of CANDU nuclear power plant components
N285.5	Periodic inspection of CANDU nuclear power plant containment components
N285.8	Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors
N286	Management System Requirements for Nuclear Power Plants
N286.7	Quality Assurance of Analytical, Scientific and Design Computer Programs for Nuclear Power Plants
N286.7.1	Guideline for the application of N286.7-99, Quality assurance of analytical, scientific and design computer programs for nuclear power plants
N287.1	General Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants
N287.2	Material requirements for concrete containment structures for CANDU nuclear power plants
N287.3	Design Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants
N287.	Construction, fabrication and installation requirements for concrete containment structures for CANDU nuclear power plants
N287.5	Examination and Testing Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants
N287.	Pre-Operational Proof and Leakage Rate Testing Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants
N287.7	In-service examination and testing requirements for concrete containment structures for CANDU nuclear power plants
N288.1	Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities
N288.2	Guidelines for Calculating Radiation Doses to the Public from a Release of Airborne Radioactive Material under Hypothetical Accident Conditions in Nuclear Reactors
N288.4	Environmental monitoring programs at Class I nuclear facilities and uranium mines and mills

Figure 16—List of Standards

Standard	Title of the Standard
N289.1	General requirements for seismic design and qualification of CANDU nuclear power plants
N289.2	Ground motion determination for seismic qualification of nuclear power plants
N289.3	Design procedures for seismic qualification of nuclear power plants
N289.4	Testing Procedures for Seismic Qualification of CANDU Nuclear Power Plants
N289.5	Seismic Instrumentation Requirements for CANDU Nuclear Power Plants
N290.1	Requirements for the Shutdown Systems of CANDU Nuclear Power Plants
N290.13	Environmental Qualification of Equipment for CANDU Nuclear Power Plants
N290.14	Qualification of Pre-Developed Software for Use in Safety-Related Instrumentation and Control Applications in Nuclear Power Plants
N290.15	Requirements for the safe operating envelope of nuclear power plants
N290.4	Requirements for the Reactor Regulating Systems of CANDU Nuclear Power Plants
N290.5	Requirements for Electrical Power and Instrument Air Systems of CANDU Nuclear Power Plants
N290.6	Requirements for monitoring and display of nuclear power plant safety functions in the event of an accident
N291	Requirements for Safety-Related Structures for CANDU Nuclear Power Plants
N292.2	Interim Dry Storage of Irradiated Fuel
N292.3	Management of Low- and Intermediate-Level Radioactive Waste
N293	Fire Protection for CANDU Nuclear Power Plants
N294	Decommissioning of facilities containing nuclear substances

Figure 16 (cont.) —List of Standards

3 GENERAL CODE LAYOUT COMPARISONS

3.1 RCC-M versus ASME General Layout Comparison

Highlights

- ASME information pertaining to nuclear components is presented in various sections, whereas the RCC-M is specific to PWR nuclear island components.
- While the RCC-M may not include certain information found in the ASME BPVC pertaining to the nuclear industry, these requirements are generally found in other AFCEN codes; for example, ASME Section XI versus the RSE-M.

The following paragraphs compare the general layout of the whole RCC-M and ASME BPVC and also the layout of the sections particular to nuclear island components, i.e., Section III Division 1 for the ASME BPVC and Section I for the RCC-M. A comparison of the two layouts and the information they contain can be found in Table 1.

Table 2 provides a comparison of Section I of the RCC-M and ASME Section III Division 1, which both deal with nuclear island components.

These Volumes and Subsections were written with the same objective and this can be illustrated in practice in an overall quasi-identical numbering of the sections as can be seen in Table 2 below. The similarities between these sections of the RCC-M and ASME are further evident in the respective Appendices, where Roman numerals indicate a mandatory appendix, while letters indicate non-mandatory appendices.

Finally, it is worth noting here that a detailed comparison of the structure of the two codes can be misleading as certain requirements integrated directly into the ASME BPVC are addressed in different codes published by AFCEN. For example, rules for in-service inspection of nuclear power plant components, which are defined in ASME Section XI, are not defined in the RCC-M but can be found in AFCEN's RSE-M, "*Règles de Surveillance en Exploitation des Matériels mécaniques des îlots nucléaires REP.*" Another example is that the ASME BPVC includes requirements for metal containments in Subsection NE for Class MC components, while it is the RCC-G that gives very detailed rules concerning concrete and metallic structures.

Table 1—Codes General Layout Comparison

RCC-M	Section Title	ASME Equivalent	Section Title
Section I	*Matériel des îlots nucléaires* (Nuclear Island Components)	Section III	Rules for Construction of Nuclear Power Plants Components
Section II	*Matériaux* (Materials)	Section II and Section III	Materials
Section III	*Méthode de Contrôle* (Examination methods)	Section V and Section III	Nondestructive Examination
Section IV	*Soudage* (Welding)	Section IX and Section III	Qualification Standard for Welding and Brazing procedures, welders, brazers, and weld
Section V	*Fabrication* (Fabrication)	Included in Section III	Fabrication and Installation

* The italic writing in the tables indicates that the text has been taken from the original text in French.

Table 2—Nuclear Island Components Section Layout

RCC-M Section I	Section Title	ASME Section III	Section Title
Volume A	*Généralités* (General Comments)	Subsection NCA	General Requirements for Division 1 and Division 2
Volume B	*Matériels de Niveau 1* (Level 1 Equipment)	Division 1 Subsection NB	Class 1 Components
		Division 1 Subsection NH	Class 1 Components in Elevated Temperature Service
Volume C	*Matériels de Niveau 2* (Level 2 Equipment)	Division 1 Subsection NC	Class 2 Components
Volume D	*Matériels de Niveau 3* (Level 3 Equipment)	Division 1 Subsection ND	Class 3 Components
Volume E	*Petits Matériels* (Small Components)	Part of Division 1 Subsection NC-3900	Zero psi to 15 psi (0 kPa to 100 kPa) Storage Tank Design
Volume G	*Equipements Internes du Réacteur* (Reactor Internals)	Division 1 Subsection NG	Components Core Support Structure
Volume H	*Supports* (Supports)	Division 1 Subsection NF	Components Supports
Volume J	*Réservoirs de Stockage* (Storage Tanks)	Division 1 Subsections NC and ND	
Volume P	*Traversées d'Enceinte* (Containment Penetration Components)	Part of Division 1 Subsection NE	Class MC Components
Volume Z	*Annexes Techniques* (Technical Appendices)	Division 1 Appendices	Appendices

* The italic writing in the tables indicates that the text has been taken from the original text in French.

3.2 JSME versus ASME General Layout Comparison

Highlights

- ASME Section III information is divided among three JSME Codes.
- ASME BPVC Section III is organized per component class; JSME is organized per component type.

Among the JSME nuclear codes listed in Figure 8, the following three codes are the subject of comparison of Class 1 component rules.

- JSME S-NC1-2008: Rules on Design and Construction for NPPs, Div. 1 LWRs,
- JSME S-NB1-2007: Rules on Welding for NPPs
- JSME S-NJ1-2008: Rules on Materials for Nuclear Facilities.

The first one (NC-1, Design Code) covers the general aspects for the design and construction of nuclear components that include material, design, fabrication, examination, testing and overpressure protection. In this sense, this code is the primary subject of the comparison. The latter two codes give specific requirements on welding and materials, respectively. These two codes are also included in the comparison because some requirements given in ASME Section III Subsection NB are specified in these JSME Codes. For example, some welding-related requirements given in the Article NB-4000 are provided in the Welding Code (S-NB-1) of JSME. Table 3 provides the contents of JSME Design Code.

Observing Table 3, first it is noted that the JSME Sections are structured in a component-oriented manner, while the ASME Sections III Subsections are laid out in a component class-oriented manner (NB for Class 1, NC for class 2 and so on). This comparison of organizational structure of ASME and JSME Codes is schematically illustrated in Figure 17.

Table 4 provides comparison of the structure of Class 1 vessel rules, i.e., Subsection NB of ASME and Subsection PVB of JSME.

Table 3—JSME Design Code Organization and Section Titles

JSME Section Title			Remarks
Sec. 1	GNR	General Requirements	See footnote 1
Sec. 2	GTM	Mechanical Testing	
Sec. 3	GTN	Non-destructive Testing	
Sec. 4	PVA, PVB, …	Vessels	See footnote 2
Sec. 5	PPA, PPB, …	Piping	See footnote 2
Sec. 6	PMA, PMB, …	Pumps	See footnote 2
Sec. 7	VVA, VVB, …	Valves	See footnote 2
Sec. 8	SSA	Support Structures	
Sec. 9	CSS	Core Support Structures	
Sec. 10	SRV	Safety Valves	
Sec. 11	PHT	Pressure Testing	
Sec. 12	RST	Surveillance Test	

Notes:

1. As is discussed in this report, the general requirements in JSME Code do not cover QA and administration-related issues such as "Responsibilities and Duties," "Authorized Inspection" and "Certificates and Stamping."
2. For example, the Section 4 for Vessels is divided into some subsections including PVA (general), PVB (Class 1 vessels), PVC (class 2 vessels), and so on. This subdivision structure applies to some other sections such as piping, pumps and valves.

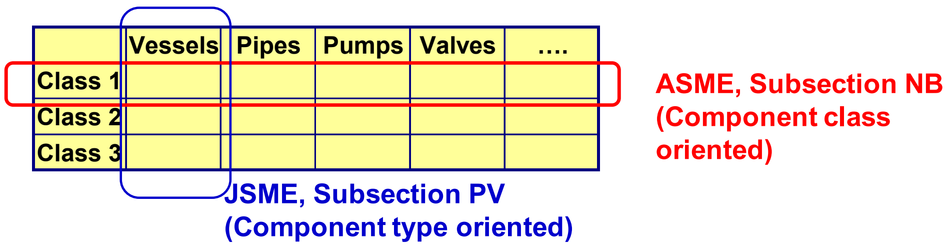


Figure 17—Comparison ASME and JSME Code Organization

Table 4—Comparison of ASME NB and JSME Class 1 Rules

Articles of ASME Subsection NB		**Subsections of JSME**	
NB-1000	Introduction	PVB-1000	Applicability
NB-2000	Material	PVB-2000	Material for Class 1 Vessels
NB-3000	Design	PVB-3000	Design of Class 1 Vessels
NB-4000	Fabrication and Installation	PVB-4000	Fabrication of Class 1 Vessels
NB-5000	Examination	**JSME S-NB1 Welding Code**	
NB-6000	Testing	PHT	Pressure Testing
NB-7000	Overpressure Protection	NC-CC-001 (2006)(1)	
NB-8000	Nameplates, Stamping and Reports	N.A.	

Note:
1. Code Case NC-CC-001 (2006), Rules on Overpressure Protection.

3.3 KEPIC versus ASME General Layout Comparison

Highlights

- KEPIC was developed consistent with the ASME BPVC layout
- The English to SI unit conversion system adopted in KEPIC is different from that of ASME BPVC.

Basically, the composition of the machinery parts of KEPIC was developed to conform to ASME BPVC, as shown in Table 5. The technical contents and composition systems are also the same as those of ASME BPVC. However, in terms of the unit conversion of U.S. commercial units to SI, KEPI adopted a soft conversion, different from ASME, which adopted a hard conversion. Table 5 shows the composition of KEPIC-MN corresponding to ASME BPVC Sec. III Div. 1 and Div. 3, and Table 6 shows the composition of KEPIC-MNB that corresponds to ASME BPVC Sec. III Div. 1 subsection NB.

Table 5—Composition of KEPIC-MN and Reference Standards

KEPIC	ASME BPVC	Title	Remarks
MNA	Sec. III NCA & Div. 3 WA	General Requirements	Equivalent
MNB	Sec. III Div. 1 Subsec. NB	Class 1 Component	Identical
MNC	Sec. III Div. 1 Subsec. NC	Class 2 Component	Identical
MND	Sec. III Div. 1 Subsec. ND	Class 3 Component	Identical
MNE	Sec. III Div. 1 Subsec. NE	Metal Containment	Identical
MNF	Sec. III Div. 1 Subsec. NF	Support	Identical
MNG	Sec. III Div. 1 Subsec. NG	Core Support Structure	Identical
MNS	Sec. III Div. 3 Subsec. WC	Class TC Transportation Containment	Identical
MNT	Sec. III Div. 3 Subsec. WB	Class SC Storage Containment	Identical
MNZ	Sec. III Div. 1 Appendices	Appendices	Identical

NOTE: Compatibility with the reference standards is in accordance with ISO/IEC Guide 21.

Table 6—Composition of KEPIC-MNB and ASME NB

KEPIC-MNB	Contents	ASME NB
MNB 1000	Introduction	NB-1000
MNB 2000	Material	NB-2000
MNB 3000	Design	NB-3000
MNB 4000	Fabrication and Installation	NB-4000
MNB 5000	Examination	NB-5000
MNB 6000	Testing	NB-6000
MNB 7000	Overpressure Protection	NB-7000
MNB 8000	Nameplates, Stamping and Reports	NB-8000

3.4 CSA versus ASME General Layout Comparison

Highlights

- ASME BPVC is used in various Canadian provinces and N285.0 written to define how ASME BPVC Section III is adopted to fit the Canadian laws.
- N285.0 provides rules for classification of the various components; once classification is done, the relevant ASME BPVC Section III part is used.

The relationship between the ASME Boiler and Pressure Vessel Code and CSA Standards started with non-nuclear areas over 75 years ago. The Canadian Jurisdictions adopted the technical requirements of the ASME Boiler and Pressure Vessel Code as the basis for their acceptance of pressure boundary construction and began participation in their development. This was done mainly through their relationship with the organization known today as the National Board of Boiler and Pressure Vessel Inspectors, of which all Provinces and Territories of Canada participate as members. This not only provided them an entry into the U.S. markets but also mitigated the need to develop a similar document in Canada.

Regulation of safety is a provincial responsibility and each Province has its own laws and processes through which the construction of the pressure boundary is controlled. It was apparent that there was a need to develop interfacing documents that allowed the application of the ASME Boiler and Pressure Vessel Code in the various Provinces and Territories and to provide some consistency in approach throughout Canada. The CSA Standard B51 was the vehicle that was developed to provide this consistency. It defined how the ASME BPVC is adopted in Canada. This approach has proven to be very successful over the years.

With introduction of nuclear power and the development of the CANDU concept as Canada's contribution to the industry, it became obvious that a document similar to B51 would provide similar benefits. This was particularly true for nuclear power because the CANDU concept introduced materials, components and methods of construction that were not part of the ASME BPVC that was developing. The Section III Code was being written to facilitate the development and use of the U.S. concepts and with the heavy influence of the USA Regulatory Authority, the USNRC, some of the CANDU requirements could not be met at that time. In was in this milieu that the Canadian Standard N285.1 was developed in the mid-1970s. Starting in 1980 a new Standard CSA N285.0 was written and this became the upper tier document in a series of Standards.

N285.0 has evolved over the years but essentially it filled the same purpose as the B51 document; it provided the approach for adopting the ASME BPVC for use in the construction of the CANDU pressure boundary. Besides providing this intermediate document, other members of the Series provided requirements for the use of the materials and components that were unique to the CANDU concept. However, even in these cases, the technical requirements of Section III have been adopted when they are applicable.

N285.0 provides rules for classification of the process and special safety systems and, by default, the classification of the components in those systems or section of systems. Once the classification of a component has been defined, the requirements for the construction of the ASME BPVC can be used to construct the component. Only those items that are unique to the CANDU concept use the other CSA Standards and, even in these cases, they are referenced directly to a section of the Section III Code for technical requirements.

Table 7—List of the N285.0

Sections	Title
Main Body	
1	Scope
2	Reference publications
3	Definition
4	Effective date for standards
5	Classification
6	Registration
7	Design
8	Materials
9	Fabrication and installation
10	General requirements for quality assurance
11	Examination and pressure testing
12	Documentation
13	In-service requirements
14	Repairs, replacements and modifications
Annex	
A (normative)	Classification
B (informative)	Registration numbers
C (informative)	Registration procedures
D(informative)	Design documentation
E (informative)	Implementation of quality assurance programs
F (normative)	Registration exemptions
G (informative)	Servicing Class 6 overpressure protection devices
H (informative)	Qualification of licensee's verifiers
I (normative)	Requirements for Class 1C, 2C and 3C pressure-retaining components and supports in nuclear power plants
J (normative)	Design rules for containment boundary components
K (informative)	In-service plugging by fusion welding of Class 1, 2 and 3 heat-exchanger tube or tube sheet holes with a one-inch maximum diameter
L (normative)	Reconciliation of modifications and as-built changes
M(informative)	Alternative requirements for pressure testing of Class 1, 2, 3 and 6 systems after repairs, replacements and modifications

4 RCC-M VERSUS ASME BPVC SECTION III COMPARISON

4.1 Abstract

The American and French nuclear industries are among the two largest in the world. In these two countries though, the evolution of two different codes has developed, the RCC-M Code in France and the ASME BPVC in the U.S., and although the RCC-M Code has its roots based on Section III of the ASME BPVC, they have diverged over the years. With the globalization of the markets today, the different existing codes can lead to a barrier for manufacturers used to working with one code and then switching to another.

As of today, there exists a set of practical examples as well as various documents that have been drafted to compare the codes, but no report reflecting mutual agreement and effort from French and American parties exists. This part of the report attempts to fill this gap.

The sections compared here are based on Section III from the ASME BPVC versus the RCC-M Code. Starting from a line-by-line comparison of the two codes, each paragraph of the codes was ranked in four categories, varying from “same” to “technically different.” The main body of this section was then built based on the identified main differences from the line-by-line comparison.

The first conclusion is that the two codes are dissimilar in many aspects. However, most differences can be classified in two categories: differences due to technical requirements and differences due to regulatory requirements. A reconciliation of the technical differences is manageable, provided additional work is carried out, while the regulatory differences would require political and regulatory effort.

This part has identified the main differences between the codes, technical and regulatory. For the technical part, this section constitutes a tool for an owner (manufacturer, designer, etc.) wanting to assess the differences between the two codes. It will enable the individual to highlight the areas where in-depth technical knowledge is required to bridge the gap between the codes. Concerning the regulatory requirements, they are dependent on the politics and cultural background of the countries, so would be more resistant to modification.

4.2 Introduction

The objective of this section is to summarize the major differences identified in the specific comparison of the two codes, ASME BPVC and RCC-M Code. This specific comparison is presented as an attachment (Appendix 1) of this report. Indications between brackets will be given when a paragraph from this text relates directly to the table in Appendix 1. In the case that certain sections of either of the two codes are not mentioned in this summary, this implies that there are no significant differences between the two codes in this area. While the detailed comparison provided in Appendix 1 may identify some specific differences, these were considered to have no real impact in practice.

For Class 1 vessels, the RCC-M is generally more prescriptive than ASME Section III; ASME has a larger scope than RCC-M while RCC-M focuses specifically on PWR components.

RCC-M and ASME Section III are used with a different QA organization.

Many differences are reported and will lead to non-conformances with existing regulator practices, but many of these differences can be solved by the manufacturer through complementary requirements.

Again, it is necessary to bear in mind that the main idea is to provide a general overview of any significant dissimilarity between the codes and permit an assessment of how these differences might impact various regulatory and licensing requirements.

As a reminder, the two codes that will be compared here are the ASME 2007 Edition and the RCC-M 2007 Edition without any consulting of the additional Addenda published after 2007, generally without appendices or code cases consideration.

The ASME BPVC has today become an international standard to design pressure and mechanical equipment as a whole. On the other hand, the RCC-M has grown to become an internationally recognized code in the nuclear industry, being also used worldwide in countries such as, among others, Korea, China, South Africa and Finland. Nevertheless, when assessing the differences between the RCC-M and ASME BPVC, the original basis for development of these respective codes should be kept in mind.

The ASME BPVC aims at laying down rules for nuclear components as a whole, as its title indicates for multiple types of nuclear power plant designs. On the other hand, the RCC-M Code is focused mainly on the rules for construction of mechanical equipment for PWR reactors. This difference implies having information in the ASME BPVC relating to the nuclear industry scattered in different sections. This last point is particularly important when comparing the codes section to section, as is done in the rest of this Section.

The first subsection compares the NB-1000 preliminary paragraphs from the ASME BPVC to their equivalents from the RCC-M Code. The second subsection addresses the NB-2000 paragraphs about materials and the third one deals with the NB-3000 paragraphs about design. The NB-4000 about fabrication and installation is discussed in the subsection named Fabrication and Welding. Examination from the NB-5000 is dealt with in the subsection with the same name. The NB-6000 paragraphs about testing are partially covered in the subsection named Pressure Tests. NB-7000 about overpressure protection is addressed in the last subsection before a short overview on quality aspects in the codes, and the Conclusion.

4.3 Preliminary Paragraphs and Scope Presentation

Highlights

- No stamping and no certificate holder in RCC-M
- No boundaries of jurisdiction consideration in RCC-M.

This section aims at describing the differences between the preliminary paragraphs Section III Division 1 NB-1000 of the ASME BPVC and their equivalent in the RCC-M Code.

In the American code, these paragraphs give an introduction to the contents of the Section III Division 1 NB paragraphs and, more importantly, define the scope of the section. Conversely, in the closest section in the RCC-M, which is Section I B-1000, the route taken is different: this paragraph goes over the documents that are required and should be kept at the disposition of the surveillance agents as well as the identification to be used. These differences in the layouts are best summarized in Tables 8 and 9. But beyond these line-by-line comparison discrepancies, more important differences in the two codes should be commented on here.

The rest of this section is organized in three paragraphs. The first provides comments on the differences between the two codes as regards the practices used, such as stamping and certificate holders, as well as the Design Specification. A second part describes deterioration aspects and, finally, a third paragraph deals with the jurisdictional boundary definition and penetration assemblies.

A first comment about the two codes pertains to stamping and certificate holders. In the ASME BPVC, it is specified in Section III Division 1 NB-1110 (a) that the "*Subsection NB contains rules for the material, […], stamping, and preparation reports by the Certificate Holder […].*" The RCC-M does not have any stamping or certificate holders (Appendix 1 – line NB-1110). This point will be developed more in detail in the paragraph about overview of quality aspects. Moreover, the term

"Design Specification" appears in the paragraph NB-1131 of the ASME BPVC, but is not identified as such in the RCC-M Code (design requirements are included in equipment specification in RCC-M). This also is a major difference: where the RCC-M is in most cases self-supported, the ASME BPVC, on the other hand, states that a Design Specification issued by the owner should be used. In particular, it is mentioned here as having to define the boundary of components.

Moreover, the ASME BPVC mentions clearly in the paragraph NB-1110 that the scope of this code will not cover any deterioration of material in-service. The RCC-M does not specify it will in the introduction, but deterioration is partially covered in the French code in various sections about fatigue, fracture and so on (Appendix A – line NB-1110).

Finally, the definition of the jurisdictional boundary is not clearly specified in the RCC-M. In Section III H-1220 and P-1100 paragraphs, a description of the scope of these sections, pertaining respectively to supports and containment penetration, is briefly done. Conversely, the ASME BPVC chose to make this topic a whole paragraph, the NB-1130. In the latter, a full description is made of the equipment for which Section III Division 1 subsection NB applies (Appendix 1 – line NB-1130).

One last difference is the electrical and mechanical penetration assemblies that are considered in RCC-M in Section III, subsection P, and not in the ASME BPVC (Appendix 1 – line NB-1140).

Table 8—Location in RCC-M of Paragraphs Equivalent to ASME Section III Division 1 NB-1000

ASME Section III NB-1000	Section Title	RCC-M Equivalent Section(s)	Section Title
NB-1110	Aspects of construction covered by these rules	Section I A-1000	*Objectifs et structure du recueil* (Objectives and structure of the code)
NB-1120	Temperature limits	Section II	Various material specifications
NB 1130	Boundaries of jurisdiction applicable to this subsection	Section I H-1220	*Domaine d'application du volume H* (Jurisdictional Boundaries of subsection H)
		Section I P-1100	*Introduction*
NB 1140	Electrical and mechanical penetration assemblies	Section I Volume P	*Traversées d'enceinte* (Containments penetration)

Table 9—Location in ASME BPVC of Paragraphs Equivalent to RCC-M Section III B-1000 Paragraphs

RCC-M Section III B-1000	Section Title	ASME Equivalent Section(s)	Section Title
B-1100	*Introduction*	N/A	N/A
B-1200	*Documents à établir* (Required documents)	Section III Division 1 NB-8000	Nameplate, Stampings and Reports
B-1300	*Identification*	Section III Division 1 NB-8000	Nameplate, Stampings and Reports

4.4 Materials

Highlights

- ASME allows numerous materials in Section II, whereas RCC-M limits the number to the materials described in B-2000 (PPS/STR).
- Implementation of the PPS/STR requires fewer supplements in RCC-M than in ASME; RCC-M is more prescriptive, in particular relative to application of materials for specific PWR components.
- For procurement, tensile tests are required to be done at room temperature and high temperature in RCC-M; ASME relies on trend curves for high temperature without additional tensile test.
- Homogeneity of the material properties should be evaluated for certain material applications in RCC-M (for Class 1 equipment).
- Deterioration of material in service: owner responsibility in ASME (Section III NB 2160); AFCEN partially covers deterioration of material in Section I B-2200 (PPS).
- Standards to determine characteristics of material properties are different in the two codes, including the location of the test samples.

This section relates to the code requirements dealing with materials of the ASME BPVC Section III, Division 1 as well as their characteristics and is organized in four paragraphs, the first recalling the standards used in each of the codes, the second dealing with material procurement, the third highlighting an important difference regarding material testing and, finally, the fourth comparing the material composition and properties using illustrative examples. Specific comparison details relative to NB-2000 requirements are provided in Appendix A of this report.

Section II of the ASME BPVC also contains information relating to materials and their chemical composition and relies also on complementary information from the ASTM Standards. In addition, the materials stress and yield limits necessary for the design of components may be found in Section II Part D, Properties. Section II of the RCC-M contains the chemical composition of the materials, but unlike the ASME, the material characteristics and properties are collected in Section I, Appendix Z.

The ASME and the RCC-M both include requirements pertaining to materials for use in Section III Division 1 2000 paragraphs of ASME and Section I 2000 paragraphs of RCC-M. This is summarized in Tables 10 and 11, herein.

A first general comment is that neither code refers to the same material reference (example in Appendix 1 – lines NB-2320): the ASME uses its own specification system (based on the ASTM), whereas the RCC-M uses the European AFNOR norm as well as its own *Spécification Technique de Référence*. This does not make the comparison any easier as there is no clear correspondence between the standards used, although an approximate equivalent of a material in one code can nevertheless be found in the other code. The material properties comparison Tables 12 and 13 as well as Figure 18 provide a tangible and quantifiable illustration of what is meant by "approximate" in the previous sentence. It should be noted here that the RCC-M Code includes all the information about the materials for the nuclear industry in the code itself, whereas the ASME BPVC requires identification of some of the information in the ASTM standards. The codes are also dissimilar in many aspects relative to material procurement, as is illustrated by Table 15.

Taking first the 2000 paragraphs of Section I of the RCC-M, it is possible to see that the material is prescribed for each component to be built. The Table B-2200 is a summary of the various equipment of the Nuclear Island and a material STR number to be used is associated with each piece of equipment (Appendix 1 – first lines of NB-2000, Material). The methodology in RCC-M is to impose a material (or to select one from a list of materials) according to the level and nature of the product or part. For example, the aforementioned Table B-2200 imposes PPS (STR) M2115 for the material of tube plate of steam generators, to which the ASME BPVC Section II equivalent would be the SA-508/SA-508 M. Note that, in addition, the PPS (STR) in Section II of RCC-M also defines associated tests and NDE, which are not required as mandatory for SA-508/SA-508 M. The scope of RCC-M is therefore not identical to that of ASME Section II for material specification: the ASME BPVC gives a selection of different alternatives, with one to be retained in the purchase order with associated procurement specification.

On the other hand, looking at Section III Division 1 of the ASME and the 2000 paragraphs, these include general requirements on the materials that should be used for each component. An example of such a paragraph is Section III Division 1, Section NB-2120 relating to pressure-retaining material. The paragraph gives general requirements but leaves freedom to the designer to select the material. The idea in ASME Section III is that the owner has not to completely define and choose the material in the design specification. Nevertheless, the design report issued by the designer and certified by a Registered Professional Engineer (RPE) must allow the N-certificate holder to issue the material specification that will be used, within adequately defined conditions, by the material manufacturer. Only with this process, optional parts of ASME Section III like Appendix W, which is never called in the body of the Section III, can become mandatory. This should, in this case, be specified by the owner or the designer. Each actor in the decision process has a responsibility that will, in the end, guarantee a material selection equivalent to the RCC-M (such as the M2115 versus SA-508/SA-508 M mentioned above).

To end this discussion, it should be highlighted that if materials are selected from Section II of the ASME BPVC, used along with Appendix II only, and that in addition the selection is done by a designer without an RPE and/or by a material producer without any quality management certification, it is impossible to guarantee a final material equivalent to the RCC-M one.

Another discrepancy lies in the material testing and more specifically the tensile tests (Appendix 1 – line NB-2340). Considering two materials of very similar chemical composition, the SA-508 Grade 3 in the ASME and the 16MND5 in the RCC-M, which can respectively be found in Section II SA-508/SA-508M and in Section II Section M2111, it can be seen that:

- In Part 6.0 of the section of the ASME mentioned above, there is no need for a high-temperature tensile test and only a room temperature one.
- In the section of the RCC-M specified above, it is mentioned clearly in part 4.3 a requirement for "*tension testing at room temperature and at high temperature*."

Similar requirements can be found in different parts of the two codes when assessing the mechanical requirements for other materials. Among other parts of the RCC-M, a high-temperature tensile test is also required for filler material acceptance (Section IV, Section S-2536).

The discussion from the previous paragraph about material procurement explains this difference. These tests are justified in RCC-M to ascertain the characteristics at ambient temperature of the material ordered and/or supplied. ASME, on the other hand, considers that the attentive survey of the Third Party will ascertain that the required characteristics, ordered with the appropriate documentation (see previous paragraph) and with the adequate testing requirements, meet the actual characteristics of the material supplied. The absence of a Third Party in the RCC-M Code is compensated by a series of additional tests.

Moreover, the ASME BPVC relies on other design factors to account for uncertainties in the material properties given in Section II. As an example, looking at Figure 19 and at the ultimate strength of the SA-336 Cl F316LN and of the Z2CND18-12, it can be seen that the allowable of the former is much lower than that of the latter.

A last set of differences to mention in this subsection is the tests to be performed: RCC-M uses Charpy V-notch test, drop weight test, or calculates RT_{NDT} with ISO standard as a basis, whereas ASME uses U.S. standards, as mentioned in the paragraph NB-2300 of the ASME BPVC (Appendix 1 – line NB-2320). The discrepancies in the values used can be seen in Table 14. The same comments could be made for examination and repair (NB-2500) and material organization quality system programs (NB-2600).

Concerning the material composition and using as an example the SA-508 Grade 3 in the ASME and the 16MND5 in the RCC-M, which can respectively be found in Section II SA-508/SA-508M and in Section II Section M-2111, it can be seen that the prescriptions in chemical compositions are different as regards the contents, as can be seen in Table 12. For example, cobalt content is 0.03% in M-2111 in RCC-M and not mentioned in SA-508. When working with the ASME BPVC, the designer may recall and/or impose these limits in the technical specifications based on the experience gathered through the years. In practice, two materials produced as per ASME requirements and RCC-M requirements will potentially have differences in their chemical composition, but it is of the responsibility of the owner or designer to add extra requirements that ensure adequate quality.

For example, designer will have to address:

- The need to minimize intergranular attack in austenitic stainless steels as in Section I B-2300 of RCC-M
- The need of material cleanliness for long-term service as in B-3176 of RCC-M
- Lamellar tearing as in B-3177 of RCC-M.

Multiple other differences could be found concerning the material composition and selection, but this discussion will be ended here. See Appendix 1 for other differences. All the examples given above lead indeed to one conclusion: the ASME leaves much more responsibility and/or freedom to the owner or designer. It is not self-supporting and relies on additional specifications. The RCC-M gives a very detailed listing of the steps that should be followed and the materials allowed. Finally, regarding the Class 1 material properties, two illustrative examples will be taken with the SA-508 Grade 3 Class 2 in the ASME and the 16MND5 (M2111) in the RCC-M, already selected above, and the SA-336 Cl F316LN and Z2CND18-12 (M3301, diameter bigger than 150 mm). As can be seen in Figures 19 and 20, the compared properties as regards design stress, yield strength and ultimate strength are very similar. As mentioned above, the ultimate strength allowable is sometimes lower for the materials in the ASME to compensate for the fact of not carrying out tensile tests at high temperatures. The comparison between the 16MND5 and the SA-508 Grade 3 Class 2 is more extensive and can be seen in Tables 12 to 14.

An additional requirement found in the RCC-M regarding the properties is the assessment of the latter within the material. Concerning main components (M140) and new material qualification, in RCC-M Section M-143.6, it is stated that when qualifying a component or part, the fabricator should assess the homogeneity of the material (Appendix 1 – lines NB-2221 and NB-2223). No such requirement can be found in the ASME. A dedicated requirement for main parts is the technical qualification M 140 for forged parts and M160 for main castings. This is explained in the section on Fabrication – Welding.

To conclude, the main differences for this section are first, the responsibility that the ASME leaves to the ordering chain (owner, designer, Third Party, and/or supplier), whereas the RCC-M will typically be more prescriptive.

Table 10—Location in RCC-M of Paragraphs Equivalent to ASME Section III Division 1 NB-2000

ASME Section III NB-2000	Section Title	RCC-M Equivalent Section(s)	Section Title
NB-2100	General requirements for material	Section I B-1000, B-2000, B-4000 and Appendix Z V	
		Section II M-1000 to 6000	Material Procurement Specification
NB-2200	Material test coupons and specimens for ferritic steel material	Section II M-1000 to 6000	Material Procurement Specification
		Section II M-150	*Traitements thermiques* (Heat Treatment)
NB 2300	Fracture toughness requirements for material	Section II M-1000 to 6000	Material Procurement Specification
		Section III MC-1200	*Essais Mécaniques* (Mechanical tests)
NB 2400	Welding material	Section IV S-2000	*Recettes des produits d'apport* (Acceptance of filler material)
NB 2500	Examination and repair of pressure-retaining material	Various paragraphs of Section II	
NB 2600	Material organizations' quality system programs	Section I A-5000	*Assurance de la qualité* (Quality Assurance)
NB 2700	Dimensional standards	Section I A-1300	*Liste des normes et de leur édition applicable* (List of Standards and applicable editions)

* The italic writing in the tables indicates that the text has been taken from the original text in French.

Table 11—Location in ASME BPVC of Paragraphs Equivalent to RCC-M Paragraphs about Materials from Sections I and II

RCC-M Section II	Section Title	ASME Section II	Section Title
M 000	*Généralités* (General Provisions)	Part A	Material Specifications – Ferrous
M 1000	*Aciers non alliés* (Carbon steels)		
M 2000	*Aciers Alliés* (Alloy Steels)		
M 3000	*Aciers Inoxydables* (Stainless steels)		
M 4000	*Alliages Spéciaux* (Special alloys)	Part B	Material Specifications – Non-Ferrous
M 5000	*Divers* (Miscellaneous)		
M 6000	*Fontes* (Iron Castings)	Part C	Material Specifications – Welding Rods, Electrodes and filler Metals
RCC-M Section I	**Section Title**	**ASME Section II**	**Section Title**
2000 paragraphs	*Matériaux* (Materials)	2000 paragraphs	Material
Section Z-ZI	*Caractéristiques des matériaux à utiliser pour la conception* (Properties of materials to be used in Design)	Part D	Properties

* The italic writing in the tables indicates that the text has been taken from the original text in French.

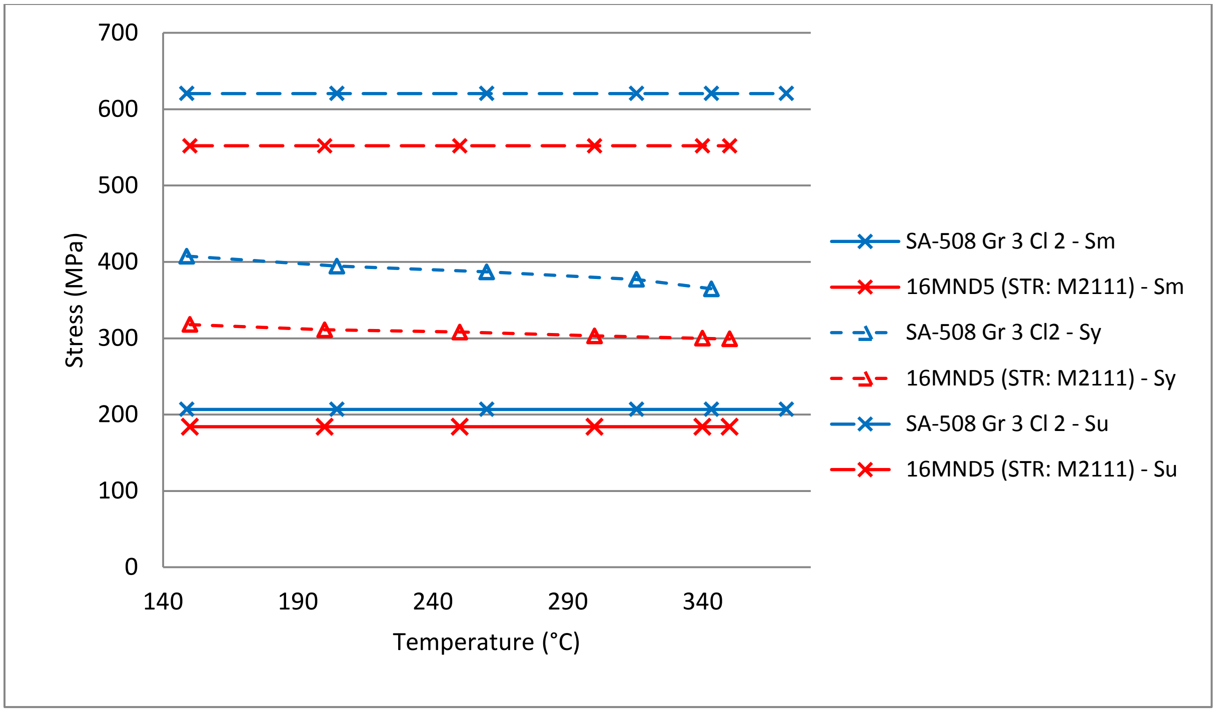


Figure 18—Design Stress (S_m), Yield Stength (S_y) and Ultimate Strength (S_u) Comparison of Two Carbon Steels, SA-508 Gr 3 Cl2 and 16MND5 (M2111)

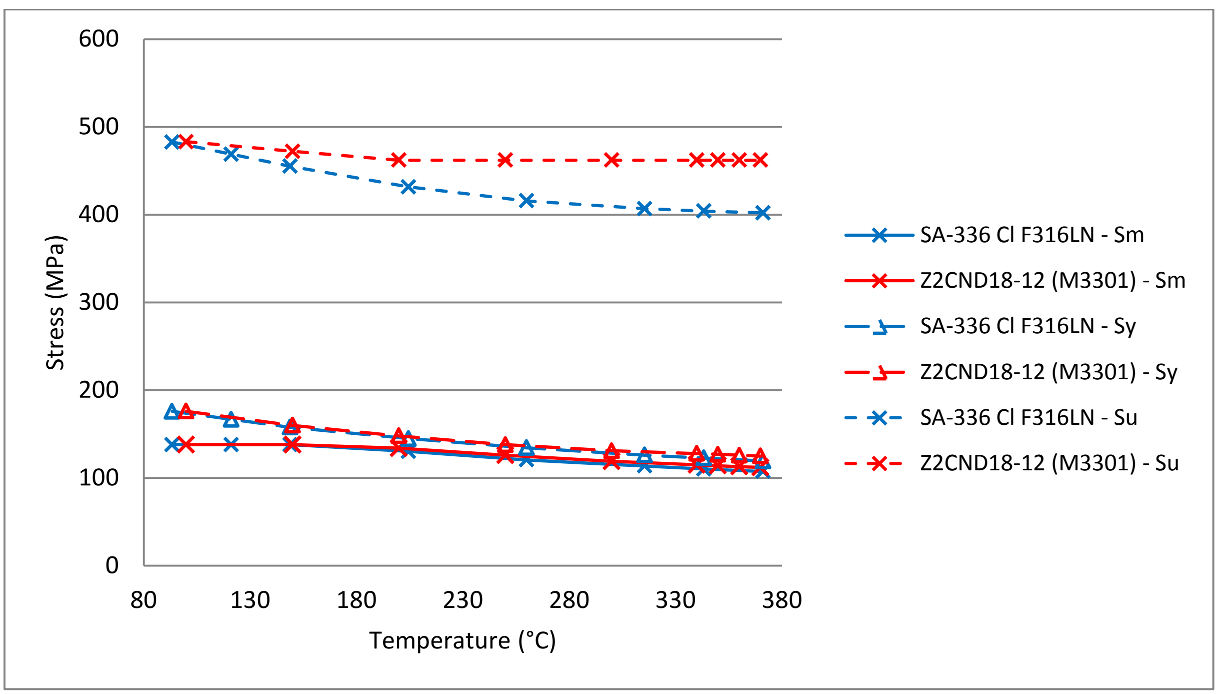


Figure 19—Design Stress (S_m), Yield Stength (S_y), and Ultimate Strength (S_u) Comparison of Two Carbon Steels, SA-336 Cl F316LN and Z2CND18-12 (M3301)

Table 12—AFNOR 16MND5 (STR: M2111) as per RCC-M and SA-508 Grade 3 as per ASME – Specification for Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels

Element	Ladle analysis %		Product analysis %	
	16MND5		SA-508 Grade 3 Class 1	
	M2111	SA508	M2111	SA-508+SA-788
Max. Carbon	0.20	0.25	0.22	0.25
Manganese	1.15-1.55	1.20-1.50	1.15-1.60	1.20-1.50 Variation 0.03 ~ 0.09
Max. Phosphorus	0.008	0.025	0.008	0.025
Max. Sulphur	0.005	0.025	0.005	0.025
Silicon	0.10-0.30	0.40 0.15 when required	0.10-0.30	0.40 0.15 when required
Nickel	0.50-0.80	0.40-1.00	0.50-0.80	0.40-1.00 Variation 0.03
Max. Chromium	0.25	0.25	0.25	0.25 Variation 0.03 ~ 0.06
Molybdenum	0.45-0.55	0.45-0.60	0.43-0.57	0.45-0.60 Variation 0.03 ~ 0.08
Max. Vanadium	0.01	0.05	0.01	0.05 Variation 0.01
Max. Columbium	–	0.01	–	0.01
Max. Copper	0.08	0.20	0.08	0.20
Max. Calcium	–	0.015	–	0.015
Max. Boron	–	0.003	–	0.003
Max. Titanium	–	0.015	–	0.015
Aluminum Max. Preferred Max.	– 0.04	0.025 –	0.04 –	0.025 –
Max. Cobalt	0.03	–	0.03	–

Table 13—Comparison of Chemical Composition Requirements in M2111 for 16MND5 through the Years, and in SA-508 and in SA-788 for SA-508 Grade 3 Class 1

Elément (% massique)	1,2MDO7 SENA 1961	SA 508 Cl3 CPFC 1974	16MND5 RCC.M 1980	1983	1985	1988
Carbone max.	0,23	0,20	0,20	0,20	0,20	0,20
Manganèse	1,0/1,5	1,2/1,5	1,15/1,55	1,15/1,55	1,15/1,55	1,15/1,55
Phosphore max.	0,025	0,012	0,012	0,008	0,008	0,008
Soufre max.	0,025	0,015	0,010	0,008	0,008	0,008
Silicium	0,15/0,35	0,15/0,35	0,10/0,30	0,10/0,30	0,10/0,30	0,10/0,30
Nickel	0,30/0,70	0,40/0,80	0,50/0,80	0,50/0,80	0,50/0,80	0,50/0,80
Chrome max.	0,20	0,25	0,30	0,25	0,25	0,25
Molybdène	0,35/0,55	0,45/0,60	0,45/0,55	0,45/0,55	0,45/0,55	0,45/0,55
Vanadium max.		0,01	0,01	0,01	0,01	0,01
Cuivre max.	0,25	0,10	0,10	0,08	0,08	0,08
Cobalt max.	0,02	0,03	0,03	0,03	0,03	0,03

Table 14—Charpy Impact Test Values for AFNOR 16MND5 (STR: M2111) as per RCC-M and SA-508 Grade 3 as per ASME

	Test Temperature	Properties	Required Value: Axial Direction	Required Value: Circumferential Direction
M2111	0°C	Min. average value	80J	80J
		Min. individual value	60J	60J
	-20°C	Min. average value	40J	56J
		Min. individual value	28J	40J
	+20°C	Min. individual value	104J	120J
SA-508	4.4°C	Min. average value	41J	
		Min. individual value	34J	

Table 15—Typical Material Specification Comparison for the RCC-M (left) and ASME (right)

RCC-M Typical Material Specification (Section II – Part 1 & 2)		ASME Typical Specification (Section II – Part A)	
M 2111	PART PROCUREMENT SPECIFICATION - MANGANESE-NICKEL-MOLYBDENUM ALLOY STEEL FORGINGS FOR PRESSURIZED WATER NUCLEAR REACTOR SHELLS IN THE BELTLINE REGION	SA-508/ SA-508M	SPECIFICATION FOR QUENCHED AND TEMPERED VACUUM6TREATED CARBON AND ALLOY STEEL FORGINGS FOR PRESSURE VESSEL
0	SCOPE	1	SCOPE
1	MELTING PROCESS	2	REFERENCED DOCUMENTS
2	CHEMICAL REQUIREMENTS	2.1	ASTM Standards
2.1	REQUIRED VALUES	2.2	ASME Standard
2.2	CHEMICAL ANALYSES	3	ORDERING INFORMATION
3	MANUFACTURE	4	MATERIALS AND MANUFACTURE
3.1	MANUFACTURING PROGRAMME	4.1	MELTING PROCESS
3.2	FORGING	4.2	HEAT TREATMENT
3.3	MACHINING	4.3	AUSTENITIZING PROCEDURE
3.4	DELIVERY CONDITION - HEAT TREATMENT	5	CHEMICAL COMPOSITION
3.5	STRUCTURE	5.1	HEAT ANALYSIS
4	MECHANICAL PROPERTIES	5.2	PRODUCT ANALYSIS
4.1	REQUIRED VALUES		
4.2	SAMPLING	6	MECHANICAL PROPERTIES
4.3	TESTING OF REPRESENTATIVE AS-DELIVERED PART SAMPLES	6.1	TENSION TEST
4.3.1	Number and content of tests	6.2	IMPACT TEST
4.3.2	Additional impact tests	7	WORKMANSHIP AND QUALITY LEVEL REQUIREMENTS
4.3.3	Test procedure	8	NONDESTRUCTIVE INSPECTION REQUIREMENTS
4.4	RETREATMENT	8.1	GENERAL REQUIREMENTS
4.5	TESTING OF SAMPLES SUBJECTED TO SIMULATED STRESS-RELIEVING TREATMENT	8.2	MAGNETIC PARTICLE INSPECTION
		8.3	ULTRASONIC INSPECTION

Table 15—Typical Material Specification Comparison for the RCC-M (left) and ASME (right) (cont.)

RCC-M Typical Material Specification (Section II – Part 1 & 2)	
5	BASE MATERIAL TEST COUPONS
6	SURFACE EXAMINATION - SURFACE DEFECTS
7	VOLUMETRIC EXAMINATION
7.1	TIME OF EXAMINATION
7.2	PROCEDURES
7.3	SCANNING PLAN AND DEGREE OF EXAMINATION
7.4	EVALUATION OF INDICATIONS
7.5	RECORDABLE CONDITIONS AND EXAMINATION CRITERIA
8	REMOVAL AND REPAIR OF UNACCEPTABLE AREAS
9	DIMENSIONAL CHECK
10	MARKING
11	CLEANLINESS - PACKAGING - TRANSPORTATION
12	TEST REPORTS
ANNEX 1 TO SPECIFICATION M 2111	
DETERMINATION OF RT_{NDT} TEMPERATURE	

ASME Typical Specification (Section II – Part A)	
9	REPAIR WELDING
10	CERTIFICATION AND REPORTS
11	PRODUCT MARKING
12	KEYWORDS
SUPPLEMENTARY REQUIREMENTS	
S1	Simulated Post-Weld Heat Treatment of Mechanical Test Samples
S2	Ultrasonic Testing-Reference Block Calibration
S3	Charpy V-Notch Impact Transition Curve
S4	Additional Charpy Data
S5	Alternative Impact Test
S6	Drop-Weight Test
S7	Restrictive Chemistry for Grades 4N and 5
S8	Additional Vanadium
S9	Restrictive Chemistry for Grades 2, 3 or 4N
S10	Alternative Fracture Toughness Requirements
S11	Vacuum Carbon-Deoxidized Steels
S13	Minimum Tempering Temperature
S14	Cooling from the Tempering Temperature
S15	Product Analysis
S16	Silicon Content

4.5 Design

Highlights

- Different limits and rules of reinforcement approach for vessel openings in RCC-M (RCC-M Appendix ZA and through finite element analysis).
- RCC-M requirements for additional justification for Class 1 vessel Stress Classification; generally, RCC-M C 3000 table can be used.
- Some differences in allowable stresses, in particular associated to nonlinear analysis.
- Differences in fatigue analysis, such as differences in strain correction factor Ke or crack-like defect analysis.
- Differences in rupture analysis, larger scope and more detail analysis in RCC-M (in accordance with RCC-M Appendix ZG, more prescriptive than ASME III Appendix G).

This part covers the sections on design of the two codes: these are Section 3000 of the Volume B in Tome I of the RCC-M Code and the Chapter 3000 of Section III Division 1 Subsection NB of the ASME Code.

RCC-M has a specific volume for small components (vessels, piping, pumps and valves under a certain pressure, and certain sizes): Volume E. There is no similar Chapter in ASME III.

These parts covering design are overall quite comparable as far as the restrictions, stress limits and even wording of the paragraphs. Table 16 draws a parallel between the organizations of these two codes and this makes the comparison relatively straightforward.

As far as the contents are concerned, some similarities are obvious. For instance, the general stress analysis philosophy also is the same: both are based on stresses calculated using elastic calculations and the Tresca Stress Intensity as a yield criterion. Both codes also require the write-up of a stress report to demonstrate the compliance of the design to the requirements. But the part of interest for this report, and the rest of this section, is the differences between the codes.

The first difference that will be addressed here is the reinforcement of openings. A second part will then present how the stresses are classified in both codes and a third section will make a comparison between the categories dealt with. Finally, a deeper insight of fatigue analysis will be given in a fourth paragraph.

First, concerning the openings in the vessel wall, the approach between the two codes is quite different. As stated in the ASME Code, there are clear mandatory rules to follow when it comes to design openings in vessels and especially how to reinforce them to facilitate the stress analysis. A reinforced opening as per ASME Section III, Division 1, NB-3334 will typically not require a detailed calculation of the stresses outside a so-called Limit of Reinforcement. This limit defines a zone where a sufficient amount of material that was taken away from the vessel when punching the opening has been compensated for on either side of the opening. In practice, calculations using the classic Continuum Mechanics equations will be sufficient to demonstrate the compliance of the opening to the ASME rules for all or simple nozzle designs. It is not fully adapted for modern nozzle designs that are more “progressive” and “smoother” than previous designs.

Conversely, in the RCC-M Code, these rules are stated in the non-mandatory appendices (Appendix ZA). The reinforcement of openings for design is an indication that may or not be followed. In practice, this will translate in an additional effort in analysis and calculations to obtain a more optimized design.

It is important to note at this point that with modern types of nozzles, for instance, with the smooth transition profiled nozzles fabricated with an extrusion process versus the former welding of the nozzle on the vessel, it has become more and more difficult to apply the Limit of Reinforcement rules from the ASME. The RCC-M Code, by shifting the Limit of Reinforcement method to the non-mandatory appendix, demonstrates an evolution to incorporate rules for this modern type of nozzle, which offers better design

In addition, although the general design philosophy is comparable, another difference lies in the stress classification. In both codes, the calculated stresses are first organized in various categories depending on the nature of the stress. As an example, a stress due to a pressure inside a recipient will not be of a same nature as a stress due to temperature effects and hence requires a classification system. The ASME BPVC is very instructive about this classification and gives numerous examples and even tables illustrating this classification (Section III Division 1, paragraphs NB-3217-1 and NB-3217-2).

The RCC-M Code is much less explicit and even states that "*In case of doubt, the damage mechanisms must be considered when resolving the practical problems presented by these operations.*" (RCC-M Tome I, Section B-3231.1). In practical applications, the RCC-M C 3000 table can be used (not mentioned in the 2007 Code Edition). What can seem like a minor discrepancy may have a significant impact in practice: when presenting the stress analysis work, the analyst will be expected to present at least a small explanation of the stress classification methodology used. This will force the analyst to fully master and comprehend the analysis techniques retained (this last point is required by QA; the analyst has to be familiar with the Code background, in particular for Class 1 components).

Concerning the levels of analysis and the criteria to be applied for each service level, see Table 17. The first difference is that the acceptance criterion for Level B is equivalent to that for the Level 0 criterion in the RCC-M 2007, which is more conservative. It should be noted here that Level B has been added in versions of the RCC-M issued from 2007 onwards.

The ASME Code gives slightly more stringent criteria for the Design Limits, especially concerning the membrane plus bending stress limits, as can be read in ASME Section III Division 1 NB-3221.3.

Concerning the Collapse Load analysis found in ASME Section III Division 1, NB-3228.1 and NB-3228.2, and RCC-M Tome I Sections B-3241 and B-324, both codes permit the use of limit (elastic-perfectly plastic) analysis or experimentation to determine the lower-bound collapse load, as an alternate method to satisfying the requirements for some primary stress limits. But the ASME Code, being more restrictive, requires the use of $1.5S_m$ for the yield strength in an analysis, while the RCC-M permits the use of the yield strength. The ASME Code permits the use of two-thirds collapse load as an alternative for satisfying the Design Condition stress limits for General Primary Membrane Stress, P_m (NB-3221.1), Local Primary Membrane Stress, P_L (NB-3221.2) and Primary Membrane (P_L or P_m) plus Bending Stress (P_b) (NB-3221.3). The RCC-M allows the use of two-thirds collapse load as determined by alternate analysis or testing in place of satisfying only Level 0 P_L (B-3233.2) and P_L or $P_m + P_b$ (B-3233.3) stress limits. Both codes allow similar use of collapse load limits for Level C, Level D, and Test, for external pressure.

Both the ASME and RCC-M permit the use of alternative analysis using actual material stress-strain relationships (plastic) analysis or experimentation to determine the plastic analysis collapse load, as an alternate method to satisfying the requirements for some primary stress limits (P_L or $P_m + P_b$). For the Design Condition, ASME Section III Division 1 NB-3228.3 allows use of two-thirds the plastic collapse load, while the RCC-M Tome I Section B-3243 limits the Level 0 loading to 0.4 times the instability load. The Level C limit is 120% (0.5 times the instability load) of Level 0 or the Design Condition, and Level D and Test limits are similar.

Turning to Level A Service Loadings and fatigue analysis, a first significant difference is the definition of the K_e factor (see detailed table in appendix, line NB 3222). When the stress range in fatigue analysis exceeds the given allowable ($3S_m$, as given in ASME Section III Division 1, NB-3228.5 and RCC-M Tome I Section B-3234.3), both codes permit the calculation of a strain correction factor K_e in consideration of a simplified elastic-plastic analysis (NB-3228.5 and B 3234.6), but the formulae to calculate this factor are different.

For austenitic steels as well as the nickel-chromium-iron alloys, the RCC-M has separate expressions for the calculation of K_e for the mechanical contribution to the stress range and the thermal contribution to the stress range. The ASME, overly conservative, uses the same expression for the combined mechanical and thermal stress range. This implies a noticeable difference in practice for fatigue results for austenitic steels as well as the nickel-chromium-iron alloys. Figure 20 shows the corresponding curves for the K_e values. See Figure 20 for illustration of these differences.

Still concerning Level A criteria, the RCC-M Tome I Section B-3234.7 gives advice about any geometrical discontinuity and indicates special finite element modeling requirements in Appendix ZD. The latter contains a method on how to analyze geometrical singularities.

The ASME, on the other hand, specifies Strength Reduction Factors, defined NB-3213.17, to address fatigue crack initiation: ASME NB-3252.4 (d-5) indicates, for instance, that a Strength Reduction Factor of no less than 4 should be used. If no factor is specified in the Owner Design Specification, the ASME leaves it to the analyst's discretion to make the decision with the associated justifications. See Table 18 for factor of safety comparison between the two codes.

Turning to fracture analysis, both the ASME Code (NB-3211, Appendix G) and RCC-M (B 3260, Appendix ZG) require an evaluation of the vessel design for protection against fracture. The ASME Code focuses on nonductile failure of ferritic materials, while the RCC-M examines both ductile and nonductile fracture, for austenitic or austenitic-ferritic materials, and ferritic materials, respectively.

Except for Class 1 reactor pressure shells, the RCC-M provides exemptions from evaluation based on material properties.

The second level is based on large reference defects. Postulated flaws applied in the evaluations are similar between the two codes (except for RCC-M, where the maximum flaw depth is 20 mm instead of 1/4 t in ASME, including thick wall). For thick vessels, 1/4 wall thickness with a width to length ratio of 1/6 is used, except near nozzle corners for the RCC-M, where the width to length ratio of 1/2 is prescribed. The RCC-M requires the crack center, as well as the ends, to be evaluated. Examinations for the ASME Code are based on crack tip stress intensity, K_I, while the RCC-M requires examination of either crack tip stress intensity, K_{cp} (elastic KI plus plasticity effect correction factor), or crack extension force, J, for the ductile evaluation. All the detailed formulae for elastic K_e evaluation of all locations are attached to RCC-M through RSE-M Appendix 5; nothing similar is available in ASME III Code. Particular attention is required on dissimilar-metal welds in RCC-M (methods and data are analyst responsibilities); nothing similar is available in ASME III Code.

Both codes allow for a conservative simple calculation method and a more detailed calculation method, when the simple evaluation is too conservative.

The detailed methods are similar to some extent, but more detailed for the RCC-M. RCC-M provides simple conservative rules for consideration of the plastic zone at the crack tip.

If exemption rules and reference large defect criteria cannot exceptionally be fulfilled, RCC-M permits the detailed methods of determining flaw size based on in-service crack monitoring (RSE-M, Appendix 5.4) with an associated pre-service inspection of the location.

The ASME allows the use of the Welding Research Council Bulletin WRCB-175 for determination of the critical flaw size, which also considers the effect of the plastic zone at the crack tip, but only when WRCB-175 is to be applied.

The critical stress intensity factor, KIC, used as an acceptance criterion for flaw size, is based on static initiation fracture toughness obtained under slow loading conditions for both codes.

Factors of Safety to be applied for Level A-B service levels are nearly the same but the ASME Code does not require any factors for Level C and D. Both codes require the effects of irradiation on the fracture toughness to be considered, but the RCC-M also prescribes methods for consideration, as well as consideration of thermal aging and strain aging (that are mainly used during periodic safety review of existing plants).

Overall, the ASME Code has a limited scope, based on simple assumptions (some are conservative, some are not, some are based on very old data and so on) with respect to design, while the RCC-M is more prescriptive and detailed with respect to analytical requirements and provides an increased understanding of margins.

Both codes use their design methods for Pressure-Temperature limits of PWR in Operation.

RSE-M uses the reference defect analysis and margins to define its In-Service-Inspection program: this justifies the need of "realistic and conservative" methods and data to reach an understanding of the margins. Today, analyses of all Class 1vessel welds and cast materials are systematically required by different regulators or different owner design specifications. RCC-M answers to these latest requirements; ASME BPVC Section III needs more investment of the analyst in terms of methods and material properties. Many important decisions on this "rupture" topic have to be made quite early in the design of new plants to ensure safety and optimum operation.

Finally, both the ASME and RCC-M permit the use of alternative analysis using actual material stress-strain relationships (plastic) analysis to evaluate for progressive deformation under cyclic loading, as an alternate method to satisfying the requirements for thermal stress ratchet (NB-3222.5 or B 3234.8) and progressive distortion of non-integral connections (NB-3227.3 or B 3238.3). Either code allows plastic analysis strain range results to be applied in the fatigue analysis, in determining the alternating stress. The ASME Code is less restrictive as it allows exemptions from shakedown analysis for ductile materials.

To sum up, one main conclusion is that the requirements from the two codes are similar as far as the methods for primary stress evaluation as well as regards allowable limits.

The RCC-M nevertheless includes more experience feedback for the analysis related to two major failure modes: fatigue and fracture, that need more state-of-the-art methods and data, in order to reach a better understanding of margins and take decisions early in the design process of new plants or components. This detailed understanding of margins is also important for the definition of an optimum In-Service Inspection program.

4.5.1 Piping, Valves and Pumps

Highlights:

- Major differences for pumps, valves and piping are associated to design rules; the principles for material selection, fabrication-welding and control are extremely similar between vessel and piping, pumps and valves
- Design report is required for DN 100 or over in ASME III, and DI 25mm and over in RCC-M
- RCC-M proposes to use B 3300 and B 3200 to design piping, pumps and valves; ASME III proposes to use only NB 3300

- No fatigue exemption rules in RCC-M, but as for vessels optimized fatigue analysis rules, supplemented by a particular piping fatigue analysis appendix (Appendix ZE)
- For pumps, the RCC-M scope is more limited than ASME III in pump types;
- For valves, a particular body shape rules for internal radius is proposed by RCC-M for fatigue sensitive valves
- For piping, the level A criteria (equation 10), the stress indices and the seismic criteria are different between RCC-M B 3600 and ASME III NB 36000.

4.5.1.1 Pumps

For Pumps, the scope of RCC-M B 3400 and ASME III NB 3400 are very similar.

The small pumps less than 165 KW are covered by a particular sub-section E in RCC-M, no small pumps (DN < 100) are considered in ASME III.

The RCC-M scope is limited to centrifugal/single volute casing pumps and ASME III considers more different types of pumps.

The design requirements are similar for both codes: ASME III NB 3350 or RCC M B 3350, RCC-M accept the use of B 3200 instead of B 3300; more severe requirements in RCC-M to consider external loads (Peb) than ASME III; same differences than vessels for fatigue analysis (K_e optimization and crack like defects) and rupture analysis.

For bolting the rules are similar.

For support ASME III proposes subsection NF and RCC-M subsection H, which are similar.

Design report is required for DN 100 or over in ASME III, and DI 25mm in RCC-M

4.5.1.2 Valves

The scopes are similar (no particular rules for pressure relieve valves in RCC-M), but RCC-M does not cover bellows, springs and diaphragms; the ratings are limited in RCC-M to PWR operating conditions, larger number of ratings in ASME III; same as for pumps: B 3300 is proposed (+ B 3200 for RCC-M), design report is required for DN 100 or over in ASME III, and DI 25mm in RCC-M.

One difference in body shape rules for valves sensitive to thermal fatigue: r3 is limited to $0.05t_m$ (fig. NB 3544.1(c)-1) in ASME III NB 3500 and 0.1 T_r (fig. B 3544.1.b) in RCC-M B 3500.

Same differences than vessels for fatigue analysis (K_e optimization and crack like defects) and rupture analysis.

4.5.1.3 Piping

The scopes are similar and the differences very similar to pumps and valves (no miters and no non-welded piping joints in RCC-M).

The complementary differences are:

- In level C, the ASME III NB 3600 criteria is 2.25Sm instead of 1.9Sm in RCC-M B 3600
- In level A, ΔT_1 is included in RCC-M equation (10) not in ASME III 2007 (it was in the past ASME editions); but the K_e is more realistic in RCC-M than in ASME III for fatigue analysis (see figure 4.5.1)
- No fatigue analysis exemption rules for class 1 piping in RCC-M

- Class 2 design rules for non-fatigue sensitive piping is not accepted in RCC-M
- A particular appendix is proposed in RCC-M for piping system fatigue analysis (Appendix ZE); less severe than basic rules
- The stress indices are also different between ASME III and RCC-M.

Table 16—Location in ASME BPVC of Paragraphs Equivalent to RCC-M Paragraphs About Design

RCC-M Tome I Section B-3000	Section Title	ASME Section III Division I NB-3000	Section Title
B-3100	*Règles générales de conception* (General Design Rules)	NB-3100	General Design
B-3200	*Règles générales d'analyse du comportement des matériels* (General Rules for analyzing components behaviour)	NB-3200	Design by analysis
B-3300	*Conception générale des recipients* (General Vessel Design)	NB-3300	Vessel Design
B-3400	*Conception générale des pompes* (Pump Design)	NB-3400	Pump Design
B-3500	*Conception générale des organs de robinetterie* (General Design of Valves)	NB-3500	Valve Design
B-3600	*Conception des tuyauteries* (Piping Design)	NB-3600	Piping Design

Table 17—Both Codes Loading Category and Applied Criteria

<table>
<tr><th colspan="2">RCC-M Loading Categories</th><th>RCC-M Applied Criteria</th><th>ASME Loading Categories</th><th>ASME Applied Criteria</th></tr>
<tr><td colspan="2">Situation de Référence (Design Case)</td><td>Niveau 0 (Level 0)</td><td>Design Loadings</td><td>Design Limits</td></tr>
<tr><td rowspan="2">Situation de deuxième catégorie (Second category situations)</td><td>Situations normales (Normal situations)</td><td>Niveau A (Level A)</td><td rowspan="4">Service Loadings</td><td>Level A Service Limits</td></tr>
<tr><td>–</td><td>–</td><td>Level B Service Limits</td></tr>
<tr><td colspan="2">Situation de troisième catégorie (Third category situations)</td><td>Niveau C (Level C)</td><td>Level C Service Limits</td></tr>
<tr><td colspan="2">Situation de quatrième catégorie (Fourth category situations)</td><td>Niveau D (Level D)</td><td>Level D Service Limits</td></tr>
<tr><td colspan="2">Situations d'essai (Test situation)</td><td>Niveau T (Level T)</td><td>Test Loadings</td><td>Test Limits</td></tr>
</table>

Table 18—Factors of Safety for Ferritic Materials

	ASME	RCC-M	ASME	RCC-M	ASME	RCC-M	ASME	RCC-M
Service Level	**Primary Membrane Stress**		**Primary Bending Stress**		**Secondary Membrane Stress**		**Secondary Bending Stress**	
Level A and B	2.0	2.0(1)	2.0	2.0(1)	1.0	2.0(1)	1.0	2.0(1)
Level C	(2)	1.6(3)	(2)	1.6(3)	(2)	1.6(3)	(2)	1.6(3)
Level D	(2)	1.2(4)	(2)	1.2(4)	(2)	1.2(4)	(2)	1.2(4)
Test	1.5	1.0	1.5	1.0	1.0	1.0	1.0	1.0

Notes:

1. Except above the transition temperature range, where 1.6 can be used.
2. Not specified.
3. Except above the transition temperature range, where 1.3 can be used.
4. Except above the transition temperature range, where 1.0 can be used.

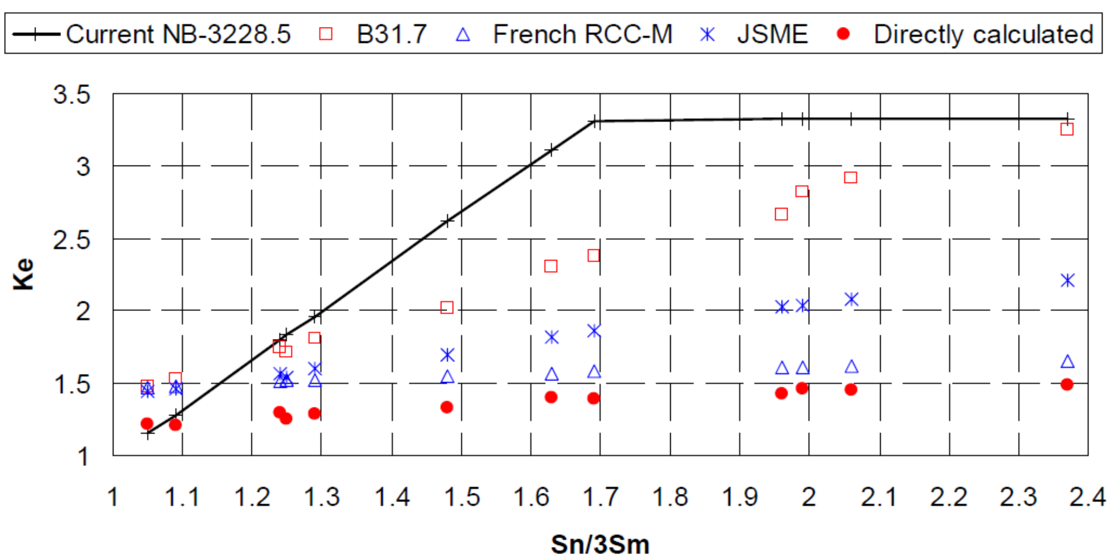


Figure 20—K_e vs. S_n/S_m Curves per ASME, RCC-M, JSME and Direct Calculation (Gurdal, PVP 2009)

4.6 Fabrication – Welding

Highlights

- To qualify a material manufacturer process per RCC-M, a qualification piece is required before fabrication for components listed in M 141 & M 160 in Section II.
- Test coupons required even after welding qualification in the RCC-M.
- Brazing is not covered in RCC-M, nor is capacitor discharge welding.
- Attachments and appurtenances for welding are dealt with in detail in ASME.
- Friction welding is not covered in ASME.
- Hubbed flanges are not covered in RCC-M for Class 1 equipment.
- Cleanliness requirements during fabrication and assembly are covered in RCC-M Section III F-6000 and are under owner responsibility in ASME.
- The differences of format and documentation requirements can lead to deviation in front of each national authority, although the manufacturing processes are similar in the two codes.

This part covers the differences in welding and fabrication. These parts are dealt with separately in the RCC-M but overlap in the ASME. They have been grouped together in one section here but will be addressed in two paragraphs.

Welding is included in Section IV of the RCC-M Code and the equivalent provisions can be found in parts of Section III Division 1 NB paragraphs and parts of Section IX of the ASME BPVC.

This part begins with differences in welding qualifications. A second paragraph will then highlight how different the weld processes are, and finally, a third section will analyze the weld examination methods.

Concerning the weld and welding process qualification, the RCC-M stipulates that the ISO norms should be followed. Turning to Section IV Section S-3200 for instance, a foreword indicates that the rest of the section will be in accordance with the prescriptions from the norm NF EN ISO 15614-1. In the following paragraphs, the numbering is virtually the same as in the norm. It should nevertheless be noted here that additional requirements exist in the RCC-M and that may not be found in the norm. In the ASME, the welds and welding process qualification should be done as per Section IX and additional provisions specific to the nuclear industry in Section III.

ASME and RCC-M have a similar approach of PQR and WP. The manufacturer or contractor, as stated respectively in Section IX QW 200.2 in ASME or in quality assurance management requirements in Section I A-5000 in RCC-M, reviews and certifies Procedure of Qualification Record (PQR) and Welding Procedures (WP). The RCC-M requires in Section I, Sections ZZ-400 and ZY-400 that a Notified Body reviews the WP or PQR (Appendix 1 – line NB-4310).

Finally, to conclude this paragraph, and concerning documentation for welding in general, it has to be noted that the format of documentation is different in ASME and RCC-M for PQR and WPS, even if the process is identical in itself and differs only by a few parameters. As an example, first taking the RCC-M Section IV S-3150, there is a list of reports to provide to approve the welding procedure qualification. One of these relates to the acceptance of filler material. The code then refers to Section IV S-2000 and gives in S-2800 and S-2900 reference data sheets for filler material. This reference is interesting because, although it appears not to be compulsory to strictly follow this layout, it provides an example of a typical data sheet in the RCC-M Code philosophy. An example of this sheet necessary in the Welding Procedure Qualification can be seen in Figure 21.

On the other hand, the Welding Qualification Procedure is provided in detail in the ASME BPVC Section IX QW 200.2. In this part, it refers to a series of reference non-mandatory documents located in Section IX Non-mandatory Appendix B. An example of one sheet is given Figure 22.

Both codes include welding techniques that the other code does not deal with and/or designates as prohibited. The first example is friction welding: it is excluded from use for pipes in the ASME BPVC Section III Division 1 NB-4311.4 but allowed in the RCC-M Code (Appendix 1 – line NB-4311). An interesting account of a practical example of how the gap was bridged to qualify friction welding in the U.S. is given in Reference [3]. This consists of a practical example of a component manufactured in France but destined to the American market.

On the other hand, the ASME BPVC mentions capacitor discharge welding in Section III Division 1 NB-4311.2, whereas this process is not mentioned anywhere in the RCC-M (Appendix 1 – line NB-4311).

Finally, the ASME BPVC has dedicated a whole paragraph to brazing, Section III Division 1 NB-4500. This process can essentially be used, as specified by the ASME BPVC, for attachment of cladding to the base material and of tubes to tubesheets. Appurtenances and piping filling specific criteria may be brazed also (Appendix 1 – line NB-5000). This process is not dealt with in the RCC-M and for the previous example, the manufacturing processes used are described in Section IV S-3600 and S-3700.

Finally, RCC-M can be more conservative when it comes to examination of the weld. A first example is for volumetric examination of ferritic welds in Class 1 components: RCC-M Section IV Section S-7713.2 specifies that such examination requires the use of radiographic and ultrasonic techniques while the ASME Section III Division 1 Section NB 4400 does not include such a requirement (Appendix 1 – line NB-4400).

Furthermore, and comparing the preparation of the test coupons and specimens dealt with in ASME Section III Division 1 Section NB 4334 and in the RCC-M Section IV S-3000, it can be seen that the tests are different. First, the RT_{NDT} is not required for all materials in RCC-M, whereas it is required for all materials in ASME. On the other hand, chemical analysis is required in RCC-M but not in ASME (Appendix 1 – line NB 4334).

In addition, RCC-M permits no undercut as can be seen in RCC-M Section IV, Sections S-7460 and S-7714 for Class 1 and 2 welds. On the other hand, ASME Section III, Section NB-4424.1 permits 1/32 inch. (1 mm). This stems from the fact that the French authorities have identified undercuts as being a potential cause for weld failure (Appendix 1 – line NB-4334).

Moreover, multiple test coupons are to be taken as instructed in RCC-M Section IV, Section S-7800. For the most part of the equipment manufactured, test coupons will be necessary to demonstrate the know-how of welders but also necessary for every Weld Procedure Specification (WPS) and component, even after a welding procedure has been qualified. On the other hand, the ASME does not require so many test coupons after the qualification of the welding procedure. ASME will typically rely in practice on manufacturer work under survey of a third party (either ANI or AIA).

Fabrication is mentioned in Section I of the RCC-M but most of the instructions related to fabrication are included in Section V. It should also be noted that Section II Section M-100 includes some requirements related to pre-qualification of equipment before “mass production.” The Fabrication and Installation paragraphs can all be found in Section III of the ASME. Table 4.3.3.2 below presents the layout comparison between the two codes.

Both codes contain a first section on the pre-fabrication stage. The next paragraph lists in more detail the discrepancies related to the fabrication part itself.

The RCC-M states in Section II M-140 that a qualification is necessary for material or part supplier of a component in the list M-141, thereby requiring the workshop to forge the first piece to demonstrate its capability to complete the task, monitoring all parameters of forging while doing so. For future pieces, it is not necessary to demonstrate the monitoring of all the same parameters, if the manufacturer has already been qualified as per the RCC-M to produce parts and can demonstrate continuity in competencies. This process philosophy from the RCC-M is based on evidence of monitoring the right production parameters by the part manufacturer. After the successful completion of the qualification piece, the batch of equipment can be produced, but only within the limits defined by the qualification piece. Overall, RCC-M aims at providing evidence on actual material for the qualification piece. It should be noted that, depending of the country of regulation, a third party will be mandatory, in addition to RCC-M requirements. Concerning the so-called qualification piece or "prototype," it should be highlighted here that it should be treated as a first-of-a-kind type part, does not have to be scrapped, and can be used industrially as long as it shows the adequate level of quality.

On the other hand, the ASME BPVC considers that a qualified supplier has knowledge that allows manufacture of parts, validated through the following approach.

- Qualification program and certification (NCA 3800, for example) of the material producer
- Mandatory procurement specification taking into account owner and designer requirements
- Acceptance by third party (ANI or AIA) of final forged part for integration in equipment

If the Designer orders a part correctly, a third party (ANI or AIA) will check that the performance specified for the part manufacturing is adequate, with the right implementation of the know-how of the manufacturer.

Concerning the Fabrication itself, the RCC-M is, overall, more prescriptive than the ASME and this can be illustrated by the following examples.

First, the RCC-M lays down very stringent steps to follow concerning the forming, bending and cutting. Documentation is necessary (Section V F-4112), the qualification process and tests follow a very detailed process (Section V F-4120), and the results of the qualification can be subject to examination by Inspectors (Section V F-4126).

The RCC-M has grouped all experience feedback related to cleanliness in a dedicated section of the code, Section V Section F-6000. The ASME BPVC does not have an equivalent section pertaining to cleanliness requirements. Part of basic cleanliness requirements can be found in various sections of the ASME BPVC, such as Section III Division 1 NB-4412, pertaining to Cleanliness and Protection of Welding Surfaces (Appendix 1 – line NB-4412). The RCC-M Code is particularly stringent on this aspect and it forces the workshop to have an irreproachable cleanliness to manufacture components for the nuclear industry. The ASME BPVC tends to consider implicitly this aspect as the responsibility of the owner.

Finally, Section V F-5000 of the RCC-M deals with surface treatment as a whole. It encompasses various domains ranging from cladding to painting. The ASME BPVC has, for instance, information pertaining to cladding in Section III Division 1 NB-4000 and in Section IX. However, no section dedicated specially to surface treatment can be found in the ASME BPVC, leaving the user to juggle between the different sections to identify the mandatory requirements.

While the ASME permits the use of fabricated hubbed flanges as specified in Section III Section NB-2125, they are excluded from use for Class 1 equipment in the RCC-M, as specified in Section I Appendix Z-V (Appendix 1 – line NB-2125).

Table 19—Location in RCC-M of Paragraphs Equivalent to ASME Section III Division 1 NB-4000

ASME Section III NB-4000	Section Title	RCC-M Equivalent Section(s)	Section Title
NB-4100	General requirements	Section I B-4100	*Généralités* (General)
		Section I B-2000	*Matériaux* (Materials)
		Section IV S-7600	*Réparation par soudage* (Repair by welding)
NB-4200	Forming, fitting and aligning	Section V F-4000	*Formage et tolérances dimensionnelles* (Forming and dimensional tolerances)
NB-4300	Welding qualification	Section IV S-3000	*Qualification de mode opératoire de soudage* (Welding procedure qualification)
		Section I B-4231	*Soudage* (Welding)
NB-4400	Rules for governing making, examining and repairing welds	Section I B-4400	*Soudages et techniques connexes* (Welding and associated techniques)
		Section IV S-7000	*Soudures de production* (Production welds)
NB-4500	Brazing	Not covered	
NB-4600	Heat treatment	Section IV S-1300	*Généralités sur les traitements thermiques* (General remarks on heat treatments)
		Section V F-8000	*Traitements thermiques* (pièces et matériels) (Heat treatment (parts and components))
NB-4700	Mechanical joints	Section V F-7000	*Assemblages mécaniques vissés* (Screwed joints)

Table 20—Location in ASME BPVC of Paragraphs Equivalent to RCC-M Paragraphs about Welding from Section IV

RCC-M Section IV	Section Title	ASME	Section Title
S 1000	*Généralités* (General)	Section IX Part QW Article I	Welding General Requirements
S 2000	*Recette des produits d'apports* (Acceptance of Filler Material)		
S 3000	*Qualification de mode opératoire de soudage* (Welding procedure qualification)	Section IX Part QW Article II	Welding Procedure Qualification
S 4000	*Qualification des soudeurs en opérateurs* (Qualification of welders and operators)	Section IX Part QW Article III	Welding Performance Qualification
S 5000	*Qualification des produits d'apports* (Qualification of filler materials)	Section III Division 1 Section NB-4300	Welding Qualifications
S 6000	*Qualification technique des ateliers de fabrication* (Technical qualification of production workshop)	Section IX Part QW Article III	Welding Performance Qualification
S 7000	*Soudures de production* (Production welds)	Various parts of Section IX	
S 8000	*Rechargements dûrs par fusion sur aciers non-alliés, faiblements alliés ou alliés* (Weld-deposited hardfacing on carbon, low-alloy or alloy steels)	Parts of Section IX	
RCC-M Section I	**Section Title**	**ASME Section I**	**Section Title**
Section B-4000	*Fabrication et contrôles associés* (Fabrication and associated examination)	Section III Division 1 Section NB-4300	Welding Qualifications

Table 21—Location in ASME BPVC of Paragraphs Equivalent to RCC-M Paragraphs about Fabrication from Section V

RCC-M Section V	Section Title	ASME	Section Title
F 1000	*Introduction* (Introduction)		
F 2000	*Procédés de marquage* (Marking Procedure)	Section III Division 1 NB-8000	Nameplates, Stamping and Reports
F 3000	*Découpage réparation sans soudage* (Cutting repair without welding)	Section III Division 1 Section NB-4120	Cutting, Forming and Bending
F 4000	*Formage et tolérances dimensionnelles* (Forming and dimensional tolerances)	Section III Division 1 Section NB-4220	Forming tolerances
F 5000	*Traitements de surface* (Surface treatment)	Parts of Section III Division 1 Section NB-4000 cover cladding only	
F 6000	*Propreté* (Cleanliness)	Parts of Section III Division 1 Section NB-4000 (ex : NB-4412)	NB-4412 – Cleanliness and protection of welding surfaces
F 7000	*Assemblages Mécaniques Vissés* (Screwed joints)	Section III Division 1 Section NB-7000	Mechanical Joints
F 8000	*Traitements Thermiques (pièces et matériels)* (Heat treatment (parts and components))	Section III Division 1 Section NB-6000	Heat Treatment
RCC-M Section I	**Section Title**	**ASME Section I**	**Section Title**
Section B-4000	*Fabrication et contrôles associés* (Fabrication and associated examination)	Parts of Section III Division 1 Section NB-4000	

CLASSIFICATION : E 7018 - E 380 B E 420 B STANDARD : AWS A5.1 NF EN ISO 2560 GRADE : Carbon steel	**PROCESS**: Manual arc **TYPE OF PRODUCT**: Covered electrode	**DATA SHEET** No. S 2810

1) CHEMICAL ANALYSIS

%	C	Si	Mn	P	S	Ni	Cr	Mo	Co	Cu	V	Fe	N_2	Ta Nb	Calculated δ ferrite
In welding material															
In deposited metal	≤ 0.100	≤ 0.90	≤ 1.40	≤ 0.025(1) 0.030(2)	≤ 0.025	≤ 0.30*	≤ 0.20*	≤ 0.30		≤ 0.25 (1)	≤ 0.04*				

2) MECHANICAL PROPERTIES

a) TENSILE STRENGTH

CHARACTERISTICS / DEP'D METAL COND.	TENSILE STRENGTH AT ROOM TEMPERATURE				TENSILE STRENGTH AT °C				TENSILE AT °C			
	in MPa		in %		in MPa		in %		in MPa		in %	
	$Rp_{0.2}$	R_m	A	Z	$Rp_{0.2}$	R_m	A	Z	$Rp_{0.2}$	R_m	A	Z
	min.		min.	min.	min.		min.	min.	min.		min.	min.
As welded or after simulated stress relieving heat treatment in accordance with S 2534**					Varies according to the base metal see S 2540							

b) IMPACT STRENGTH

CHARACTERISTICS / DEP'D METAL COND.	KV room temperature		KV 0°C						
	J		J		J		J		°C
	mean	min.	mean	min.	mean	min.	mean	min.	
Same as above			≥ 60	≥ 42	(1)				
			≥ 40	≥ 28	(2)				

3) BASE METAL - TYPE OF WELD:

1 = Strength welds and buttering
2 = TIG root pass and seal welds
3 = Cladding

BASE METAL	WELD 1	WELD 2	WELD 3	BASE METAL	WELD 1	WELD 2	WELD 3
Steels as per NF EN 10028-2	X						
Steels as per NF EN 10025-2	X						
16 MND 5 - 18 MND 5	X						

4) COMMENTS

* If analysis is required elsewhere (1) for class 1 components (2) for components outside class 1

S 2000 / 16

Figure 21—Filler Material Reference Data Sheet Example for Filler Material Acceptance from RCC-M Section IV S-2800

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATIONS (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code) A08

Company Name ____________ By ____________
Welding Procedure Specification No. ____________ Date ____________ Supporting PQR No.(s) ____________
Revision No. ____________ Date ____________

Welding Process(es) ____________ Type(s) ____________
(Automatic, Manual, Machine, or Semi-Automatic)

JOINTS (QW-402) — Details

Joint Design ____________
Root Spacing ____________
Backing: Yes ____________ No ____________
Backing Material (Type) ____________
(Refer to both backing and retainers)

☐ Metal ☐ Nonfusing Metal
☐ Nonmetallic ☐ Other

Sketches, Production Drawings, Weld Symbols, or Written Description should show the general arrangement of the parts to be welded. Where applicable, the details of weld groove may be specified.

[At the option of the manufacturer, sketches may be attached to illustrate joint design, weld layers, and bead sequence (e.g., for notch toughness procedures, for multiple process procedures, etc.)]

*BASE METALS (QW-403)

P-No. ____________ Group No. ____________ to P-No. ____________ Group No. ____________
OR
Specification and type/grade or UNS Number ____________
to Specification and type/grade or UNS Number ____________
OR
Chem. Analysis and Mech. Prop. ____________
to Chem. Analysis and Mech. Prop. ____________
Thickness Range:
Base Metal: Groove ____________ Fillet ____________
Maximum Pass Thickness ≤ $^1/_2$ in. (13 mm) (Yes) ____________ (No) ____________
Other ____________

*FILLER METALS (QW-404)	1	2
Spec. No. (SFA)		
AWS No. (Class)		
F-No.		
A-No.		
Size of Filler Metals		
Filler Metal Product Form		
Supplemental Filler Metal		
Weld Metal		
Thickness Range:		
Groove		
Fillet		
Electrode-Flux (Class)		
Flux Type		
Flux Trade Name		
Consumable Insert		
Other		

*Each base metal-filler metal combination should be recorded individually.

(03/08)

241

Figure 22—Example of Documentation Sheets to Give for Welding Procedure Specification from ASME Section IX Nonmandatory Appendix B

A08

QW-482 (Back)

WPS No. ________ Rev. ________

POSITIONS (QW-405)	POSTWELD HEAT TREATMENT (QW-407)
Position(s) of Groove ________	Temperature Range ________
Welding Progression: Up ________ Down ________	Time Range ________
Position(s) of Fillet ________	Other ________
Other ________	

PREHEAT (QW-406)
Preheat Temperature, Minimum ________
Interpass Temperature, Maximim ________
Preheat Maintenance ________
Other ________
(Continuous or special heating, where applicable, should be recorded)

GAS (QW-408)

	Percent Composition		
	Gas(es)	(Mixture)	Flow Rate
Shielding			
Trailing			
Backing			
Other			

ELECTRICAL CHARACTERISTICS (QW-409)

Weld Pass(es)	Process	Filler Metal		Current		Volts (Range)	Travel Speed (Range)	Other (e.g., Remarks, Comments, Hot Wire Addition, Technique, Torch Angle, etc.)
		Classification	Diameter	Type and Polarity	Amps (Range)			

Amps and volts range should be recorded for each electrode size, position, and thickness, etc.

Pulsing Current ________ Heat Input (max.) ________
Tungsten Electrode Size and Type ________
(Pure Tungsten, 2% Thoriated, etc.)
Mode of Metal Transfer for GMAW (FCAW) ________
(Spray Arc, Short Circuiting Arc, etc.)
Electrode Wire Feed Speed Range ________
Other ________

TECHNIQUE (QW-410)
String or Weave Bead ________
Orifice, Nozzle, or Gas Cup Size ________
Initial and Interpass Cleaning (Brushing, Grinding, etc.) ________
Method of Back Gouging ________
Oscillation ________
Contact Tube to Work Distance ________
Multiple or Single Pass (Per Side) ________
Multiple or Single Electrodes ________
Electrode Spacing ________
Peening ________
Other ________

(03/08)

242

Figure 22—Example of Documentation Sheets to Give for Welding Procedure Specification from ASME Section IX Nonmandatory Appendix B (cont.)

4.7 Examination

Highlights

- RCC-M personnel qualification must preferably follow European Standard but any equivalent specification can be admitted; ASME refers to U.S. standards (SNT-TC-1A).
- Existence of differences in examinations techniques and methods between ASME and RCC-M.
- ASME Section III considers pre-service examinations in accordance with Section XI requirements, while RCC-M allows owners requirements for pre-service examination.

Examination methods are addressed Section III of the RCC-M and Section V of the ASME BPVC. The RCC-M refers to examination in its Section I but, in Subsection A, essentially refers and instructs the user to look into Section III for the documentation relating to examination. The other Subsections of Section I (B, C and D), for the examinations associated to manufacturing, refer to Section IV Welding.

ASME Section III includes in its Division 1 Section NB-5000 requirements that are unique to the nuclear industry, including specification of limits for acceptance after examination. A significant part of the information on nondestructive examination (NDE) is nevertheless concentrated in a different section, as in the RCC-M, and the latter is Section V.

It should be mentioned that both RCC-M and ASME include also provisions for NDE in their Material sections, Section II in both codes, especially about the extent, the time (stage) and acceptance criteria for the examination. Special examination requirements for welding are also included in the Section IV of the RCC-M and the Section IX of the ASME.

This section will first describe the differences in practice for NDE personnel qualification and then, in a second paragraph, focus on the differences between the techniques and methods used.

NDE personnel qualification is done per SNT-TC-1A according to the ASME Section III Division 1 NB-5510. In paragraph Section III Division 1 NB-5522, it is stated that the employer has the responsibility of the adequacy of the qualification program as well as the certification of Level I, II and III NDE personnel. This is sufficient in the U.S. to become certified by the American Society of Nondestructive Testing or ASNT.

RCC-M Section III Section MC-8000 invites the user to comply with the European norm NF EN 473. Numerous common points between the two certifications can be highlighted: three levels of certification, experience and practical examination are required to progress to upper levels, certificate expires every 5 years. The certification in Europe requires the intervention of a third party to qualify the NDE personnel. This third party must be accredited by NF EN ISO/IEC 45012 to deliver certification according to the NF EN 473 performs qualification. Outside Europe, RCC-M accepts a certification granted by an independent organization following an equivalent standard after approval by The Contractor (MC 8000). A qualification from the employer as in the U.S. is not fully equivalent in process, but the technical result is level equivalent provided the employer is fully reliable.

In addition, it should be highlighted here that the qualification from the employer in ASME BPVC is not fully equivalent to certification EN 473 delivered by a third party in Europe in the process itself, despite the fact that the levels of competencies are similar (Appendix 1 – line NB-5520).

To conclude this discussion, in practice, despite the difference highlighted above, this certification issue can be overcome. The detailed comparison work was done in Reference [3] and the conclusion was that the requirements for Inspector Certification per SNT-TC-1A and per EN 473 offer the same guarantees.

The following discussion focuses on the differences between the techniques and methods presented in each of the codes.

Firstly, in RCC-M Section IV S-7363, it is mentioned that liquid penetrant examination is required for Class 1 and 2 welds before starting any welding. In ASME Section III NB-4400, no such provision can be found. Looking at this method of examination in the two codes, it can be seen that the ASME Code is very descriptive as regards the liquid penetrant examination (ASME BPVC Section V, Article 6). Moreover, the penetrant removing technique is different as well as the drying method. But as analyzed in Reference [3], this gives equivalent results in practice.

The ASME Section III Division 1 NB-5410 requires examination of the weld joints by liquid penetrant or magnetic particle in addition to carrying out all pre-service volumetric examinations (Appendix 1 – line NB-5410). The RCC-M Section I B-5240 does not call for such stringent examination after the hydrotest. The philosophy is different: instead of asking for more stringent check after the test, there exists other testing, as specified Section I B-5300, that will make any problem visible. The RCC-M requires visual examination in the case of tracking gross plasticity distortion, as per RCC-M Section I B-5520. RCC-M Section IV S-7460 requires also visual examination of Class 1 and 2 welded joints.

The RCC-M requires removal and liquid penetrant examination of all arc strikes. This examination is not required by ASME. Arc strikes are generally removed and only visually examined.

For ultrasonic examination of welds, the classification of defects as planar or non-planar is essential as a planar defect is unacceptable. For this classification, the RCC-M refers to a European standard. The ASME leaves this responsibility to the NDE personnel.

The ASME BPVC includes also a paragraph about pre-service examination, Section III Division 1 NB-5332. Conversely, it should be noted here that for the PSI, it is the AFCEN RSE-M Code that covers this and that no paragraph about this topic can be found in the RCC-M (Appendix 1 – lines NB-5280 and NB-5332). At this stage though, it is also interesting to mention that the RCC-M Code allows the use of ASME BPVC Section IX for pre-service and in-service inspection. Using the RCC-M Code does not mean that the RSE-M Code should be used exclusively for these types of inspections. For the ASME BPVC, if the component is manufactured per the ASME BPVC, it is often more challenging to switch to another code for pre-service and in-service inspection.

It should also be noted that all that relates to brazing cannot be found in the RCC-M: this includes ASME BPVC Section III Division 1 NB-5274 and NB-5370 (Appendix 1 – lines NB-5274 and NB-5370).

Finally, a last point of comparison between the codes is the acceptance criteria. Taking first the radiographic examination, it can be seen first in ASME BPVC Section III Division 1 NB-5320 that the term "indication" is used. It can refer to a gas cavity as well as an inclusion. The RCC-M distinguishes the two and provides acceptance criteria depending on the nature of the indication (Appendix 1 – line NB-5320). Table 24 gives an example of the acceptance criteria for the radiographic examination from the two codes.

Turning to the ultrasonic examination, it is possible to see that the criteria given in Section III Division 1 NB- 5330 are more or less identical to the radiographic examination criteria (Appendix 1 – line 5330). On the other hand, the RCC-M is particularly extensive about this examination as can be seen in Section IV S-7714.4.

From the two previous examples, it can be seen that the RCC-M offers a more detailed and prescriptive set of requirements. One final example deals with the magnetic particle examination. In this case, it is not as easy to conclude which of the two codes is really more restrictive. The comparison can be seen in Table 25 (Appendix 1 – line 5340).

Other examples of criteria and method differences for this paragraph could be found, but instead of going into more detail, a general conclusion on examination is given here. As can be seen in the description made here, overall, examination methods and procedures are often more detailed in the RCC-M than the ASME BPVC. One counterexample of this point is for the hydrotest, where the ASME BPVC requires more than visual inspection after its completion, whereas visual inspection is sufficient in RCC-M, but with an additional amount of tests. This demonstrates a difference in the philosophy of the two codes, more stringent inspection after test versus increased number of tests required.

Table 22—Location in RCC-M of Paragraphs Equivalent to ASME Section III Division 1 NB-5000

ASME Section III NB-5000	Section Title	RCC-M Equivalent Section(s)	Section Title
NB-5100	General requirements for examination	Section III MC-2000 MC-3000 and MC-4000	
		Section IV S-7700	*Examens non destructifs des soudures de production* (Nondestructive examination of production welds)
NB-5200	Required examination of welds for fabrication and preservice baseline	Section IV S-7700	*Examens non destructifs des soudures de production* (Nondestructive examination of production welds)
NB-5300	Acceptance standards	Section IV S-7700	*Examens non destructifs des soudures de production* (Nondestructive examination of production welds)
NB-5400	Final examination of vessels	Part of Section III MC-7100	*Examens visuels* (Visual examination)
NB-5500	Qualification and certification of nondestructive examination personnel	Section IV MC-8000	*Qualification et certification des agents de contrôles non destructifs* (Qualification and certification of nondestructive control examination personnel)

Table 23—Location in ASME BPVC of Paragraphs Equivalent to RCC-M Paragraphs about Fabrication from Section IV

RCC-M Section IV	Section Title	ASME	Section Title
MC-1000	*Essais Mécaniques, Physiques, Physico-Chimiques et Chimiques* (Mechanical, Physical, Physico-chemical and chemical tests)	Section V Subsection A Section V A-1	General Requirements
MC-2000	*Examen par Ultrasons* (Ultrasonic examination)	Section V Subsection A Section V A-5	Ultrasonic examination methods for materials and fabrication
MC-3000	*Examen par radiographie* (Radiographic examination)	Section V Subsection A Section V A-2	Radiographic examination
MC-4000	*Examen par ressuage* (Liquid penetrant examination)	Section V Subsection A Section V A-6	Liquid penetrant examination
MC-5000	*Examen par magnetoscopie* (Magnetic particle examination)	Section V Subsection A Section V A-7	Magnetic particle examination
MC-6000	*Examen par courants de Foucault des produits tubulaires* (Eddy current examination of tubular products)	Section V Subsection A Section V A-8	Eddy current examination of tubular products
MC-7000	*Autres méthodes d'examen* (Other examinations methods)	Parts of Section V Subsection A	
MC-8000	*Qualification et certification des agents de contrôle destructif* (Qualification and certification of nondestructive personnel)	Section III Division 1 NB-5500	Qualifications and certification of nondestructive examination personnel

Table 24—Radiographic Examination Acceptance Criteria for RCC-M and ASME BPVC

RCC-M Section IV S-7114.3			ASME BPVC Section III Division 1 NB-5320	
Wall thickness e (mm)	**Gas cavity size (mm)**	**Isolated inclusion size (mm)**	**Thickness of the thinner portion of the weld t (mm)**	**Indication size (mm)**
e ≤ 4.5	e/3	1.5	t ≤ 19	6
4.5 < e ≤ 6	1.5	1.5		
6 < e ≤ 10	2	3	19 < t ≤ 57	t/3
10 < e ≤ 25	2.5	e/3		
25 < e ≤ 50	3	e/3		
50 < e ≤ 60	4	e/3	57 < t	19
50 < e	4	20		

Table 25—Magnetic Particle Examination Acceptance Criteria for RCC-M and ASME BPVC

	RCC-M Section IV S-7114.2	ASME BPVC Section III Division 1 NB-5340
Size of recordable indication (mm)	>2 mm	>1.5 mm
Unacceptable indication size (mm)	>4 mm	>5 mm
Unacceptable in line indications criteria	3 or more indications in line, less than 3 mm apart edge to edge or extending more than 20 mm, if this distance is between 3 and 6 mm	4 or more rounded indications in a line separated by 1.5 mm or less edge to edge
Unacceptable surface indications	–	Ten or more rounded indication in any 4000 mm^2 of surface with the major dimension of this area not to exceed 150 mm […]

4.8 Pressure Tests

Highlights

- Higher hydrotest pressure in the RCC-M (B-5000) than in ASME NB-6200
- No pneumatic testing in the RCC-M.

This paragraph presents the pressure that should be chosen for the tests. These pressures can be found in RCC-M Section I B-5000, while it is Section III Division 1 NB-6220 that includes these provisions. Table 26 presents the layout in ASME BPVC and indicates where the equivalent paragraphs are located in the RCC-M Code. In this paragraph, only one table is proposed because no other section from the RCC-M covers pressure tests than the one specified in the Table 26, so unlike the other sections, there was no need to create a second table.

The ASME states that the hydrostatic test pressure should only be 1.25 times the design pressure.

The RCC-M gives another formula in the RCC-M Section I Z-Z720 to determine the factor to scale up the design pressure by a factor k, which is:

Table 26—Location in RCC-M of Paragraphs Equivalent to ASME Section III Division 1 NB-6000

ASME Section III NB-6000	Section Title	RCC-M Equivalent Section(s)	Section Title
NB-6100	General requirements	Section I B-5100	*Généralités* (General)
		Parts of Section I B-5200	*Essais hydrostatiques* (Hydrostatic tests)
NB-6200	Hydrostatic tests	Section I B-5200	*Essais hydrostatiques* (Hydrostatic tests)
NB-6300	Pneumatic tests	Not covered	
NB-6400	Pressure test gages	Section I B-5240	*Exécution de l'essai* (Hydrostatic test)
NB-6500	N/A	N/A	N/A
NB-6600	Special test pressure situations	Section I Appendix Z IV	*Règles de calculs des matériels soumis à la pression extérieure* (Design rules for components subjected to external pressure)

4.9 Overpressure Protection

Highlights

- Two different certifications of pressure relief equipment in the RCC-M.

This paragraph highlights the differences between the two codes that relate to overpressure of the equipment. The prescriptions are given RCC-M Section I B-6000 and ASME Section III Division 1 NB-7000. A comparison of the layouts of the two sections is given Table 27.

These two sections are essentially equivalent, including even the layout of both sections in Table 27. The RCC-M Code essentially differs from the ASME BPVC because it refers to other European and French regulations, such as EN 764-7 (Appendix 1 – line NB-7314).

The RCC-M Section I Section B-6700 indicates how to certify pressure relief equipment and offers a possibility to comply with one of two different standards to do so. The first Standard given is the ASME while the second is the EN IS 4126 parts 1 to 5 European Norm. The European Norm does not require any Authorized Observer to validate the test and deliver the certification.

It is worth mentioning, though, that additional requirements are attached in France and in Europe to the PED requirements, and especially justification for paragraph 2.11.1 of the PED Appendix 1, "Fail-safe modes, redundancy, diversity and self-diagnosis."

On the other hand, the ASME Section III Division 1 Section NB-7738 states clearly that laboratory acceptance of the pressure-relieving capacity test is required under the presence of an Authorized Observer. The Authorized Observer is accepted by the ASME Committee and has to fulfill the requirements of ASME PTC-1994 (Appendix 1 – line NB-7700 and after).

Despite these differences in the reference made to different standards and norms, the provisions are equivalent for this section.

Table 27—Location in RCC-M of Paragraphs Equivalent to ASME Section III Division 1 NB-7000

ASME Section III NB-7000	Section Title	RCC-M Equivalent Section(s)	Section Title
NB-7100	General requirements	Section I B-6100	*Généralités* (General)
NB-7200	Overpressure protection report	Section I B-6200	*Dossier de protection contre les surpressions* (Overpressure protection report)
NB-7300	Relieving capacity	Section I B-6300	*Capacité de décharges* (Relief capacity requirements)
NB-7400	Set pressures of pressure relief devices	Section I B-6400	*Pression de tarage des dispositifs pour la limitation directe de la pression* (Set pressure for direct pressure limitation devices)
NB-7500	Operating and design requirements for pressure relief valves	Section I B-6500	*Spécifications de conception et de fonctionnement pour les robinets de décharge de pression* (Design and operating specifications for pressure relief valves)
NB-7600	Nonreclosing pressure relief devices	Section I B-6600	*Dispositifs de décharge de pression non refermables* (Non-reclosing pressure relief devices)
NB-7700	Certification	Section I B-6700	*Détermination de la capacité de débit* (Determination of flow capacity)
NB-7800	Marking, stamping and data reports	Section I A-3800	*Documents de programmation, de suivi et de compte-rendu final* (Technical preparation, follow-up and final report documents)
		Section I B-1300	*Identification*

4.10 Overview on Quality Aspects

Highlights

- QA in the RCC-M Code is based on International standards and recommendations.
- ASME uses NQA-1 versus RCC-M uses ISO-9001 and IAEA 50 C/SG.
- Professional Engineer certification only exists in ASME Code.

While outside the scope of this report, a brief discussion is provided herein to identify some basic differences regarding Quality Assurance and Engineer Certification aspects of the codes.

On the request of the American National Standards Institute (ANSI), the ASME brought together the Committee on Nuclear Quality Assurance, which in 1979 issued the Nuclear Quality Assurance (NQA-1) report. This report provides quality assurance program requirements for Nuclear Type or N-Type Certificate Holders. The ASME refers to this Standard, in its Section III Division 1 NCA-4000.

The RCC-M refers in Section I A-5000 to a combination of the 50 C/SG Quality Standard written by the International Atomic Energy Agency (IAEA) and the ISO-9001/9002 Standard, first implemented in the late 1980s. The first objective of these ISO standards is customer satisfaction while the ASME Code relies on a very technical and nuclear industry oriented Standard.

Moreover, the ASME specifies, in its Section III Division 1 Section NCA-4000, the existence of an Authorized Inspection Agency (AIA) and Authorized Nuclear Inspectors (ANI). The ASME had assembled, in 1973, a Committee on Qualifications for Authorized Inspection (QAI), which issued the QAI-1 standard to qualify Authorities for Inspection. Even before that, the National Board of Boiler and Pressure Vessel Inspectors (NBBPVI) was created in 1919 to make sure that pressure vessels were built according to an acceptable standard and qualify inspectors capable of verifying the implementation of the standard. The NBBPVI nowadays qualifies the inspectors as per the QAI-1 to enable them to perform third-party verification of nuclear pressurized components.

The ASME developed Subsection NCA, which provides the general rules for ASME N-Type certification program for construction of Division 1 and 2 components, including Class 1 pressure vessels. The ASME N-Type certification program provides rules and requirements for designers, component owners, authorized inspection, professional engineers, material suppliers, qualification documents, and the application of the N-stamp, quality assurance, and registration with the ASME.

In contrast, the RCC-M gives more responsibility or freedom to the owners. Owners may here be the contractor, the manufacturer or the supplier, as specified in Section I A-5100. It is the responsibility of the owner to prepare and implement a quality system that is compliant with the code, to notify the various contractors, suppliers and manufacturers that it interfaces with of the quality system used and, finally, verify that they all are compliant with the defined quality system.

These are, in essence, two different ways of achieving the same objective.

There are also differences between the two codes as far as Personnel Qualification is concerned, especially in the area of Engineering Qualification. The ASME requires a Registered Professional Engineer to certify the component, the design specification, the overpressure protection report, design report and/or construction report.

For Engineering Qualification, the requirements of the ASME Code may be found in Section III Division 1, Appendix XXIII. It is described how to qualify a Professional Engineer, i.e., personnel able to certify Designs and Equipment. In practice, a Professional Engineer has to start the process after graduating with a Bachelor's degree from an accredited university (accreditation by the Accreditation Board of Engineering and Technology [ABET]) by taking the Fundamentals in Engineering (FE) exam.

After gaining experience in one specialty field as well as in regulation and licensure requirements (4 years), the final step is then to take the final Professional Engineering exam.

In the RCC-M, there is no such equivalent accreditation. The code does not address this certification, but every company has a QA program and internal requirements to assign engineers to particular tasks. The tools that can be used to assess the technical ability of an individual or an engineering organization are numerous. They range from simply looking at the résumés to looking at the scientific publications of an individual. It should also be noted that the IAEA 50 SG/Q, ISO 9001 and also, when applied, the non-mandatory Appendices ZZ and ZY, all require adequate competence of personnel. As for the manufacturer certification above, it is the owner responsibility to ensure this last point.

To conclude, it should not be forgotten that the RCC-M is a set of guidelines that is almost compulsory to follow in practice, but the French ASN does not enforce the use of any code. The AFCEN is, nevertheless, in close contact with the ASN to periodically collect its comments about the code. Moreover, an external document measuring the adequacy of the RCC-M provisions to the directives can be found (RM 09012, "File regarding the assessment of RCC-M Ed.2007 requirements versus ESPN Order of December, 12th 2005"). Nevertheless, on the European and French markets, the European directives and French laws are above the code and should be the first point of entry when manufacturing equipment for these markets.

For a strict consideration of QA, it must be noted that countries such as France, Finland and the United Kingdom have specific regulations that supersede any Code requirements.

4.11 Conclusion

A preliminary remark is that this conclusion does not include the results of Section 4.10, "Overview On Quality Aspects," as this paragraph is clearly out of the scope of the report as defined in the Introduction.

Two charts summarizing the differences based on the Appendix 1 can be seen Figure 23 and Figure 24. These two bar diagrams give a good general picture of the nature and number of differences between the two codes.

To summarize what has been said before, the first point concerns the prescriptive nature of the RCC-M Code compared to the ASME. The RCC-M dictates the specific design of a respective component to a greater degree than ASME Section III, which, due to the broader scope, leaves more responsibility to the owner (designer and/or manufacturer). As defined in the foreword, the ASME BPVC is intended to apply broadly to the mechanical equipment industry, while the RCC-M focuses on PWR components and is derived from the industrial experience in France. The ASME BPVC is intended to apply more generally and does not attempt to represent the specific experience of a single industry, as is the case regarding the RCC-M Code. In practice, the owners (individual utilities, designers and/or manufacturers) define the additional experience-based requirements used in conjunction with the requirements defined in the ASME BPVC to achieve an end result.

The second point concerns the evolutionary nature of the RCC-M, which tends to include more experience feedback, as can be illustrated by the part of the code on cleanliness, stemming directly from practical cases. Since its first edition in 1984, materials have been added, paragraphs have evolved and new results from R&D have been integrated.

These are two different approaches. The RCC-M approach, being more prescriptive, will guide the user to attain the desired end result, whereas, although a similar end will likely result through implementation of the ASME Section III rules by an experienced designer, the ASME does not provide the same level of direction. This difference is particularly apparent with respect to selection of materials. While, except for a few instances particularly based on French experience, the materials applied to address either RCC-M or ASME Section III requirements are very similar for like components, the RCC-M typically explicitly defines the material to be applied for a particular component while the selection in the case of the ASME component is generally based on design/manufacturing experience.

The comparison between the RCC-M Code and ASME Section III indicates that two types of differences can be identified: purely technical differences and differences resulting due to regulatory requirements. The former can be identified based on the work presented in this report with the responsibility left to the owner (designer and/or manufacturer) to address these differences. Concerning the latter, those differences resulting due to regulatory requirements are therefore related to some degree to cultural and political decisions resulting from the interpretation of industry developments. Addressing these kinds of differences requires discussion and reconciliation between the regulatory authorities of the respective countries.

One last positive note to end this part is the example given in Reference [3], which illustrates that in practice, adaptation of components from one code to the other is a challenge that can be overcome, even as regards regulatory aspects.

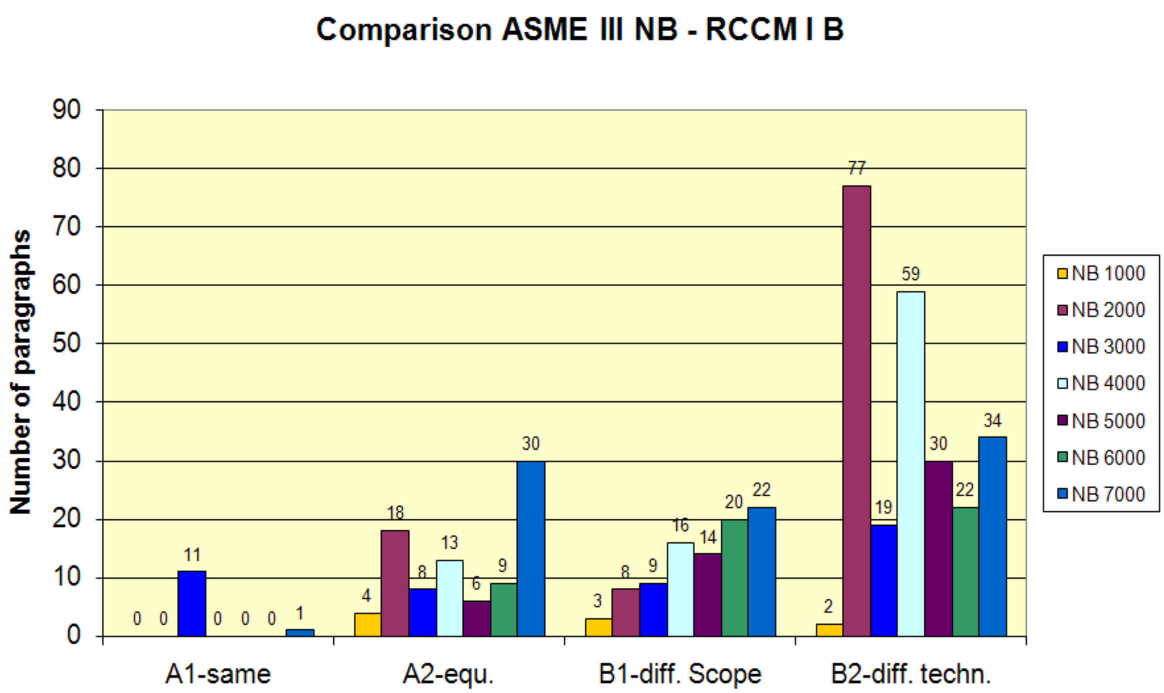


Figure 23—Detailed Section-by-Section Comparison Between ASME BPVC Section III NB Paragraphs and RCC-M Section I B Paragraphs

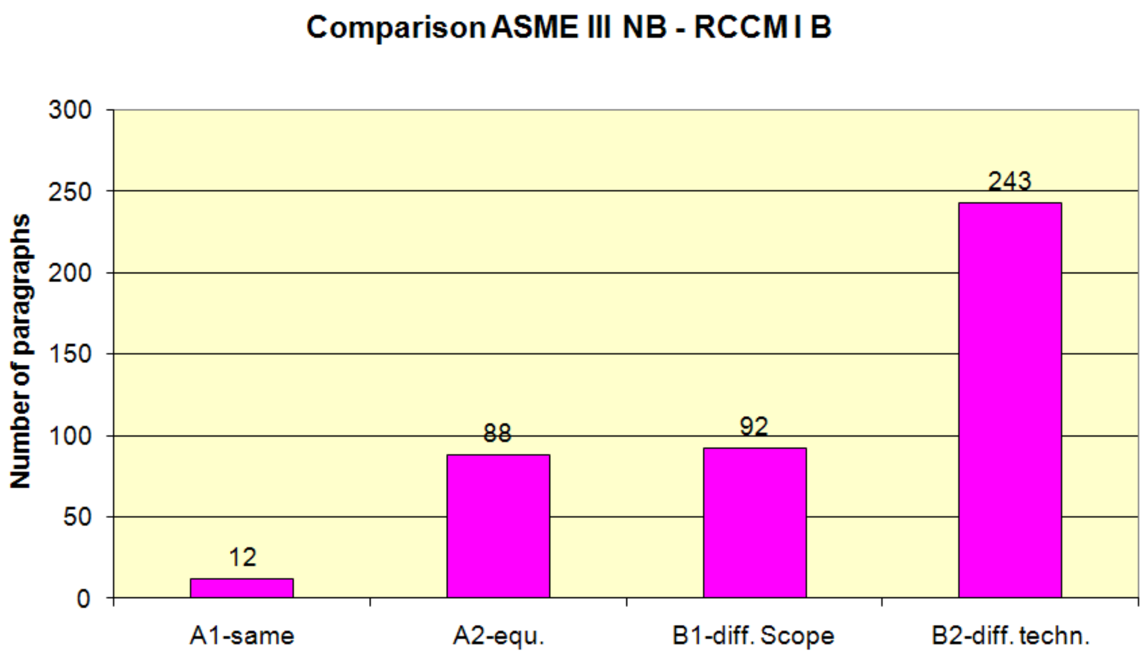


Figure 24—General Comparison Between ASME BPVC Section III NB Paragraphs and RCC-M Section I B Paragraphs

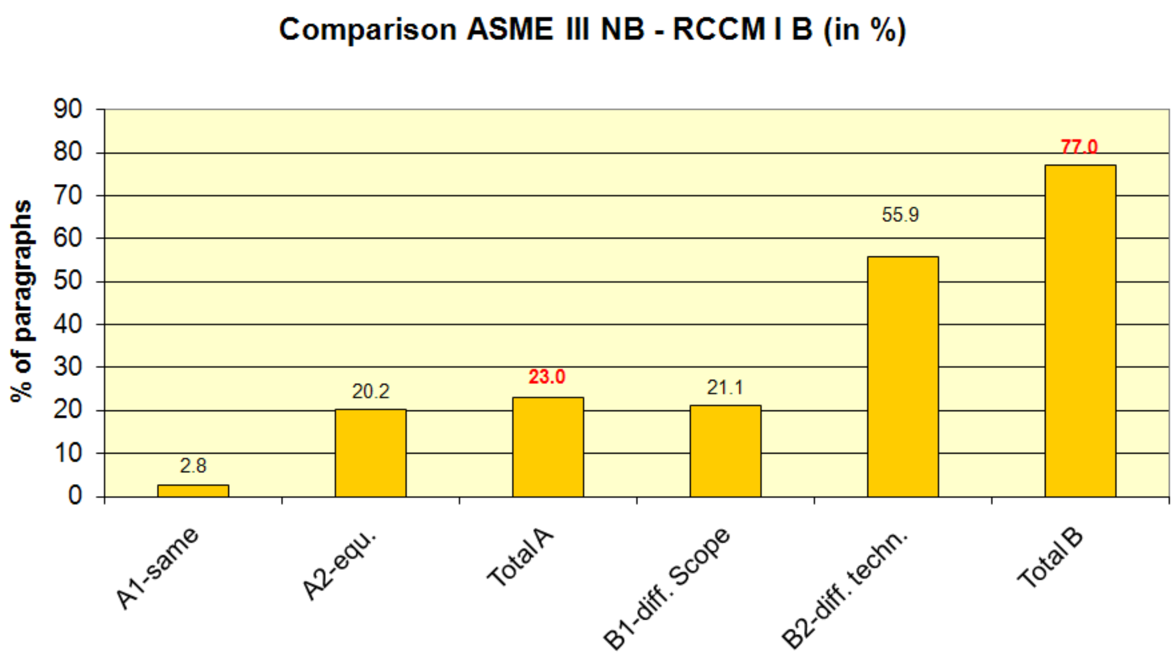


Figure 25—General Comparison Between ASME BPVC Section III NB Paragraphs and RCC-M Section I B Paragraphs in Percentages

5 JSME VERSUS ASME BPVC SECTION III COMPARISON

5.1 Abstract

The JSME nuclear code (JSME S-NC-1 2008: Rules on Design and Construction for NPPs, Division 1, LWRs) is currently primarily applied to domestic plants in Japan.

Considering globalization of the nuclear industry, it is considered beneficial for the industry in general that the similarities and differences of the codes and standards of various countries be identified and clarified to support possible future harmonization of these codes and standards. From this perspective, a comprehensive line-by-line comparison was made between JSME S-NC-1 and ASME BPVC Section III for Class 1 component rules. This part of the report describes the main result of the comparison.

As a result of the comparison, it was found that the very basic technical requirements are the same between ASME BPVC Section III and JSME S-NC-1. In particular, the basic design allowable limits for the failure modes that should be considered in design and operating conditions are fundamentally identical. This similarity comes from the fact that the origin of the JSME Code is based on repealed government regulation, METI Notification 501, which essentially relied on ASME BPVC Section III.

There are, of course, a number of minor differences in the requirements of JSME and ASME Codes. A large part of these differences fall into a category of ASME requirements that are not addressed or addressed in less detail in JSME.

It should be also noted that the Quality Assurance (QA) related and administrative requirements are quite different between JSME and ASME, reflecting the difference of regulatory environment and industry practice between Japan and the U.S.

5.2 Introduction

The comparison of JSME and ASME Codes on the rules of Class 1 components (vessels, piping, pumps and valves) is described in this section. First, a description of the comparison scope and strategy is provided, and then the comparison results are given, where the major differences are summarized. Appendix 2 provides summary tables that identify the major differences between JSME and ASME Code rules on the Class 1 vessel and Class 1 components (piping, pumps and valves), respectively.

As was agreed upon among the participating SDOs, the first comparison was made on the rules for Class 1 components (vessels, piping, pumps and valves), and JSME made comparison between JSME and ASME Codes. Along with the comparison of the technical requirements, the QA and related administrative requirements were also included in the comparison.

A detailed, line-by-line comparison was made of the JSME Code technical requirements with corresponding ASME requirements, and the comparison results were summarized in a tabular format. Sources or causes of the major differences were identified and classified, which will be discussed in the latter portion of this report.

As for the QA requirements, contrary to the technical requirements, comparison was made on the whole, since the code organization and contents of the QA requirements are significantly different between Japan and the U.S.

For the technical part of the design and construction rules for Class 1 vessels, the following ASME and JSME Codes were subjected to comparison.

(a) For ASME,

(1) ASME B&PV Code Section III 2007 Edition, Subsection NB, Class 1 Components: Articles NB-1000 through NB-7000

(2) Related Appendices

(b) For JSME Nuclear Power Generation Facility Codes,

(1) JSME Nuclear Power Generation Facility Codes

(2) JSME S-NC1-2008: Rules on Design and Construction for NPPs, Div. 1 LWRs

(3) JSME S-NB1-2007: Rules on Welding for NPPs

(4) JSME S-NJ1-2008: Rules on Materials for Nuclear Facilities.

For the general and QA related requirements, the following ASME and JSME Codes were subjected to comparison.

(a) For ASME,

(1) ASME B&PV Code Section III 2007 Edition, Subsection NCA

(2) ASME NQA-1-1994

(b) For JSME and JEA[2],

(1) JSME S-NC1-2008: Rules on Design and Construction for NPPs, Div. 1 LWRs

(2) JEAC 4111-2003: Code of Quality Assurance for Nuclear Power Plant Safety[3].

The comparison results were classified into the following four categories.

1. Equivalent	Code requirements of ASME and JSME are practically the same.
2. Not Equivalent	Requirements in JSME are different from those in ASME.
3. Not Addressed in JSME	No rules in JSME corresponding to ASME requirement.
4. JSME Unique	Rules unique to JSME and not addressed in ASME.

[2]JEA: Japan Electric Association, one of three major SDOs for nuclear codes and standards of Japan.
[3]Unofficial translation of the code title.

5.3 Preliminary Paragraphs and Scope Presentation

Highlights

- No stamping and no certificate holder in JSME S-NC1
- No detailed boundaries of jurisdiction consideration in JSME S-NC1.

This section summarizes the major differences between the introductory paragraphs of ASME BPVC Section III Division 1 NB 1000 and JSME S-NC1 section GNR.

One of the most significant differences is that marking, stamping and preparation of reports by the Certificate Holder of items are not required in JSME. The scope of JSME S-NC1 is limited to material, design, fabrication, examination, testing and overpressure relief. This difference is closely related to the significant differences of QA/QC requirements between ASME and JSME, which is overviewed in Section 5.11 of this report. Behind these differences lies the historical background of JSME S-NC1 development. JSME S-NC1 was first developed, by policy, mainly based on MITI Notification No. 501, which contained the detailed technical rules for structural design of nuclear components established by the regulatory authority. In developing MITI Notification No. 501, they sifted through ASME Section III and adopted provisions therein that were judged necessary from the regulator's point of view. With this background, there are number of provisions that exist in ASME Section III but not in JSME Code.

Differences are also found in the boundary of jurisdiction. The boundaries of components and jurisdiction are described clearly and in detail in ASME NB-1130, while JSME S-NC1 has limited descriptions. First, while ASME NB-1131 mandates the Design Specification to define the boundary of a component to which piping or another component is attached, JSME S-NC1 does not. In JSME S-NC1, descriptions are only given that correspond to NB-1132.2 (a) through (e). In JSME, there are no explicit distinctions between pressure-retaining and non-pressure-retaining attachments, or structural or nonstructural attachments (NB-1132.1) either.

The last major difference in this section is component classification definitions. While, in ASME, the component classification is entrusted to the Design Specification, component classification definitions are given in JSME S-NC1, such as, "Class 1 components are those components that constitute the reactor coolant pressure boundary." Lists of major systems and components that belong to each class (Classes 1, 2, 3, MC, etc.) are given in the explanatory part of JSME S-NC1 (which is not the code itself). This comes also from the historical background of JSME S-NC1.

5.4 Materials

Highlights

- JSME does not specify welding materials.

Generally, the requirements for test coupons, fracture toughness test, nondestructive examinations (NDE) for base material and repair activities (NB-2000 in ASME) are almost the same between JSME and ASME. However, there are some differences between JSME and ASME that are listed below.

First, JSME does not define nomenclatures in detail as ASME NB-2110, e.g., JSME does not define "pressure-retaining material" or "nominal thickness."

Second, JSME does not specify welding materials, NB-2121. Manufacture qualifies applicable welding material based on the welding procedure qualification test conducted in accordance with the performance requirement of Part 2 of JSME S NB1-2007, "Rules on Welding for Nuclear Power

Plants." JSME requires welding materials to have strength equal to or greater than that of base material in N-1040 of JSME S NB1-2007.

In addition, JSME does not specify requirements for Certified Material Testing Report (CMTR), NB-2130. Japan Industrial Standards (JIS) is applied for it.

Moreover, ASME specifies QA requirements such as material identification, NB-2150, and heat treatment procedure, NB-2180, whereas JSME does not. ISO 9001 is applied as QA requirements in Japan.

It should also be noted that detailed requirements of NDE are partly different. This can be seen in Figure 26.

ASME also specifies requirements for qualification of welding procedures and welders (NB-2539.2, NB-2573.3), and NDE procedure requirements (NB-2575.4). JIS requirements are applied in Japan.

Finally, ASME specifies requirements for material organization's quality system programs, NB-2600. QA programs based on ISO 9001 are applied in Japan.

	ASME	JSME
UT requirements for plate	Angle UT for 2 in. thickness and below Straight UT for over 2 in. thickness, and all vessel material, NB-2531	Straight UT for all materials, PVB-2411
Time of examination	After heat treatment, NB-2537(a)	Not related to heat treatment, PVB-2413

Figure 26—Comparison of Detailed Requirements for NDE in ASME and JSME Codes

5.5 Design

Highlights

- K_e factor in JSME is formulated based on the elastic follow-up model for local plasticity.

Generally, the requirements for the design rules for Class 1 vessels (NB-3000 in ASME) are almost the same. Especially, the basic design allowable limits for the failure modes that should be considered in design and for every operating condition are identical. However, there are some differences between JSME and ASME and those are listed here.

First, concerning the plastic analysis, the ASME BPVC, NB-3228, specifies limit analysis, experimental analysis and plastic analysis as primary stress evaluation methods. Shakedown analysis is also specified in ASME. JSME PVB-3160, meanwhile, only specifies limit analysis as a primary stress evaluation method. Instead, JSME has a Code Case specifying evaluations for primary stress, primary plus secondary stress and shakedown assessment by direct use of inelastic FE analysis results, NC-CC-005. The JSME Code Case has clear methodologies for those evaluations, while the ASME provisions specify only requirements as shown in Table 28.

Concerning the K_e factor, ASME NB-3228.5, JSME PVB-3300 specifies original K_e factors that are formulated based on the elastic follow-up model for local plasticity, reflecting Japanese R&D results. The K_e factors are compared for some typical cases between ASME (NB-3328.5) and JSME (PVB-3315) in Figure 27. It is noted that JSME gives less conservative values.

For openings and reinforcement, the ASME Code (NB-3339) specifies alternative rules for nozzles in cylindrical shells, spherical shells and formed heads, while JSME PVB-3551 only specifies nozzles for cylindrical shells. JSME PVB-3552 generally requires more area reinforcement for values of $d/\sqrt{(Rt_r)}$ between 0.2 and 0.4 than does NB-3339.3, based on use of the formula in WRC Bulletin 133.

The following formulae produce nearly identical results.

(a) ASME ─ $A_r = [4.05(d/\sqrt{(Rt_r)})^{1/2} - 1.81]dt_r$

(b) JSME ─ $A_r = [3.75(d/\sqrt{(Rt_r)}) - 0.75]dt_r$

It should also be mentioned here that reflection of plant operating experiences in Japan is integrated in the code. The following JSME unique appendices are established reflecting operating experiences in Japanese plants.

(a) Non Mandatory Appendix 4-B: Fluid-elastic Vibration Evaluation of U-bend Tubes in Steam Generators

(b) Non Mandatory Appendix 5-A: Evaluation of Flow-Induced Vibration

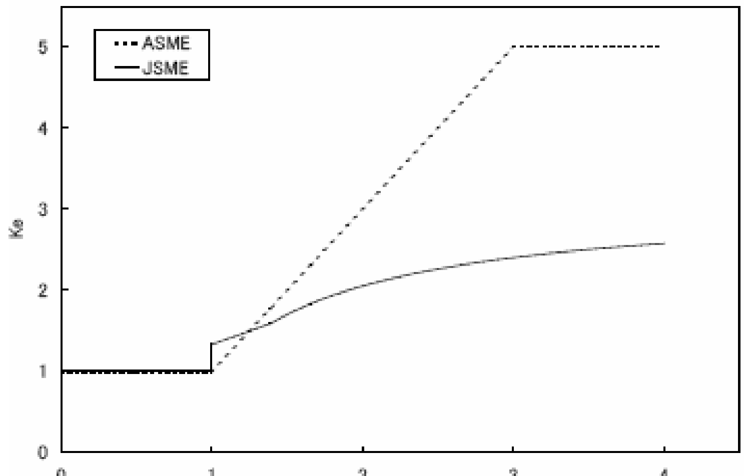
(c) Non Mandatory Appendix 5-B: Evaluation of High-Cycle Thermal Fatigue.

Regarding the requirements that are addressed in the mandatory appendices in ASME Section III, Subsection NB, there are several differences identified as below:

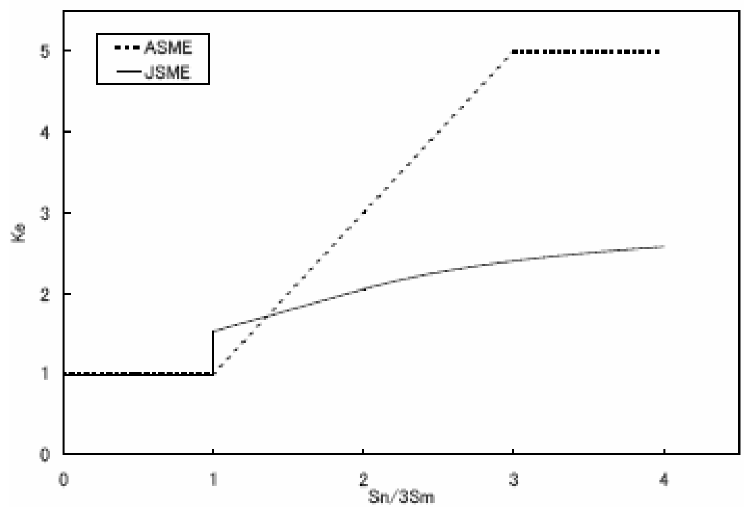
(a) Mandatory Appendix II, Experimental Stress Analysis: JSME does not specify experimental stress analysis.

(b) Mandatory Appendix III, Basis for Establishing Design Stress Intensity Values and Allowable Stress Values: Regarding new material test data, ASME permits use of available data for similar material if suitable test data do not exist, while JSME Material Code requires taking these data.

(c) Mandatory Appendix IV, Approval of New Materials under the ASME Boiler and Pressure Vessel Code: JSME specifies requirements for base material only. JSME requires welding materials to have strength equal to or greater than that of base material.



(a) Case of "Sp/Sn=2" for Carbon Steel



(b) Case of "Sp/Sn=5" for Carbon Steel

Figure 27—Comparison of K_e Factor Used in the Simplified Elastic-Plastic Analysis Between JSME and ASME

Table 28—Comparison of Plastic Analysis Between JSME Code Case and ASME

	JSME Code Case	ASME NB-3228
Primary Loads	– Lower-Bound Approach Method (EP FEA) – Twice-Elastic-Slope Method (EP FEA) – Elastic Compensation Method based on the lower bound theorem (Elastic FEA) [Note: The yield strength is S_m and the collapse load calculated is used.]	– Limit Analysis (EP FEA) [Note: The yield strength is $1.5S_m$ and two-thirds of the lower-bound collapse load is used.] – Experimental Analysis – Plastic Analysis [Note: The stress- strain relationship is not specified.]
Cyclic Loads	Shakedown Assessment – Cyclic Yield Area Evaluation (Elastic FEA) Ratchet Assessment (when Shakedown Assessment is not satisfied) – Equivalent Plastic Strain Criterion – Elastic Region Width Criterion (The elastic region shall remain in the wall thickness and the size shall not reduce.)	– The Design shall be considered to be acceptable if shakedown occurs. [Note: No clear evaluation method for shakedown is specified.]
Fatigue	Fatigue analysis using Ke-factors calculated by the Ke"-equation $Ke''=1+(\tilde{q}_p\, l\,)(\,\tilde{l}\,3\ S_m/S_p)$ where, – Ke"-equation with fixed elastic follow-up factor q_p $qp=(\tilde{q}_l\, q_0\,)(\tilde{l}\,3\ S_m/S_p)$ $q_0 = 1.5$, $q_l = 4.0$ – Ke"-equation with valuable q_p evaluated by elastic-plastic analysis	– The numerically maximum principal total strain range multiplied by one-half the modulus of elasticity of the material is used for fatigue analysis.

5.5.1 Piping, Valves and Pumps

Highlights

- While in ASME the piping stress limits against seismic loads (stress due to inertial reversing dynamic loads, Level D service limits) are given by $3S_m$ with a reduced B2 index, in Japan, JEAC 4601 requires fatigue analysis.
- JSME does not request welding specifications for pumps.

This section summarizes the major results and findings obtained through the comparison of design rules on Class 1 piping, pumps and valves between JSME and ASME. Regarding the requirements other than design, i.e., material, fabrication, examination and testing, the similarities and differences between JSME and ASME are actually the same as in the case of Class 1 vessels; the comparison was rather focused on the design requirements.

The portions JSME and ASME Codes subjected to comparison are summarized in Table 29.

A summary table of the major differences is given in the Appendix 2. This section is divided into three parts: the first one concerning the piping design, the second, the pump design, and the third and final, the valve design.

First, concerning the piping design, the first paragraph addresses considerations for Local Conditions and Transients (NB-3612.4). These ASME requirements on piping systems design aspects are not addressed in JSME. They are covered by the requirements of the applicable ministerial ordinance or manufacturer's practice.

When it comes to allowance (Corrosion or Erosion, NB-3613.1), ASME requires that when corrosion or erosion is expected, the allowance of wall thickness shall be considered. On the contrary, JSME does not require consideration of corrosion or erosion in the design phase, while in the actual design practices they are considered by the industry designers. In addition, for the operation and maintenance phase, requirements are specified by another standard for the management and control of piping wall thickness by periodical measurement for identified piping portions of potential erosion or corrosion (JSME S CA1-2005, "Rules on Pipe Wall Thinning Management").

For threading, grooving, miters and extruded outlet piping (NB-3613.2, NB-3643.2, NB-3644), ASME allows the usage of threading, grooving, miters and extruded outlet piping, while JSME stipulates that connections between pipes shall be limited to a welding joint or a flange joint (PPB-3430).

Furthermore, the requirement for miters and extruded outlet piping does not exist in JSME since these items are not used in the actual plants.

Concerning Design and Service Loadings (NB-3621), ASME identifies and classifies the loads to be concerned in design with detail and clear definitions, while JSME leaves them to the design specification (GNR-2220 and PPA-3300).

About the requirements for Class 1 Piping Analysis (NB-3630), ASME states that piping of NPS1 or less may be designed in accordance with the design requirements of NC (Class 2 piping), while JSME does not have such an alternative route. Class1 piping shall be designed in accordance with the design requirements of PPB (Class1 Piping).

For the elbow requirements (NB-3642.2), ASME states that the wall thickness of a short elbow crotch region (the portion of Φ=210~330° defined in Figure 28) shall be 20% greater than the minimum wall thickness required for the straight pipe, but JSME does not have such a requirement.

Another difference relates to the requirement for reinforcement (NB-3643.3). Although two-thirds of the opening reinforcement must be required within the defined region, a part of an equation to calculate the defined region is not stipulated in JSME (PPB-3424).

Although the definite distance between two openings shall be required for two unreinforced openings in order not to have reinforcements, a part of the requirement for openings not requiring reinforcement is not stipulated in ASME (PPB-3422).

In the case of two openings closer to each other, JSME defines the available ranges for reinforcement and the distance between two openings, while these definitions are not stipulated in ASME (NB-3643.3 versus PPB-3424).

Rules for the nozzle type of branch connection in JSME differ from ASME. Although the latter approves partial-penetration welding on branch connections, JSME does not approve it and applies full penetration only.

The next difference is the requirement for closure (NB-3646). ASME states the pressure requirements on closures. JSME requires separate pressure requirements for both paneling and plate, and these requirements are based on the ones for Class 2 components (PPB-3413, PPB-3415.2).

JSME requires the applicable condition of opening on head (panel) (PPB-3423), but ASME does not require it and has the definition for the required thickness of a head depend on the opening location on the head.

Concerning the requirement for permanent blanks (NB-3647.2), ASME approves permanent blanks, while JSME does not approve and they are not used for actual plants.

In addition, ASME approves temporary blanks (NB-3647.3), while JSME does not take it as the item needs to comply with the Codes.

Currently, expansion joints (NB-3649.1) cannot be applied under ASME and JSME. ASME has been working on developing the applicable rule.

There are some differences in the allowable stresses between JSME and ASME that include allowable primary stresses for Level A and B Service limits, allowable stresses for dynamic (seismic) loads. The allowable stresses are compared in Table 30.

ASME defines the allowable primary stress (Min ($1.8S_m$, $1.5S_y$), NB-3653, etc.) for Level B Service Limits. On the contrary, JSME does not define allowable primary stresses for Level A and B Service Limits.

ASME defines allowable stress for the loads including reversing dynamic loads (NB-3656, etc.) that is different from those for (B2' =2/3 B2), where a seismic load is considered to be a typical reversing dynamic load. While JSME does not define allowable stresses for seismic condition, JEAC 4601, which is the seismic design code in Japan, requires fatigue damage evaluation instead of primary stress limit.

Furthermore, JSME PPB-3536 (Simplified Elastic-Plastic Analysis) requires that new K_e Factor (NB-3653.6, etc.) shall be applied to obtain alternating stress intensities (refer to PVB-3315). The K_e Factor is obtained by Japanese R&D results.

In addition, ASME defines the matters that shall be accounted in piping design. Examples are as follows.

(a) Design Limits of Flanged Joints (NB-3658): ASME defines the allowable moments for flanged joints in Level A to D Service Limits. However, JSME defines that flanges shall be designed to use the equivalent pressure that is converted from moments on flanges.

(b) Definitions of Joint Design (NB-3671): ASME defines the requirements for treaded joint, flared joints, compression joints and caulked joints, et al., as connections without welding. However, JSME requires that Class 1 piping shall be used welded joints or flanged joints, so JSME does not define the requirement of a wide variety of joints.

(c) Flexibility of Piping (NB-3672) Design Limits of Flanged Joints (NB-3658): ASME defines the general requirements of flexibilities (NB-3672) that piping shall be designed to have sufficient flexibility and cold springing that the maximum allowable stress due to cold springing is $2.0S_m$ (NB-3672.8, etc.). In Japan, flexibility is considered as part of general requirements and these requirements are not described in JSME.

Now turning to the pump design, one of the first differences relates to the scope and applicability (NB-3411). Among the portions and parts defined in ASME, there are some that are not included in JSME, e.g., seal housing and seal glands, and so on. This difference goes back to MITI Notification 501, on which the JSME Code is based.

MITI Notification No. 501 defined a pressure-retaining boundary from the viewpoint that it is important that the pressure-retaining parts not be damaged and pumped fluid not leak outside. Leakage is restricted by the labyrinth, and the bearing, etc. of the pump, even if parts such as mechanical seals were damaged (NB-3411). MITI Notification No. 501 did not define these parts as subject to regulation.

Another difference relates to the requirement against corrosion (NB-3418). Because quantification is difficult, it is not regulated in JSME, though consideration to environmental effects such as corrosion is requested in ASME.

Concerning the requirements for welding (NB-3431), JSME does not request welding specification.

It is the same for reinforcement of openings (NB-3433): JSME does not specify reinforcement of openings. However, when openings are necessary except inlet or outlet, it is acceptable to analyze stress taking into account openings and stress does not exceed the allowable value defined in the regulation.

Piping and supports (NB-3435, NB-3438) are specified in other articles of JSME Code, and are not included in articles of the pump.

Finally, this last part covers valve design. A first notable difference relates to the evaluation of secondary stresses on valve casing by pipe reaction forces (NB-3545.2 (b)). JSME (VVB-3330) evaluates all tensile, bending and torsion forces of pipes as pipe reaction forces on a valve casing, but ASME evaluates only bending forces of pipes.

JSME recognizes only a flange structure as a joint structure of body and bonnet (NB-3546.1) but does not recognize a general pressure-sealing structure for high-pressure valves. Contrarily, ASME recognizes particular joint structures including the pressure-sealing structure.

As for the valve fatigue evaluation (NB-3550), JSME (VVB-3370) does not admit the exceptive stipulation (excluding fatigue evaluation due to temperature change) that is admitted by ASME. In the exceptive stipulation, JSME performs a fatigue evaluation in a narrower temperature difference range (lower than 14°C) for stainless steel, while ASME adopts a temperature difference range of lower than 17°C (30°F) for both carbon and stainless steel.

Furthermore, ASME evaluates quakeproof (NB-3524) values given in a design specification by a static loading test. However, JSME includes no relevant description but JEAG 4601(1984)/ JEAC 4601(2008) includes the relevant description.

JEAG stipulates the soundness of a valve body even if a pipe connected to the valve breaks down, together with a quakeproof performance evaluation by “confirmed acceleration levels” that were obtained by a series of active function tests (vibration tests) and static loading tests.

Finally, ASME stipulates materials and structures of safety valves (NB-3590), while JSME does not. JSME (SRV-3010) stipulates that materials and structures of safety valves should conform to JIS B8210.

Table 29—Comparison of ASME NB and JSME Class 1 Rules

	ASME Sec. III, Subsection NB	JSME
Piping	Article NB-3600, Piping Design	PPB-3000 Design of Class I Piping
Pump	Article NB-3400, Pump Design	PMB-3000 Design of Class I Pumps
Valve	Article NB-3500, Valve Design	VVB-3000 Design of Class I Valves

Table 30—Comparison Between ASME/JSME Allowable Primary Stress for Class 1 Piping

Code		Stress	Allowable Stress: Design Condition	Level A Service Limits	Level B Service Limits	Level C Service Limits	Level D Service Limits
ASME		Primary Stress	1.5Sm		Min(1.8Sm,1.5Sy)	Min(2.25Sm,1.8Sy)	Min(3Sm,2Sy)
		Primary and Secondary Stress (Thermal)	—	3Sm		—	—
		Primary and Secondary	—		3Sm	4.2Sm	6Sm
		Primary, Secondary and Peak Stress	—	U≦1.0		—	—
Japanese Code	JSME	Primary Stress	1.5Sm			Min(2.25Sm,1.8Sy)	Min(3Sm,2Sy)
		Primary and Secondary Stress (Thermal)	—	3Sm		—	—
		Primary, Secondary and Peak Stress	—	U≦1.0		—	
Seismic Loads	JEAG4601	Primary Stress	—			2.25Sm	3Sm
		Primary and Secondary Stress*4	—			3Sm	3Sm
		Primary, Secondary and Peak Stress	—			$U+U_{S1}$*3≦1.0	$U+U_{S2}$*3≦1.0
	JEAC4601 (2008)	Primary Stress	—			Min(2.25Sm,1.8Sy)	— (Min(3Sm,2Sy))*2
		Primary and Secondary Stress*4	—			3Sm	3Sm
		Primary, Secondary and Peak Stress	—			$U+U_{Sd}$*3≦1.0	$U+U_{Ss}$*3≦1.0

*1: Stress due to reversing dynamic loads
*2 :In case of involving the short period mechanical loads other than seismic loads
*3: Usage factor due to seismic loads
*4:Stress due to seismic inertia and anchor movement only

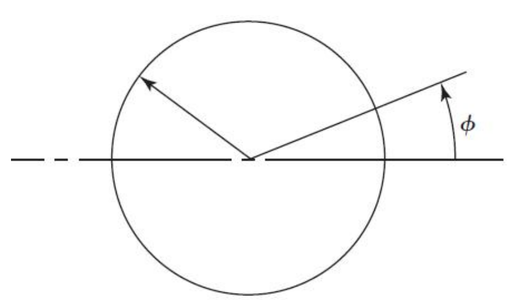


Figure 28—Comparison of ASME NB and JSME Class 1 Rules

5.6 Fabrication – Welding

Highlights

- Cutting, forming and brazing specified in ASME BPVC and not in JSME.

Generally, the requirements for fabrication for Class 1 vessels (NB-4000 in ASME) are almost the same. However, there are some differences between JSME and ASME as can be seen in this section.

First, for the matters related to brazing (reference ASME NB-4500), JSME does not specify requirements for brazing and special welding such as stud weld (reference ASME NB-4311). If necessary, procedures can be established according to JSME.

For the Quality Assurance, ISO 9001 is applied for QA requirements in Japan.

Furthermore, ASME NB-4200 specifies requirements for cutting and forming, while JSME does not specify for any other than welding.

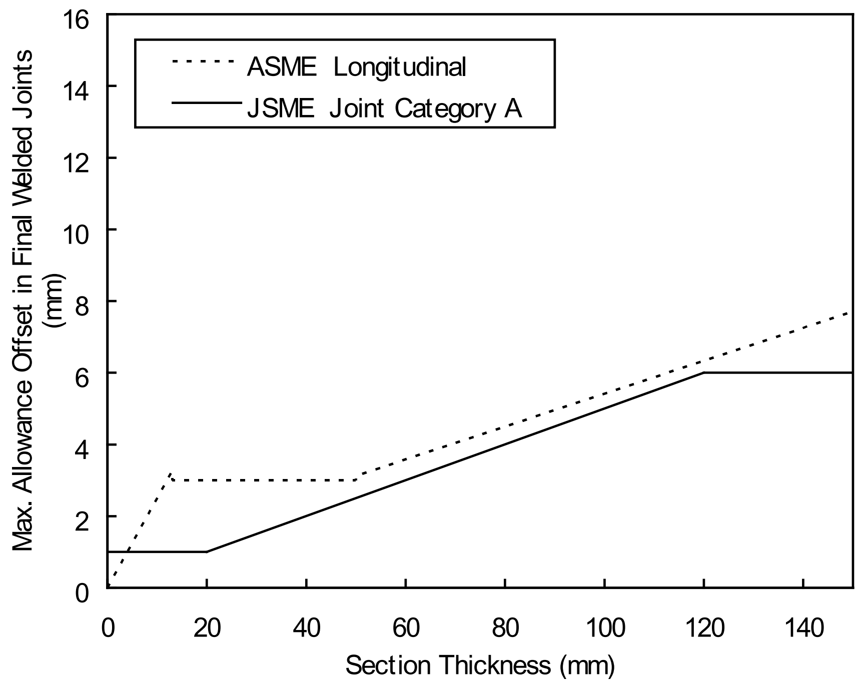
Moreover, JSME PVB-2412 does not permit exemptions for defects in base material found in the fabrication phase specified in NB-4131 of ASME Code.

In addition, JSME PVB-4110 has the same requirement of maximum difference in cross-sectional diameters of NB-4221, but does not have a requirement of maximum deviation for external pressure.

Concerning the alignment requirements for joints, JSME PVB-4231 stipulates slightly more severe requirements in the maximum allowable offset in final welded joints than ASME NB-4232. A comparison of the code requirements is shown in Figure 29.

Also, concerning the thickness of weld reinforcement, N-1080 of JSME S NB-1 has more severe requirements than NB-4426.1. A comparison of the code requirements is shown in Figure 30.

Finally, ASME permits and/or has provisions for fillet welds for piping branch connections (NB-4246), temper bead weld repair (NB-4622.9) and mechanical joints (NB-4700), while JSME does not.



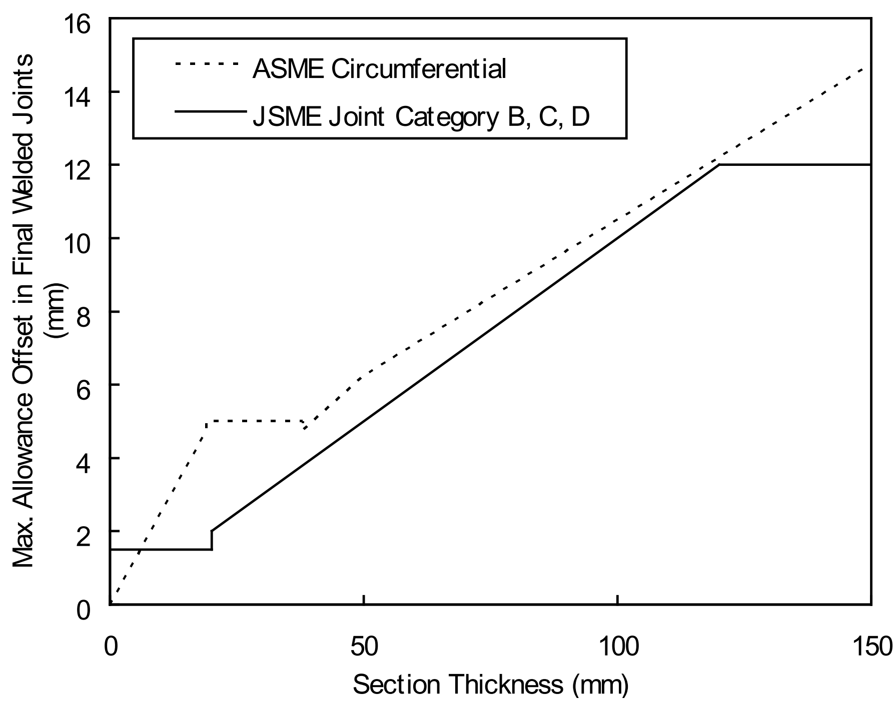


Figure 29—Comparison of Maximum Allowance Offset in Final Welded Joints Between JSME and ASME

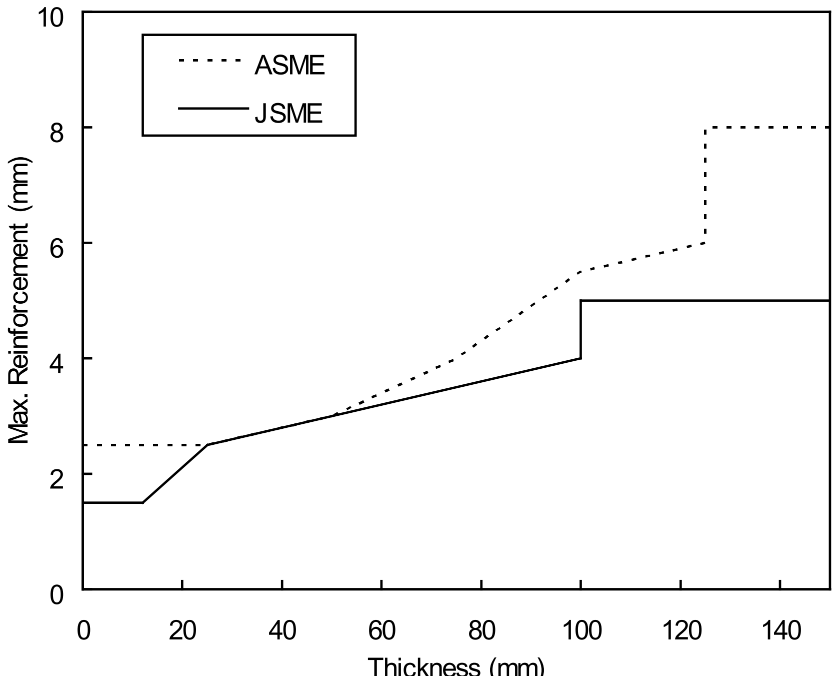


Figure 30—Comparison of Maximum Thickness of Weld Reinforcement Between JSME and ASME

5.7 Examination

Highlights

- Examination requirements and acceptance criteria based on MITI Ordinance in JSME.

Generally, the requirements for examinations for Class 1 vessels (NB-5000 in ASME) are almost the same. However, some differences exist in examination requirements and acceptance criteria. Those in JSME have their bases in the former MITI Ordinance for welding.

One other difference relates to the Quality Assurance: ISO-9001 is applied for QA requirements in Japan.

Furthermore, JSME requires PSI to prepare a baseline record for future ISI and not to perform evaluation of an indicated flaw as per ASME NB-5332.

Concerning acceptance criteria of indications of imperfections on weld edge preparation surface, N-1030(3), Tables 9 and 10 of JSME S NB-1 are more restrictive than NB-5130. They require examination of thinner materials and are generally more restrictive regarding acceptance of linear indications. The following indications are unacceptable in each code.

ASME

(1) Linear indications: greater than 5 mm

(2) Rounded indications; greater than 5 mm

JSME

Thickness	Length of linear indications
t < 16 mm	2 mm
16 < t < 50 mm	4 mm
t > 50 mm	6 mm

greater than 4mm

And for the acceptance criteria of NDE, JSME is slightly more restrictive than ASME in the following examinations.

- Radiographic examination (ASME NB-5320, Table 7 of JSME S NB-1)
- Magnetic particle examination (ASME NB-5342, Table 9 of JSME S NB-1)
- Liquid penetrant examination (ASME NB-5352, Table 10 of JSME S NB-1).

Regarding the requirements that are addressed in the mandatory appendices in ASME Section III, Subsection NB, there are several differences identified as below.

- Mandatory Appendix VI, Rounded Indication: JSME refers to JIS, so some differences exist in concepts for classification of indications, classification of contrast indicators, counting method of number of indications, indication size and acceptance criteria.

The comparison of the maximum sizes of rounded indication is shown in Figure 31.

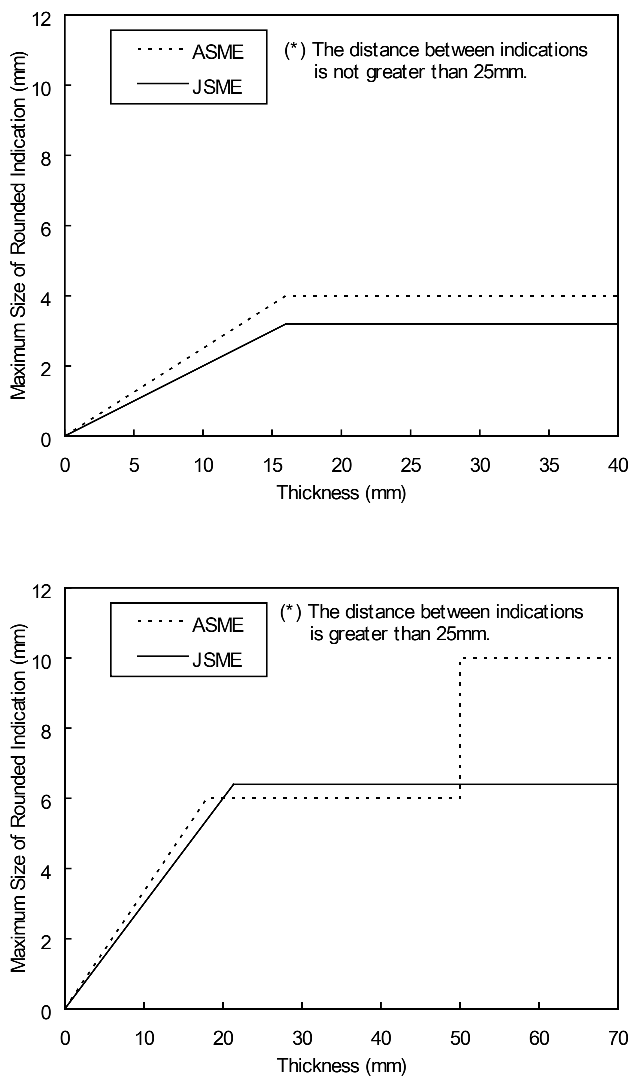


Figure 31—Comparison of Maximum Size of Rounded Indication Between JSME and ASME

5.8 Pressure Tests

Highlights

- JSME requires pressure testing at 1.1 x PO (operating pressure) if pressure test is conducted between first fuel loading and commercial operation.

Generally, the requirements for testing for Class 1 vessels (NB-6000 in ASME) are almost the same. However, there are some minor differences between JSME and ASME.

First, ASME NB-6114.2 has detailed provisions for substitution of pressure test prior to installation in the system, while JSME PHT-1112.2 does not specify in detail.

Second, JSME requires test pressure as 1.1 x PO (operating pressure) if the pressure test is conducted between first fuel loading and commercial operation (PHT-2111, 2112, 2121 and 2122).

In addition, ASME NB-6222 has different requirements for maximum permissible pressure according to classification of components, while JSME PHT-2130 stipulates the same requirement, 106% of test pressure or stress evaluation for independent classification of components.

JSME PHT-4010 stipulates a different test pressure holding time for valves than ASME NB-6223. (PHT-4010 requires 3 minutes holding time for valves and 10 minutes for other components, while ASME NB-6223 requires 10 minutes for all components.) JSME PHT-3010 stipulates more detailed requirements for components designed for external pressure than ASME NB-6610. (JSME PHT-3010 allows pneumatic test of 1.1 times design pressure besides hydrostatic test of 1.25 times design pressure, while ASME NB-6610 allows hydrostatic test of 1.25 times design pressure only.)

ASME has provisions for machining after pressure test (NB-6115), venting (NB-6211), test medium (NB-6212 and NB-6312), pressure test gauges (NB-6400) and combination units (NB-6620), while JSME does not. ASME NB-6113 has provisions for witnessing of pressure testing, while JSME does not. Again, ISO 9001 is applied for QA requirements in Japan.

5.9 Overpressure Protection

Highlights

- JSME only defines design requirements for pressure relief devices, while ASME also defines a set of detailed systems requirements for overpressure protection.

Generally, the requirements for overpressure protection for Class 1 vessels (NB-7000 in ASME) are almost the same. However, there are some minor differences between JSME and ASME.

JSME only specifies design requirements (material, structure, calculation method of relieving capacity, etc.) for pressure relief devices. Many of them refer to JIS. The JSME Code itself does not have equivalent provisions to ASME NB-7000.

JSME has a Code Case for overpressure protection; however, it does not stipulate as many details as ASME.

ASME has provisions for direct spring-loaded valves, pilot operated valves, power-actuated valves as pressure relief valves (NB-7170), while JSME stipulates direct spring-loaded valves only (OPP-2000).

ASME has a provision for an overpressure protection report (NB-7200), while JSME does not.

Both codes specify similar requirements for required number and set pressure of pressure relief devices (NB-7313 and OPP-3000); however, provisions of ASME NB-7313 are more detailed than those of JSME OPP-3000.

ASME NB-7510 stipulates relief valve operating requirements such as set pressure tolerance, while JSME does not. In Japan, JIS is applied for many such requirements.

ASME NB-7700 stipulates several methods for capacity certification, such as flow model test method, coefficient of discharge method, etc., while JSME SRV-3110 stipulates only coefficient of discharge method.

ASME NB-7800 stipulates QA/QC requirements such as stamping and marking, while JSME does not. ISO 9001 is applied for QA requirements in Japan.

5.10 Overview on Quality Aspects

Highlights

- No Authorized Inspection and Code Stamping system in JSME like ASME.

In ASME, the QA-related requirements are given in Subsection NCA of Section III and NQA-1. Their counterparts of Japanese Codes are Chapter 1, General Requirements of JSME S-NC1-2008, Rules on Design and Construction for NPPs, Div. 1 LWRs; and JEAC 4111-2003, Code of Quality Assurance for Nuclear Power Plant Safety, which is applicable primarily to plant operation rather than manufacturing.

Generally speaking, the Japanese QA requirements have their basis in ISO 9001-2000 and are performance based, while the ASME requirements are compliance QA. Therefore, there exist significant differences between ASME and JSME (including JEA).

Below is a summary comparison between ASME and JSME on the QA-related requirements.

Starting with the comparison with ASME Subsection NCA, the first difference is related to NCA-1000, SCOPE OF SECTION III. It is not equivalent, but there is no meaningful technical difference between ASME and JSME. For the rest:

(a) NCA-2000, CLASSIFICATION OF COMPONENTS AND SUPPORTS: Not equivalent, but almost no difference for their technical positions.

(b) NCA-3000, RESPONSIBILITIES AND DUTIES: No correspondence in JSME, since Japan has no society's qualification and accreditation system like ASME. Thus, an article corresponding to NCA-3000 is not prepared in JSME Code.

(c) NCA-4000, QUALITY ASSURANCE: In Japan, QA Code applicable to nuclear power plant is established and maintained by JEA (Japan Electric Associated) and endorsed by Regulatory Authority independently from JSME Code. Thus, JSME Code has no article about Quality Assurance corresponding to NCA-4000. Also, the Japanese QA Code, established and maintained by JEA, is based on the “Performance-Base QA” concept of ISO 9001-2000, and has many differences from NCA-4000 and NQA-1-1994, which are based on “Compliance QA” concept.

(d) NCA-5000, AUTHORIZED INSPECTION: Japan has no Authorized Inspection and Code Data Report system like ASME. Thus, the JSME Code has no article about Authorized Inspection corresponding to NCA-5000.

(e) NCA-8000, CERTIFICATES, NAMEPLATES, CODE SYMBOL STAMPING, AND DATA REPORTS: Japan has no Authorized Inspection and Code Stamping system like ASME. Thus, the JSME Code has no article corresponding to NCA-8000.

(f) NCA-9000, GLOSSARY: Not equivalent, but no meaningful technical difference between ASME and JSME.

Now, turning to the comparison with ASME NQA-1-1994, with regard to the Basic and Supplementary Requirements, there are significant differences. The JEA QA Code, based on the "Performance-Base QA" concept of ISO 9001-2000, is more generic and plain as compared with NQA-1-1994, which is based on the "Compliance QA" concept.

Major differences between NQA-1 and JEA QA Code include:

(a) For 18 Basic Requirements of NQA-1, JEA QA Code is "basically" or "conceptually" equivalent.

(b) For Supplementary Requirements of NQA-1, JEA QA Code has less detailed requirements.

(c) The differences between ASME and JEA Code are especially large in the following three Supplementary Requirements of NQA-1, where NQA-1 gives very detailed procedure requirements.

  (1) SUPPLEMENT 3S-1, Supplementary Requirements for Design Control

  (2) SUPPLEMENT 7S-1, Supplementary Requirements for Control of Purchased Items and Services

  (3) SUPPLEMENT 17S-1, Supplementary Requirements for Quality Assurance Records.

5.11 Conclusion

With regard to the rules on materials, design, fabrication, examination, testing and overpressure protection, it was confirmed that the very basic technical requirements are the same between ASME and JSME Codes. Especially, the basic design allowable limits for the failure modes that should be considered in design and for every operating condition are fundamentally identical.

There are, of course, a number of minor differences in the requirements of JSME and ASME Codes. A large part of these differences fall into a category, "ASME requirement that is not addressed or less detailed in JSME," which reflects the industry's level of quality activities and technologies in Japan.

Figures 32, 33 and 34 are charts summarizing the similarities and differences based on the comparison results between ASME and JSME Codes given in the Appendix 2. These bar diagrams give a good general picture of the nature and number of similarities and differences between the two codes.

From the similarity and differences of JSME and ASME Codes, it could be concluded that, although there are number of minor differences, JSME Code provides essentially the same level of requirements for Class 1 components as compared to those to ASME Code.

Nevertheless, as described in the previous section, there are differences between ASME and JSME requirements. The sources of these differences are identified and classified as follows.

(a) Utility or manufacturer's own QA program based on ISO 9001 is applied to the QA activities in Japan.

(b) JSME Code (Rules on Design and Construction) was first developed mainly based on MITI Notification No. 501, which contains the detailed technical rules for structural design of nuclear components established by the regulatory authority. In developing MITI Notification No. 501, they sifted through ASME Section III and adopted provisions therein that were judged necessary from the regulator's point of view. With this background, there are number of provisions that exist in ASME Section III but not in JSME Code.

(c) JSME Code specifies applicable JIS (Japanese Industrial Standards) for base metals, but does not specify those for welding materials. In the JSME Code, specific material specifications are not designated for welding materials. A manufacturer qualifies applicable welding material based on the welding procedure qualification test conducted in accordance with the performance

requirement of Part 2 of JSME S NB1-2007, "Rules on Welding for Nuclear Power Plants." While MITI Notification No. 501 that is the basis for JSME Code for Design referred to the ASME Code Sec. III, MITI Ordinance No. 81 that is the basis for JSME Code for Welding did not refer to ASME Code Sec. III. The structure of MITI Ordinance No. 81 is different from that of ASME Sec.III. It was developed based on the Japanese industry's experience and includes requirements for thermal power components.

(d) In the Japanese construction activities, inspections by the regulatory authority in the manufacturing stage are limited to welding inspections and shop pressure testing, since, from the standpoint of Japanese regulatory authority, confirmation of Code compliance requirements shall be carried out for completed condition during Japanese style "Stamping" by the regulatory authority and pre-operational testing.

(e) JSME Code SNA-1-2008, "Rules on Fitness-for- Service for Nuclear Power Plants," which is a JSME counterpart of Section XI, requires performing pre-service examination, but does not have acceptance criteria. This is based on a position that the objective of pre-service examination is to prepare a baseline record for ISI and not to perform evaluation of flaws revealed.

(f) The JSME Code does not have some definitions that are specified in the ASME Code. Definitions are specified according to needs.

(g) The JSME Code may not have provisions for those activities that are ordinarily expected to be performed if not specified.

(h) The JSME Code Committee has made technical judgment to establish the requirements based on available research and development results.

(i) No corresponding (equivalent) provision is made in the JSME Code. Codes and Standards issued by an SDO other than JSME are applied.

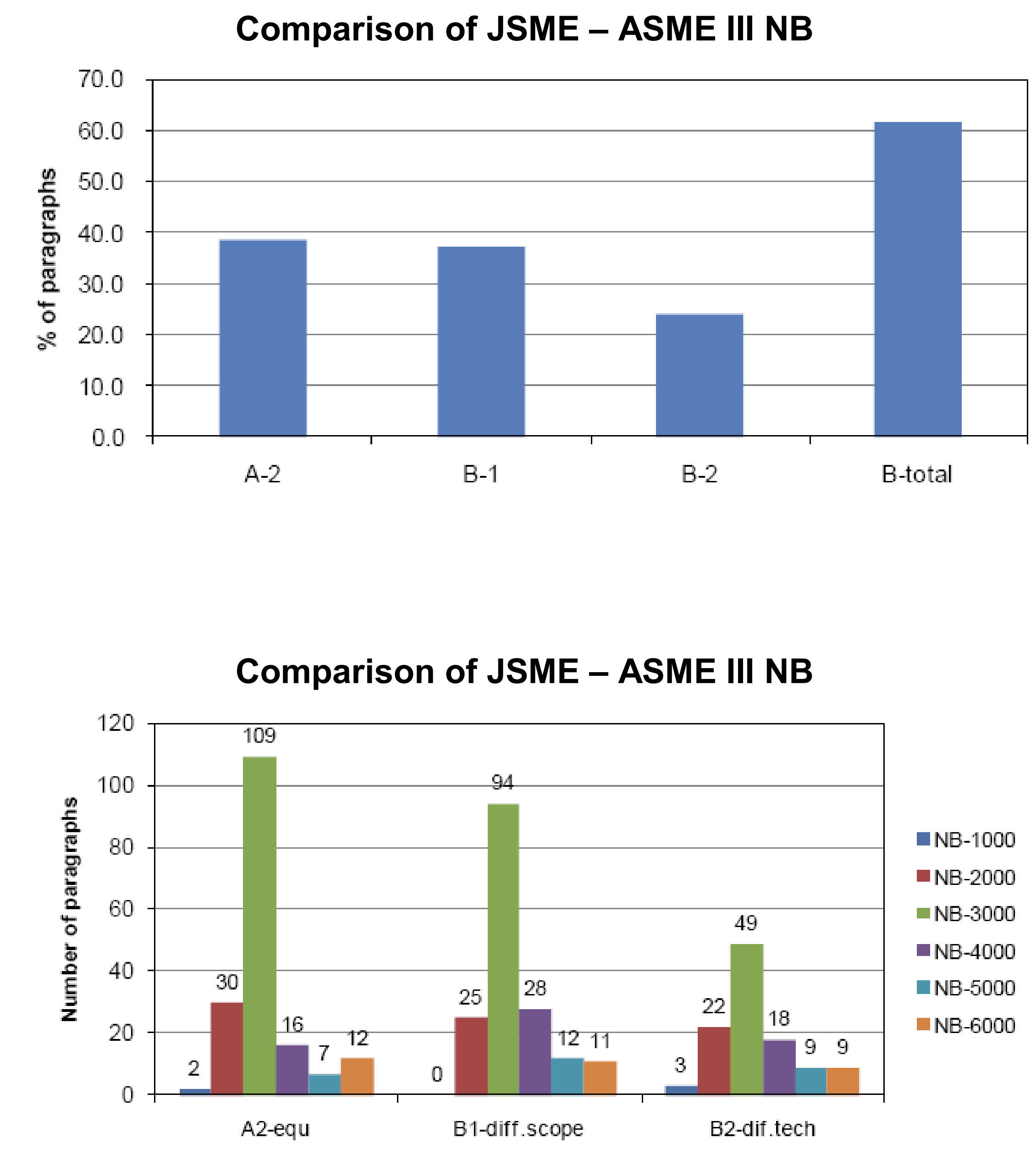


Figure 32—Detailed Section-by-Section Comparison Between ASME BPVC Section III NB Paragraphs and JSME S-NC1-2008

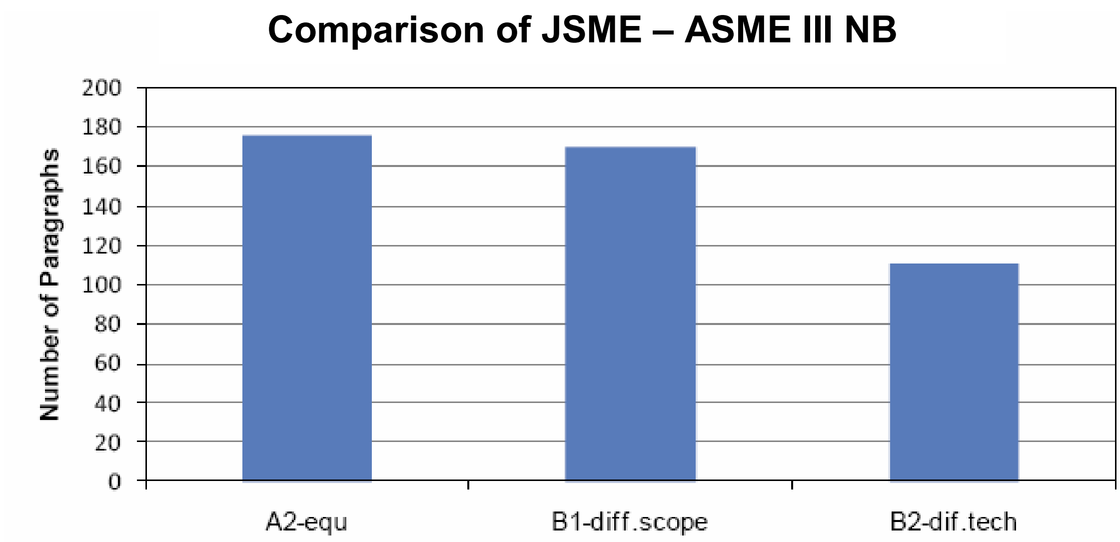


Figure 33—General Comparison Between ASME BPVC Section III NB Paragraphs and JSME S-NC1-2008

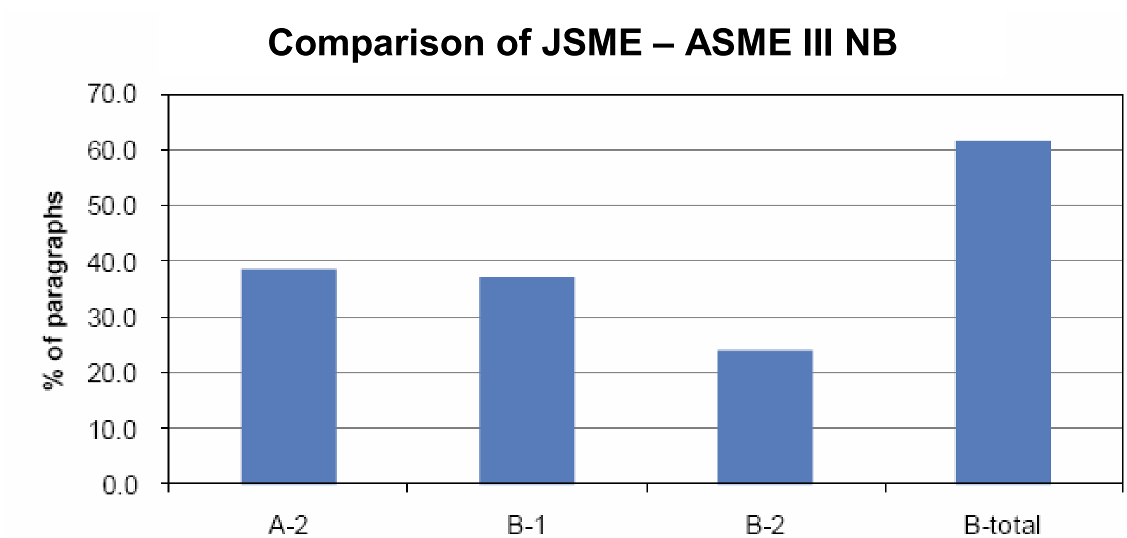


Figure 34—General Comparison Between ASME BPVC Section III NB Paragraphs and JSME S-NC1-2008 in Percentages

6 KEPIC VERSUS ASME BPVC SECTION III COMPARISON

6.1 Abstract

Nuclear power plants have been continuously constructed in Korea during the three decades since Kori Nuclear Power Plant, the first nuclear power plant built in Korea, started commercial operation in 1978.

Currently, 17 units of PWR types and 4 units of PHWR types are in operation in Korea, and the Shin-Kori, Shin-Wolsung and Shin-Ulchin Nuclear Power Plants are currently being constructed. Nuclear power has become an important energy source in Korea, and is projected to fulfill 34% of total domestic power demand in 2011.

ASME BPVC has been applied to all existing nuclear power plants, with the exception of Ulchin Plants Units 1 and 2, where RCC was applied and Wolsung Units 1 through 4, where CSA was applied. Accordingly, KEPIC has adopted the technical requirements of ASME BPVC without modification, following the spirit of safety of ASME BPVC, and has customized the requirements of system and operation for the local environment.

Thus developed, KEPIC has been applied to all new nuclear power plants under construction, starting with Units 5 and 6 of Ulchin Nuclear Power Plant, and it is also being applied to the construction of the UAE nuclear power plant.

As the global demand for nuclear power increases rapidly during this current nuclear renaissance, a demand for a comparative analysis of major nuclear power plant design codes has been identified, with the focus being the major regulatory institutions of nuclear power countries. A comparison has been conducted on ASME (USA), RCC (France), JSME (Japan), KEPIC (Korea), CSA (Canada), and ENES (Russia), and the differences in codes between each SDO and ASME 2007 edition have been compared and analyzed.

This section contains the results of a comparison of ASME and KEPIC in relation to the safety of nuclear power, Class 1 pressure vessels, piping, pumps, valves, etc. based on a study made over the last several years. As a result, it was found that there was no difference in technical requirements, with the exception of system requirements, and it has been concluded that there are no technical issues in applying equipment manufactured in accordance with KEPIC to nuclear power plants where ASME is applied.

KEA would like that the result provided in this report can be utilized as important data that will enable a better understanding of the differences in the nuclear power plant design codes of the various regulatory institutions of each country, equipment manufacturers, construction companies and certification institutions, and that technical exchanges between SDO of each country can become more active, and that collaboration to promote the safety of nuclear power plants will be increased based on this result.

6.2 Introduction

In accordance with the agreement among SDOs participating in TG MDEP, differences of ASME BPVC were noted and closely analyzed with regard to Class 1 components. In the analysis of differences, administrative requirements as well as technical requirements were included. As for the technical requirements, KEPIC-MNB and ASME BPVC Sec. III Div. 1 NB were compared. For administrative requirements, KEPIC-MNA and ASME BPVC Sec. III Div. 1 NCA were compared. With the base of requirements in the ASME BPVC 2007 Edition, corresponding KEPIC 2005 Edition – 2008 2nd Addendum was compared in summary. The requirements of KEPIC-MN deal with piping, pumps and valves, as well as Class 1 pressure vessels, the same as ASME NB, and all the requirements in KEPIC-MNB were compared with the corresponding ASME BPVC. The administrative requirements deal with the differences in the parts where KEPIC follows Korean laws and regulations much like ASME follows U.S. laws and regulations.

The comparison results were divided into four groups in accordance with the agreement among SDOs and the bases are as specified in the general introduction of this report (Section 6.1).

6.3 Preliminary Paragraphs and Scope Presentation

This section includes a comparison of the requirements on ASME NB 1000 and KEPIC-MNB 1000, a general requirement among the Class 1 equipment requirements of ASME and KEPIC.

ASME NB 1000 specifies various requirements, including aspects of construction, temperature limits and jurisdictional boundaries related to Class 1 equipment design and manufacturing. KEPIC has basically the same configuration and contents as ASME NB, but a few differences are mentioned below.

KEPIC has a sole certification and stamping system that is different than ASME but is very similar. (See Table 37)

KEPIC demands that KEPIC-MI (equivalent with ASME BPVC Sec. XI) be met for In-Service Inspection in MNB 1110.

Also, KEPIC mentions that the rules of KEPIC-MN may be used for HVAC (refrigerator and air cleaner), which are applicable to the category of KEPIC-MH (requirements for HVAC equivalent with ASME AG-1) when specified in the Design Specification.

KEPIC adopts KEPIC-MDP, MNC and MNG instead of ASME Sec. II Part D, Sec. III NC and NG; however, these are equivalent to each of the corresponding requirements.

Table 31—Composition of KEPIC-MNB 1000 and ASME NB 1000

KEPIC-MNB	ASME NB	Title	Remarks
MNB 1110	NB-1110	ASPECTS OF CONSTRUCTION COVERED BY THESE RULES	KEPIC includes KEPIC-MI for ISI and KEPIC-MH for HVAC.
MNB 1120	NB-1120	TEMPERATURE LIMITS	KEPIC adopts KEPIC-MDP instead of ASME Sec. II Part D.
MNB 1130	NB-1130	BOUNDARIES OF JURISDICTION	Same as ASME
(MNB 1131)	(NB-1131)	Boundary of Components	Same as ASME
(MNB 1132)	(NB-1132)	Boundary between Components and Attachments	KEPIC adopts KEPIC-MNC and MNG instead of ASME Sec. III NC and NG.
MNB 1140	NB-1140	ELECTRICAL AND MECHANICAL PENETRATION ASSEMBLIES	Same as ASME

6.4 Materials

Highlights

- KEPIC has adopted the calibration procedure of KRISS for a Charpy-V Impact Test Machine and the procedure has a narrower range of tolerance values and is more conservative than the requirements of ASTM E23.
- For NDE personnel, KEPIC additionally requires national license based on Korean domestic law in addition to the requirements of ASME Sec. V.

ASME requires the calibration of the Charpy-V Impact Test Machine to follow ASTM E23-02a and use the standard specimen of NIST. However, KEPIC requires following KASTO 93-21102-094 (which is equivalent with ASTM E23-93) to reflect the reality in Korea, and uses the standard specimen of KRISS (Korea Research Institute of Standards and Science) in accordance with domestic laws. For reference, KASTO is the Korea Association of Standards & Testing Organization based on Korean laws and KRISS buys standard specimens from NIST. The calibration procedures of KRISS were developed under the ISO quality assurance system based on ASTM E23. However, it has a narrower range of tolerance values and is more conservative than the requirements of ASTM E23.

As for the nondestructive examination (NDE) requirements, it adopted KEPIC-MEN, technically the same ASME Sec. V. However, as for NDE personnel, KEPIC additionally requires a national license based on Korean domestic law in addition to the requirements of ASME Sec. V.

KEPIC's code symbol system is different from that of ASME and detailed matters are described in the comparison items of the administrative requirements in Clause 5.6 (the contents should be put in examination).

6.5 Design

Highlights

- Design methodologies of KEPIC-MNB are the same as those for ASME Sec. III NB.

There is no difference between KEPIC and ASME regarding design.

6.6 Piping, Valves and Pumps

Highlights

- The requirements for piping, valves and pumps of KEPIC-MNB are the same as those of ASME Sec. III NB.

The composition and requirements of KEPIC-MNB are essentially the same as those of ASME NB, as it adopted the same composition. There are no differences except those mentioned in the previous clause. Table 32 sums up the code layout comparison.

Table 32—Composition of KEPIC-MNB and ASME NB

KEPIC-MNB	Contents	ASME NB
MNB 3400	Pump Design	NB-3400
MNB 3500	Valve Design	NB-3500
MNB 3600	Piping Design	NB-3600

6.7 Fabrication – Welding

Highlights

- Fabrication requirements of KEPIC-MNB are same with ASME Sec. III NB.
- KEPIC and ASME require t min. for the counterbore length of fittings for pre-service inspection (PSI), but KEPIC allows 0.5-inch counterbore length for fittings in Code Case.

There is no significant difference between KEPIC and ASME regarding fabrication. For reference, ASME requires t min. for the counterbore length of fittings for PSI, which is an additional requirement to acquire more NDE signals during the test conducted during the operation added after ASME BPVC 1995. This does not affect matters related to safety. Before then, the counterbore length of fittings was not separately specified even in ASME BPVC.

In any event, the related requirements of KEPIC are the same as ASME. However, in 2009 (comparing only up to 2007 Edition), the counterbore length of fittings of 0.5 inch was enabled with the Code Case, which shall be applied through an agreement with the regulatory organization. Korea has been building existing power plants by applying 0.5 inch, and has proven that it has not affected safety based on continued construction and operation of the power plants.

6.8 Examination

Highlights

- NDE personnel qualification is different as they follow different requirements.

Regarding the PSI, KEPIC-MNA does not adopt the fracture mechanics data required by ASME NCA3252 (a) (6).

Regarding the certification of NDE personnel, ASME requires following ASNT SNT-TC-1A within the requirements of NB. However, as ASNT SNT-TC-1A is adopted in KEPIC-MEN, the NDE requirements, KEPIC-MNB, must follow KEPIC-MEN.

6.9 Pressure Tests

There is no difference between KEPIC and ASME with regard to the tests.

6.10 Overpressure Protection

Highlights

- Personnel qualification follows KEPIC-QAR.

The terminology “NV Certification Holder,” which is used in ASME requirements, is expressed as “Pressure Relief Valve Manufacturer” in KEPIC, operating a different code symbol system from ASME.

ASME requires following Sec. III Appendix XXIII for Personnel Qualification with regard to the Certification of the Overpressure Protection Report. However, KEPIC requires following KEPIC’s equivalent KEPIC-QAR. KEPIC-QAR has the same basic contents as Sec. III Appendix XXIII. However, in terms of matters regarding national certification, the Korean national education system and qualification system are applied as shown in Table 33.

Table 33—Comparison Between KEPIC-QAR and ASME Sec. III Div. 1 Appendix XXIII

Description	KEPIC	ASME
Applicable Standard	KEPIC-QAR	ASME Sec.III Div.1 App.XXIII
Technical Field	Identical to ASME	Mechanical, Structural
Required National Certificate	– Professional Engineer (2-yr job experiences), or – Engineer (7-yr job experiences)	Registered Professional Engineer
Knowledge	Identical to ASME	Code &Working Knowledge
Accreditation Body	KEA	Certificate Holder

6.11 Overview on Quality Aspects

Highlights

- KEPIC adopts KEPIC-MNA and KEPIC-QAP, while ASME has Subsection NCA and NQA.

As shown in Table 34, KEPIC develops and adopts KEPIC-MNA and QAP based on ASME BPVC Sec. III NCA and NQA-1, and integrates the requirements of ASME Sec. III Div. 3 WA as MNA. Regarding the Authorized Inspection, KEPIC-QAI, which was developed based on ASME QAI-1, and the “NB Rules and Regulations” of U.S. NBBI, were applied. The differences are as shown in Table 35.

First, comparing KEPIC-MNA and ASME Subsection NCA, it can be said that KEPIC-MNA basically includes the contents of ASME Sec. III NCA and Div. 3 WA with the same basic composition as that of ASME. However, as shown in Table 36, it newly established KEPIC-MNA 6000 and has been operating various report forms, different from ASME NCA. In addition, the requirements related with Div. 2 among NCA requirements are separated as KEPIC-SNA, the general requirements of the structure part.

The code symbol system of KEPIC is based on the ASME system. However, as shown in Table 37, it is operated differently from ASME. The symbols are formally marked, rather than the use of code symbol stamping.

The differences of terminology between KEPIC-MNA and ASME NCA are shown in Table 38.

Second, comparing the KEPIC-QAP and ASME NQA-1, the KEPIC-QAP was based on the ASME NQA-1 1994 edition and 1995 Addendum, comprising QAP-1 and QAP-2 by maintaining the same structure (NQA-1, NQA-2) before the integration of ASME NQA-1 and NQA-2 (1994). All the requirements are the same as NQA-1, except matters that are applied with Korean domestic laws in terms of requirements. See Table 39 for a summary of the differences and similarities between these two quality assurance systems.

Table 34—Comparison for QA and Administrative Requirements

Code		Mechanical	Concrete Containment	TC/SC Containment
ASME Sec. III	General Requirement	NCA	NCA	WA
	Data Report	Div. 1 App.	Div. 1 App.	WA
KEPIC MN, SN	General Requirement	MNA	SNA	MNA
	Data Report	MNZ	SNA	MNZ

Table 35—Comparison for QA and Administrative Requirements

Description	ASME	KEPIC
Applicable Standard	ASME QAI-1	KEPIC-QAI
Organizations	– Enforcement Authority – Insurance Company	Independent Organization to Owner, Certificate Holder, and Material Organization
Accreditation Body	ASME	KEA
Government Acceptance	State Government Enforcement	Accepted by Regulatory Body if required

Table 36—Composition of KEPIC-MNB and ASME NB

Article	KEPIC-MNA/SNA	ASME Sec.III Subsection NCA
1000	General	
2000	Classification of Components	
3000	Responsibilities and Duties	
4000	Quality Assurance	
5000	Authorized Inspection	
6000	Documentation (KEPIC only)	
8000	Certificate, Nameplates and Code Symbol	
9000	Glossary	

Table 37—Comparison of Code Symbol System Between KEPIC and ASME

Description	ASME Sec.III Div.1	KEPIC-MN
Components	N 1	kepic IN
Parts & Appurtenance	N PT 3	kepic 3NP
Installation	NA 2	kepic 2NC

Table 38—Terminology Comparison Between KEPIC-MNA and ASME NCA

Code Subsection	ASME Sec. III Subsection NCA	KEPIC-MNA
Applicable Organization	Owner N-Certificate Holder NPT-Certificate Holder NA-Certificate Holder Material Organization Pressure Relief Device Testing Laboratory	Owner Manufacturer Manufacturer (only for Fabrication) Installer Material Organization Pressure Relief Device Testing Laboratory
Accreditation Body	ASME	KEA

Table 39—Comparison Between KEPIC-QAP and ASME NQA-1

KEPIC-QAP	ASME NQA-1	Title	Remark
QAP-1	Part I	Requirements of Nuclear Quality Assurance Program for Nuclear Facility	Basic Requirements and Applicable Supplementary Requirements are mandatory to be adopted in KEPIC-XNA 4200
QAP-2	Part II & subpart 3.2 of Part III	Quality Assurance Requirements for Nuclear Facility Application	Not adopted in KEPIC-XNA such as MNA, SNA etc., but applied in Contract Requirements

6.12 Conclusion

So far, KEPIC-MNB, the requirements for Class 1 pressure vessels, pumps, pipes, etc., has followed the spirit of ASME safety in terms of technical matters, and there are no technical differences.

In addition, in terms of QA and the administrative requirements related with nuclear safety, KEPIC-MNB adopted and has operated the requirements of ASME in most of the parts. However, it reflected the differences resulting from different laws and regulations and education systems in Korea from those of the U.S.A. KEPIC introduced ASME's code symbol system and operates independent code symbol systems through simplification. However, there are no requirements to have been relaxed from ASME levels regarding safety.

Thus far, the differences between KEPIC and ASME BPVC with regard to Class 1 component-related requirements have been analyzed. In addition, the differences in QA and administrative requirements have been noted. As explained above, KEPIC-MN has the same technical matters, as it adopted the same contents of the technical requirements of ASME BPVC NB by adopting them unchanged.

In terms of the systematic parts, both have the same basic contents. However, KEPIC tried to be more subjective relating to the regulations with regard to nuclear power safety, system operation, qualification entitlement, etc. regulations, by naturally applying Korean domestic laws, albeit through the same basic frameworks.

In conclusion, KEPIC and ASME have no noticeable differences as regards nuclear safety. Class 1 components designed and manufactured in accordance with KEPIC-MNB can be applied in the power plant construction projects that are applied with ASME BPVC Sec. III.

KEA aims to establish various cooperative relationships with ASME, such as endorsing both parties of certificate holders under KEPIC or ASME.

7 CSA VERSUS ASME BPVC SECTION III COMPARISON

7.1 Abstract

The Canadian and American nuclear industries are organized around different reactor concepts and have developed construction rules specific to each type. The CSA Standards reference the ASME BPVC and its requirements where applicable. The CSA Standards specify requirements for the materials, design, fabrication, installation, quality assurance and inspection of those pressure-retaining components and supports that are not covered by the ASME BPVC. This section attempts to provide a comprehensive comparison between the Canadian CSA Standard N285.0-08 and the ASME BPVC Section III.

7.2 Introduction

In Canada, all nuclear reactors for power production are of the CANDU design at this time. The CANDU reactor is a pressurized heavy water reactor that makes use of multiple horizontal Zircaloy pressure tubes, through which the pressurized heavy water coolant flows over fuel bundles, removing the heat of the fission reaction. In contrast, the fuel in pressurized water reactor (PWR) and boiling water reactor (BWR) reactor designs is located in a single large pressure vessel through which the coolant flows over the fuel. The CSA N285.0 Standard was developed to accommodate those unique features of the CANDU concept not addressed in ASME BPVC Section III, which was developed based on the PWR and BWR concepts.

The requirements of the CSA N285.0 Standard are directed to the licensee. It contains requirements that are wider in Scope than ASME Section III. In many ways, it acts as an intermediate document between the Regulatory requirements and the component. It places the responsibility for adherence to the requirements on the Licensee, even though the actual performance of much of the work is done by others. ASME Section III, on the other hand, is directed to the construction of components only and places the responsibility for adherence to the requirements on the Certificate Holders defined in Section III. However through N285.0, direct reference to the requirements of ASME Section III Div.1, it achieves indirectly many results identical to Section III.

The CSA N285.0 Standard specifies the technical requirements for the design, procurement, fabrication, installation, modification, repair, replacement, testing, examination and inspection of, and other work related to, pressure-retaining and containment systems, components and supports over the service life of a CANDU nuclear power plant.

This Standard applies to all pressure-retaining systems, including their components and supports, in a CANDU nuclear power plant.

This Standard applies to containment components, but does not apply to concrete containment structures.

This Standard does not apply to portable assemblies of pressurized items that are temporarily connected to a system or component to enable testing, venting, draining, calibration or other maintenance activities, provided that they do not reduce the ability of a special safety system or safety-related system to perform its design safety function; are under surveillance when connected and are removed upon completion of their function; and are constructed to Standards deemed by the licensee to be suitable for the application.

7.3 Preliminary Paragraphs and Scope Presentation

The requirements of the CSA Standard N285.0 are wider in scope than in ASME BPVC Section III. CSA Standard N285.0 places the responsibility for adherence to the requirements on the Licensee even though the actual performance of the work is done by others. The ASME BPVC Section III is intended for the construction of components only and places the responsibility for adherence to the requirements on the Certificate Holder identified in the Code.

CSA Standard N285.0 is an intermediate document between the Regulatory requirements and the construction of the component. CSA Standard N285.0 specifies the technical requirements for the design, procurement, fabrication, installation, modification, repair, replacement, testing, examination and inspection of, and other work related to, pressure-retaining and containment systems, components and supports over the life-cycle of a CANDU Nuclear Power Plant. This Standard includes metal containment components that are part of the containment system but does not apply to the concrete containment structures. This is covered by the CSA N287 Series.

This Standard does not apply to portable assemblies of pressurized items that are temporarily connected to a system or component to enable testing, venting, draining, calibration or other maintenance activities, provided that they:

(a) do not reduce the ability of a special safety system or safety-related system to perform its design safety function;

(b) are under surveillance when connected and are removed upon completion of their function; and

(c) are constructed to Standards deemed by the licensee to be suitable for the application.

As noted above, some aspects of the CANDU reactor design concepts are different than the light water reactor (LWR) concepts (PWR/BWR) for which the ASME BPVC Section III was developed. The most significant difference is associated with the reactor vessel rather than with the associated equipment such as the vessels, pumps, valves and piping systems. The CANDU concept has resulted in special materials and components not covered by the ASME BPVC Section III requirements.

CSA Standard N285.0-08, Annex I covers the construction requirements for components unique to the CANDU design. The requirements for the special Zirconium material properties used for the components are covered by the specifications in CSA Standard N285.6. This Standard also includes a specification for the material, CSA G40, commonly used for supports in CANDU design. This specification has not been adopted by ASME BPVC Section III; however, this material specification has properties that are similar to SA-56.

Another area not covered directly by the ASME BPVC Section III is the metallic components associated with containment systems. CSA Standard N285.0 has developed Annex J to cover these items.

Classification of Components

In Canada, the rules for classification of systems are provided in the CSA Standard N285.0-08; Clause 5.0 and Annex A. Once the system has been classified, the components adopt the classification of the system. The component is then constructed to the requirements of the ASME BPVC Section III except those items that are unique to the CANDU concept. The construction requirements for these items are covered in Annex I of the CSA Standard N285.0-08. The CANDU components receive a unique classification to identify them as having specific construction requirements outside the scope of ASME BPVC Section III. For example, a CANDU component in a Class 1 system will be classified as Class 1C.

The requirements for the CANDU Containment System are different from the ASME BPVC Section III requirements. The concrete portions of the Containment Systems for CANDU reactors are covered by the CSA Standards in the CSA N287 Series. ASME BPVC Section III addresses concrete containment in Division 2. The metallic portions of the Containment System are covered by Annex J of the CSA Standard N285.0-08. The classification of these metallic components is referred to as a Class 4 item.

Annexes I and J often refer back to ASME BPVC Section III with guidance on the application of the requirements in the referenced portion of the ASME BPVC Section III to these CANDU items.

Conformity Assessment

CSA has adopted a conformity assessment approach very similar to the requirements of the ASME BPVC Section III. Construction of components must be controlled under a Quality Assurance Program that satisfies the requirements of ASME BPVC Section III and that the requirements for Authorized Inspection are met including the use of nameplates and the issuance of data reports. The required level of conformance to the ASME BPVC Section III requirements is very high.

There is, however, no requirement for the components used in Canada to be stamped. The qualification of the quality programs is done by organizations acceptable to the Regulatory Authority. This is usually the Provincial authority with responsibility for the non-nuclear boilers and pressure vessels that usually perform the authorized inspection duties for non-nuclear equipment. A Certificate is issued by these organizations to indicate the successful implementation of the quality assurance program required by CSA Standard N285.0-08 for the construction of nuclear components. In Canada, there is no requirement for a Certificate of Authorization for the Owner as required in ASME BPVC Section III.

Requirements for Instrumentation and Instrument Lines

The design of sensing elements of instruments is outside the scope of the Standard, except that when an instrument is included in the design of a system, the system designer shall ensure that the pressure boundary of the sensing element is rated for the design conditions of the system. Instruments are treated as fittings and the registration of their design is required by CSA Standard N285.0-08.

Instruments included in the design of a system and that have an inlet larger than NPS 3/4 and a pressure boundary that is subject to the system flow have to meet the requirements associated with the classification of the system.

The pressure boundary portion of instrument systems or components that have an inlet of NPS 3/4 and smaller may be treated as non-nuclear fittings.

Instrument lines for process systems or safety systems have to meet the requirements for the classification of the system to which they are attached, except instrument lines NPS 3/4 and smaller may be constructed in accordance with the requirements for non-nuclear instrumentation unless they are associated with the control of systems that cool the fuel.

Design Registration

The CSA Standard N285.0-08 requires the pressure boundary design for each item be registered. Welding Procedures are also required to be registered in Canada. This is effectively an approval process and registration numbers are issued for each item registered. This is a process that has carried over from the non-nuclear pressure boundary requirements and is intricately wound into the administrative system associated with the Authorized Inspection. ASME recognizes this process by providing a field on the Date Reports for the insertion of the Canadian Registration Number (CRN), although there are no requirements for Registration of designs in ASME BPVC Section III or any other Sections of the ASME BPVC.

Requirements for Overpressure Protection

CSA Standard N285.0 has adopted all the overpressure requirements in ASME BPVC Section III except it specifies the contents of the Overpressure Protection Report. It has also added requirements when the shutdown systems are part of an integrated overpressure protection system designed to protect the heat transport system with an online reactor. The CANDU system is outfitted with two shutdown systems and various pressure-relief devices, which are required to prevent failure of the heat transport system due to overpressure. The credit allowed for the action of overpressure-relief detection devices determines the classification of loadings to be considered in the qualification of the heat transport overpressure protection system. The service limits to be used for events leading to overpressure are provided in the Standard and are referenced in the ASME BPVC Section III definitions of Levels A, B, C and D Service Limits in NCA-2140.

Overpressure protection devices are not required for small isolatable volumes, for such lower-probability events as loss-of-coolant accidents (LOCAs), or for main feedwater line or main steam line breaks, provided that a set of conditions is met, which includes:

(a) The volume involved is less than 42.5 L (1.5 ft^3);
(b) The containment boundary integrity is maintained;
(c) There shall be no impairment of fuel cooling.

Repair, Replacement, Refurbishment and Modification and Testing

The CSA Standard N285.0-08 also covers a broader scope than ASME BPVC Section III. The ASME BPVC Section III covers new construction only, whereas CSA Standard N285.0-08 includes requirements for repairs, replacements, refurbishment and modifications as well. There are also requirements for system pressure test and operational pressure test. While these rules are somewhat similar to ASME BPVC Section XI requirements, they are not based on the same principles, nor do they reference ASME BPVC Section XI the same way as the requirements in CSA Standard N285.0-08 refer to ASME BPVC Section III for new construction.

7.4 Materials

The ASME technical requirements for materials are directly referenced by the CSA N285.0 Standard as shown below. The exceptions identified in Clause 8.1.1 are associated with the materials that are unique to the CANDU concept and are not referenced in Section III.

Table 40—Equivalence Between the N285.0 and ASME NB-2000

Topic	ASME SEC III	N285.0-08
Materials	NB-2000	**8.1.1 Class 1 systems** Material for pressure retention in Class 1 systems and components shall comply with the requirements of the ASME BPVC, Section III, Division 1, NB-2000, or the CSA N285.6 Series.

* CSA N285.6 material is used when rules are not provided by ASME, for example: Although, ASME SB-658 specification applies to Zirconium alloy pipe, the N285.6 standard references ASTM B-353, Zirconium Alloy Tubing, and imposes additional requirements.

CSA N285.6 considers additional material aspects; for example, component deterioration.

7.5 Design

The ASME technical requirements for design are directly referenced by the CSA N285.0 Standard as shown in Table 41. There are no exceptions identified in 7.1.1. However, CSA has developed a series of standards, N289 Series, that identifies the Canadian requirements for considering the evaluation and impact of seismic loadings on the pressure boundary items. Canada also requires that the design of items go through an approval process known as design Registration.

Table 41—Equivalence Between the N285.0 and ASME NB-3000

Topic	ASME SEC III	N285.0-08
Design	NB-3000	**7.1.1 Class 1** Class 1 systems and components shall be designed to comply with the requirements of the ASME BPVC, Section III, Division 1, NB-3000.

* In addition to the above, CSA N285.0-08, Clause 7.1.8 – Seismic requirements states: When the system classification list or the design specification states that the effect of seismic loadings is to be considered, the licensee shall meet the system requirements of the CSA N289 series of Standards.

7.5.1 Piping, Valves and Pumps

The ASME technical requirements for design are directly referenced by the CSA Standard N285.0 as shown in Table 42. There are no exceptions identified in 7.1.1.

Table 42—Equivalence Between the N285.0 and ASME NB-3400/-3500/-3600

Topic	ASME SEC III	CSA N285.0-08
Pump Design	NB-3400	**7.1.1 Class 1** Class 1 systems and components shall be designed to comply with the requirements of the ASME BPVC, Section III, Division 1, NB-3000*.
Valve Design	NB-3500	
Piping Design	NB-3600	

7.6 Fabrication – Welding

The ASME technical requirements for fabrication and installation are directly referenced by the CSA N285.0 Standard as shown in Table 43. There are no exceptions identified in 9.2.1. However, the CSA standard requires the welding procedure receive a prior approval process that is over and above the ASME requirements.

Table 43—Equivalence Between the N285.0 and ASME NB-4000

Topic	ASME SEC III	N285.0-08
Fabrication & Installation	NB-4000	**9.2.1 Class 1 systems** The licensee shall have Class 1 systems, including their components and nonstandard fittings, fabricated and installed to comply with the requirements of the ASME BPVC, Section III, Division 1, NB-4000.

7.7 Examination

The ASME technical requirements for examination are directly referenced by the CSA N285.0 Standard as shown in Table 44. There are no exceptions identified in 11.1.1. The CSA standard requires the qualifications of the NDE personnel in Canada conform to the CGSB Standard rather than the SNT-TC-1A Standard required by ASME Section III. Qualification to the SNT-TC-1A Standard is not excluded but requires approval of the ANI and the licensee before it is acceptable. This Clause also illustrates the broader scope of N285.0 compared to Section III because it addresses repairs and replacements, whereas Section III only considers new construction.

Table 44—Equivalence Between the N285.0 and ASME NB-5000

Topic	ASME SEC III	N285.0-08
Examination	NB-5000	**11.1.1** The licensee shall have documentation to demonstrate that Class 1 systems and their components have been examined in accordance with the requirements of the ASME BPVC, Section III, Division 1, NB-5000. The effective date shall be established in accordance with Clause 4.3. Examination procedures and techniques for repairs and replacements may be in accordance with a later edition of the ASME BPVC, Section III, Division 1, NB-5000.

7.8 Pressure Tests

The ASME technical requirements for pressure test are directly referenced by the CSA N285.0 Standard as shown in Table 45. There are no exceptions identified in Clauses 11.4.1 – 11.4.4.

Table 45—Equivalence Between the N285.0 and ASME NB-6000

Topic	ASME Section III	N285.0-08
Testing	NB-6000	**11.4.1** The licensee shall have documentation to demonstrate that all new systems and components have been subjected to a pressure test in accordance with Clause 11.4. **11.4.2** A pneumatic pressure test may be used only when a hydrostatic pressure test is not practicable because of service conditions, and provided that precautions have been taken for the protection of personnel. **11.4.3** The licensee shall retain the data report to demonstrate that a pressure test has been performed to the satisfaction of an inspector, who has countersigned the data report (see Table 1). **11.4.4** The licensee shall have documentation to demonstrate that Class 1 systems and their components have been tested in accordance with the requirements of the ASME BPVC, Section III, Division 1, NB-6000.

7.9 Overpressure Protection

The ASME technical requirements for overpressure protection are directly referenced by the CSA Standard N285.0 as shown in Table 46 below. There are no exceptions identified in Clauses 7.7.1.1. Once again this Clause illustrates the difference between the U.S. and Canadian concept since there is a Class 4 and Class 6 in the Canadian context. The Standard CSA N285.0 has a list of suggested contents for the overpressure report which would take precedence over the list of contents in NB-7200.

Table 46—Equivalence Between the N285.0 and ASME NB-7000

Topic	ASME Section III	N285.0-08
OVERPRESSURE	NB-7000	**7.7.1.1** Overpressure protection of Class 1, 2 and 3 systems and Class 4 components shall comply with the requirements of Clause 7.7 and the following articles from the ASME *BPVC*, Section III, Division 1: (a) for Class 1 systems, NB-7000; (b) for Class 2 systems, NC-7000; (c) for Class 3 systems, ND-7000; and (d) for Class 4 components, NE-7000.

7.10 Overview on Quality Aspects

CSA N285.0 calls up the Section III Quality Assurance program for construction of new components. The requirement to meet NCA-3800 for materials does permit the use of other quality assurance programs provided certain added requirements in NCA-3800 are met. These are identified in the detailed Appendix.

Table 47— Equivalence Between the N285.0 and ASME NCA-4000

Topic	ASME Section III	N285.0-08
Quality Assurance	NCA-4000	**10.3 Activities undertaken by a contractor** Activities performed by a contractor or a licensee acting as a contractor associated with procurement, design, fabrication, installation, modification, replacement, or repair shall meet the following requirements: (a) For Class 1, 1C, 2, 2C, 3, 3C or 4 systems, components, and supports, activities shall be carried out under a quality assurance program that satisfies the requirements of the ASME BPVC, Section III, Division 1, NCA-4000. **10.4 Activities undertaken by a material organization** Activities performed by a material organization or a licensee acting as a material organization associated with the manufacture or supply of materials for use in Class 1, 1C, 2, 2C, 3, 3C or 4 systems or components (including welding consumables) shall meet one of the following requirements: (a) activities shall be carried out under a quality program that satisfies the requirements of the ASME BPVC, Section III, Division 1, NCA-3800*;

* Although, other quality standards apply to licensed operating CANDU stations and commercial products and service providers, Class 1 pressure boundary activities must comply with ASME requirements shown above.

7.11 Conclusion

Although the comparison of the CSA N285.0 Standard with ASME Section III has identified differences, they are relatively few given the significant volume of requirements. From the Canadian perspective, the implementation of the CSA Standard N285.0 is effectively the implementation of Section III.

It is obvious that the differences result from either different regulatory requirements or technical differences that are a result of the different concepts that are not addressed by Section III. This report identifies the technical differences, which are detailed in Appendix D.

8 REFERENCES

[1] RCC-M Code - "*Règles de Conception et de Construction des Matériels Mécaniques des Ilots Nucléaires REP*," ("Design and Construction Rules for Mechanical Components of PWR Nuclear Islands") édition 2007.

[2] ASME Boiler and Pressure Vessel Code, Section III, Division I, Rules for Construction of Nuclear Facilities Components, 2007edition.

[3] L. Durand-Roux, T. Berger, J.M. Grandemange, M. Lemoine, A practical example of code comparison evaluation of conformance to the ASME III code of large nuclear replacement parts manufactured according to RCC-M.

[4] Y. Asada, et al., Recent Development of Codes and Standards of Boiler and Pressure Vessels in Japan. Chapter 50, K.R. Rao, Editor, COMPANION GUIDE TO THE ASME BOILER AND PRESSURE VESSEL CODE, ASME, 2006.

ABBREVIATIONS AND ACRONYMS

AFCEN	*Association Française pour les règles de Conception, de construction et de surveillance en exploitation des matériels des Chaudières Electro Nucléaires* (French Association for Design, Construction and In-service Inspection Rules for Nuclear Island Components)
AFNOR	*Association Française de Normalisation* (French Association of Standardization)
AIA	Authorized Inspection Agency
AISC	American Institute of Steel Construction
ANI	Authorized Nuclear Inspector
ANSI	American National Standard Institute
ASME	American Society of Mechanical Engineers
ASN	*Autorité de Sûreté Nucléaire française* (French Safety Authority)
ASNT	American Society for Nondestructive Testing
ASTM	American Society for Testing and Materials
BPVC	Boiler and Pressure Vessel Code
CEA	*Commissariat à l'Energie Atomique* (Atomic Energy Authority)
CNSC	Canadian Nuclear Safety Commission
COFREND	*Confédération FRançaise pour les Essais Non-Destructifs* (French confederation for nondestructive testing)
CORDEL	
CSA	Canadian Standards Association
CSWG	MDEP Codes and Standards Working Group (formerly WGCMO)
DCN	*Direction des Constructions Navales* (Naval Construction Authority)
DEP	*Département des Equipements sous Pression* (Pressure Equipment Department of French Safety Authority - ASN)
EN	European Norms
ESPN	*Equipment Sous Pression Nucléaire* (French regulation for Pressurized Equipment for Nuclear applications)
ID	Identification
ISI	In-Service Inspection
ISO	International Organization for Standardization
JEAC	Japanese Electric Association Code
JEAG	Japanese Electric Association Guide
JIS	Japanese Industrial Standards
JSME	Japanese Society of Mechanical Engineers
KASTO	Korea Association of Standards & Testing Organization
KEA	Korea Electric Association
KEPIC	Korea Electric Power Industry Code
LWR	Light Water Reactor

ABBREVIATIONS AND ACRONYMS (cont.)

MITI	Ministry of International Trade and Industry
MDEP	Multinational Design Evaluation Programme
N/A	Not Applicable
NDE	Non-Destructive Examination
NDIS	Japanese Society of Non-Destructive Inspection Standards
NRC	American Nuclear Regulatory Commission
NSSC	Nuclear Strategic Steering Committee
PED	European Pressure Equipment Directive
PPS	Product Procurement Specification, or Part Procurement Specification
PQR	Procedure of Qualification Record
PTC	Performance Test Codes
PSI	Pre-service inspection
PWR	Pressurized Water Reactor
RCC	*Règles de Conception et de Construction* (Design and Construction Rules)
RCC-M	*Règles de Conception et de Construction des Matériels Mécaniques des Ilots Nucléaires REP* (Design and Construction Rules for Mechanical Components of PWR Nuclear Islands)
REP	*Réacteur à Eau Pressurisée* (Pressurized Water Reactor)
RPE	Registered Professional Engineer
RSE	*Règles de Surveillance en Exploitation* (Rules for Safety during Operation)
RSE-M	*Règles de Surveillance en Exploitation des Matériels mécaniques des îlots nucléaires REP* (In-Service Inspection Rules for Mechanical Components of PWR Nuclear Islands)
SDOs	Standards Development Organizations
SI	*Système International* (International System)
STR	*Spécification Technique de Référence* (Technical Reference Specification)
TBT	Technical Barriers to Trade
TC	Technical Committee
WGCMO	MDEP Working Group on Component Manufacturing Oversight
WP	Welding Procedure
WNA	World Nuclear Association
WPS	Weld Procedure Specification
WTO	World Trade Organization

APPENDIX A: RCC-M VERSUS ASME SECTION III DETAILED COMPARISON TABLE

Appendix A: RCC-M vs ASME Comparison Table

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
modified cells with previous version	***modified cells with previous version***	***modified cells with previous version***	***modified cells with previous version***	***modified cells***	
Article NB-1000 Introduction		**B 1000**			
NB-1100 Scope		A 1100 - B 1100			
NB-1110 Aspects of Construction Covered by These Rules	rules for the material design, fabrication, examination, testing, overpressure relief, marking, stamping and preparation of reports by the Certificate Holder		no stamping, no certificate holder in RCCM		B2
	rules for strength and pressure integrity, failure of them would violate the pressure retaining boundary	A 1100 Objectives	equivalent		A2
	rules cover initial construction, but do not cover deterioration which may occur in service as result of corrosion, radiation, instability of material		partially covered by RCCM: fatigue, rupture, corrosion, radiation and thermal ageing	through analysis or through material technical specification	B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-1120 Temperature Limits	temperature limits of Section II, part D, Subpart 1, Tables 2A, 2B and 4	Appendix ZIII 211 Material Specification	equivalent		A2
NB-1130 Boundaries of Jurisdiction Applicable to This Subsection	boundary between component and attachments		not so detailed in RCCM than in ASME, except for support in Sub-sect H and penetration in Sub-sect P no mixing with jurisdiction in RCCM		B2
	jurisdictional boundary		no strictly jurisdiction aspect in RCCM		B4
NB-1140 Electrical and Mechanical Penetration Assemblies	constructed in accordance with vessel rules	Subsection P	piping rules, not vessel rules except hatch		B1
		B 1200	ASME NB 8000 : equivalent		
		list of documents to be produced			A2
		B 1300	ASME NB 8000 : equivalent		
		identification : marks and labels			A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
Article NB-2000 Material		**B 2000**			
		B 2100: General			
		B 2200: Application of Section II			
	Section II Part D Subpart 1 Tables 2A & 2B	Table B 2200 : list of applicable procurement specifications	more prescriptive in RCCM than ASME, mainly for pressure boundary		B2
		B 2300: Susceptibility to intergranular corrosion	not in ASME		B1
		B 2400: Cobalt content	not in ASME		B1
		B 2500: Mechanical properties			B1
NB-2100 General Requirements for Material					
NB-2110 Scope of Principal Terms Employed	definitions: material, pressure-retaining material, thickness (plates, forging, hollow forging, disk forging, flat ring forging, rectangular solid forging), casting (thickness for fracture toughness measurement or for heat treatment)		included in MTS	thickness to be considered are included in the applicable Material Technical Specification; difference connected to Code organization	A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-2120 Pressure-Retaining Material					
NB 2121: Permitted material specification	materials from Section II PartD Subpart 1 Tables 2A & 2B; except valve parts, lines and valves DN<DN25 --> NB 3671.4 for lines and NB 3500 for valves; welding and brazing	B 2200 Application of Section II B 4000 Application of Section IV	applicable specification are listed in RCCM table B 2200 small equipments defined in A 4000 and Subsection E class 1 DN<25 treated as the other pipes provision for filler materials in Subsection V S2000	RCCM B 2200 table : different equivalent specifications that consider operating conditions and potential degradations are implicitly covered	B2
NB 2122: Special requirements conflicting with permitted material specification	in case of conflict with NCA 3856; SA453 and SA638stress rupture test not required under 427°C operating temp.		no equivalent provision in RCCM		B1
NB 2124: Size ranges	no size limitation in the rules for construction, nearest specified range (NCA 3856)		no equivalent provision in RCCM		B1
NB 2125: Fabricated hubbed flanges	machined from hot rolled or forged billet/ from ring with NB 2540 examination	RCCM Appendix Z V	no hubbed flange in class 1 piping, except for small piping and procurement in Section II	Code scope	B1
NB 2126: Finned tube	integrally / welded materials	welding in Section IV, as amended in B 4000		Code organization	A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 2127: Seal membrane material	NB 2500 for t > 6mm		MTS considers it	Code organization	A2
NB 2128: Bolting material	SA 194 or one of section II nuclear material	B 2200 table			
NB-2130 Certification of Material	certified as required in NCA 3861 et 3862 : Material Test Report except from NCA 3861	Section II - Material procurement specification	certification covered in RCCM ZU 700	for French plants, connected to French regulation	B2
NB-2140 Welding Material	see NB 2400	B 4000 and Section IV	no technical content in ASME NB 2140		
NB-2150 Material Identification	see NCA 3856,not for small components	B 1300	no technical content in ASME NB 2150		
NB-2160 Deterioration of Material in Service	outside the ASME scope; Owner responsibility in accordance with NCA 3250 in Design Spec	B 2200 MPS and B 3000	not considered in ASME, covered in RCCM	ASME III has a limited scope	B2
NB-2170 Heat Treatment to Enhance Impact Properties	CS, LAS, high alloy chromium may be Heat Treated by quenching or tempering; PWHT tempering temp. not less than 595°C	Section II MPS and Section IV S 7500 for PWHT			B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-2180 Procedures for Heat Treatment of Material	temp survey and furnace calibration or measurement of material temperature by thermo-couples	Section II MPS	equivalent provision		A2
NB-2190 Nonpressure-Retaining Material	in support load path and no pressure retaining ==> see NF 2000 not in support load path and no pressure retaining, welded at or within 2t of P retaining NB 4430 repair by welding of structural steel rolled shapes	H 2000 Support B 2200 table for non-pressure retaining parts	integrated in RCCM Section II MPS		B2
NB-2200 Material Test Coupons and Specimens for Ferritic Steel Material		Section II + M 150			
NB-2210 Heat Treatment Requirements					

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 2211: Test coupon heat treatment for ferritic materials	tensile and KV same HT as the component (some exemption <50mm) under Certificate Holder and Material Organization; PWHT 80% of total time at temperature; test material, coupon and specimen performed in a single cycle	Section II + MPS + M 151 + Section IV + S 7500	equivalent provision, but MPS more self-supported than ASME	different Code organization	A2
NB 2212: Test coupon heat treatment for quenched and tempered material	cooling rate/ general procedure/ possible faster cooling rate	Section II MPS	equivalent provision, but MPS more self-supported than ASME		A2
NB-2220 Procedure for Obtaining Test Coupons and Specimens for Quenched and Tempered Material					
NB 2221: General requirements	General requirements- Coupon and specimen location / number of tension test coupons --> material specification or through following	Section II MPS	equivalent provision, but RCCM MPS more self-self-supported than ASME differences in number of test coupons for large parts and RCCM M140 Technical Qualification for some components	technical qualification of components is not required by ASME	A2
NB 2222: plates	Plates	Section II MPS			A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 2223: forging	Forgings	Section II MPS	M140 Technical Qualification for some components	no technical qualification of components required by ASME	B1
NB 2224: Bar and bolting material	Bar and bolting material	Section II MPS			A2
NB 2225: Tubular products and fittings	Tubular products and fittings	Section II MPS			A2
NB 2226: Tensile test specimen location (for quenched and tempered ferritic steel castings)	t > 50mm / longi center line 1/4 t separately cast test coupons not less than 3t x 3t x t from body of casting 1t x 1t x 3t 13mm and 1/4t from surface	Section II MPS			B2
NB-2300 Fracture Toughness Requirements for Material		Section II			
NB-2310 Material to Be Impact Tested		Section II MPS	equivalent provision		B2
NB 2311: Material for which impact testing is required	pressure-retaining material and material welded except material (1) to (7)		equivalent except differences in impact test machine strike radius	RCCM uses international standards for Cv	B2
	(1) material with nominal section 16mm or less		no impact test if not practicable		B2
	(2) bolting (studs, nuts, bolts) nominal size of 25mm or less				B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
	(3) bars 1 inch2 or less				B2
	(4) pipe, tube, fittings, pumps and valves DN150 or smaller				B2
	(5) pumps, valves and fittings with all pipe connection of 16mm nominal thickness or less				B2
	(6) austenitic stainless steels, including hardened austenitic Grade 660 (UNS S66286)		impact test required in RCCM if A% < 45%	in line with French regulatory requirement	B2
NB-2320 Impact Test Procedures		Section III MC 1230	use of ASTM E 208 Standard (1975)	new edition under review	B2
NB 2321: Type of tests	drop weight tests if required ASTM E 208-91		equivalent provision, but different standards		B2
	Charpy V -notch Tests if required SA 370				B2
NB 2322: Test specimen	location of test specimen				B2
	orientation of Impact test specimen				B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-2330 Test Requirements and Acceptance Standards		Section MPS and Section III MC 1240	equivalent requirements	Code organization: RCCM MPS more self-supported	A2
NB 2331: Material for vessels	test program : RTNDT apply to base material/HAZ/weld bar width or diam > 50mm some nozzles or appurtenances in vessels effect of irradiation test temperature of hydrotest	Section II MPS	RTNDT systematically required by ASME, case by case by RCCM		B2
NB 2332: Material for piping, pumps and valves	3 Cv tests at lowest service temperature for BM, W, HAZ with corresponding lateral expansion criteria from 0.5 to 1mm (nothing for 16mm or less)	Section II MPS			B2
NB 2333: Bolting material	bolts, studs and nuts: 3 Cv at temperature not higher than preload temp. Or lowest service temp. (Table NB 23333-1)	Section II MPS			B2
NB-2340 Number of Impact Tests Required		Section II MPS	more stringent requirements in RCCM		

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 2341: Plates	one test from each plate as HT	Section II MPS			B2
NB 2342: Forgings and castings	one test each heat each HT lot HT in a continuous type furnace one test for each forging or casting of 450kg to 4500kg alternative to previous one forging or casting > 4500kg 2 Cv and one drop weight; location selected equal number of specimens 180° apart. alternative tp previous one	Section II MPS			B2
NB 2343: Bars	one test for each lot of bars > 650mm^2; lot definition < 2700kg	Section II MPS			B2
NB 2344: Tubular products and fittings	one test on each lot; if welded with filler metal one test from the weld area; lot definition	Section II MPS			B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 2345: Boiling Material	one test from each lot of material; lot = one heat of material heat treated in one charge with limited mass	Section II MPS			B2
NB 2346: Test definition	one test = RTNDT and CV if RTNDT required one test = CV if RTNDT not required	Section II MPS			B2
NB-2350 Retests	one retest at same temp. for CV; 3 requirements: average meets mini required, not more than 1below the min, not meeting the min but not lower than 14J or 0.13mm below specified requirements retest = 2 additional specimens as near as possible to the failed specimens conditions	Section II MPS	equivalent requirements		A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-2360 Calibration of Instruments and Equipment	temperature instruments --> NCA 3858.2 (every 3 months) CV impact test machine --> NCA 3858.2 using ASTM E23-02a	MC 100 + ISO Standards			B2
NB-2400 Welding Material		Section IV - S 2000			
NB-2410 General Requirements	all welding material except cladding and hard surfacing : requirement of material specification or ASME Section IX	S 2120		- Code organization : RCCM Section IV more self-supported - in line with international regulations	A2
	Certificate holder shall provide the organization performing the testing with specific information listed (1) --> (10)		not covered in RCCM		B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-2420 Required Tests	each lot of covered, flux cored or fabricated electrode; each heat of bare electrodes, rods or wires for use with OFW, GMAW, GTAW, PAW EGW; each heat of consumable insert….	S 2500 - data sheets in S 2800-2900	equivalent requirements		A2
NB-2430 Weld Metal Tests		S 2500	equivalent requirements		
NB 2431: Mechanical properties test	tensile and impact : General test requirements / Standard tests requirements				A2
NB 2432: Chemical Analysis Test	Test method/ Requirements for chemical analysis				
NB 2433: Delta ferrite determination	Method / Acceptance standard	S 2500	Delong Diagram different in Fig. NB 2433.1-1		B2
NB-2440 Storage and Handling of Welding Material	Suitable storage and handling; minimize moisture absorption by fluxes and cored, fabricated and coated electrodes	S 7200	equivalent requirements		A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-2500 Examination and Repair of Pressure-Retaining Material		Section II			
NB-2510 Examination of Pressure-Retaining Material	except pumps and valves DN50 or less / seamless pipe, tubes and fitting DN25 or less/forged and cast pumps and valves connections over DN50 to DN100 -->surface instead of volumetric	Section II MPS		Code organization: RCCM Section II more self-supported	A2
NB-2520 Examination After Quenching and Tempering	use of this subarticle				A2
NB-2530 Examination and Repair of Plate		Section II MPS + Section III MC 2400	equivalent requirements		
NB 2531: Required examination		MC 2411			B2
NB 2532: Examination procedure		MC 2413 and MC 2414			B2
NB 2537: Time of examination		MC 2413 and MC 4141			B2
NB 2538: Elimination of surface defects					B2
NB 2539: Repair by welding					B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-2540 Examination and Repair of Forgings and Bars		Section II MPS + Section III MC 2300	equivalent requirements		
NB 2541: Required examination		MC 2313, MC 2323, MC 2333, MC 2343			B2
NB 2542: Ultrasonic examination	Examination Procedure / Acceptance standards	MC 2311, MC 2313, MC 2321, MC 2323			B2
NB 2545: Magnetic Particle Examination	Examination Procedure / Acceptance standards				B2
NB 2546: Liquid penetration examination	Examination procedure/ Evaluation of Indications/ Acceptance standards	MC 4000			B2
NB 2547: Time of examination		MC 2313, MC 2323, MC 2333, MC 2343			B2
NB 2548: Elimination of surface defects					B2
NB 2549: Repair by welding					B2
NB-2550 Examination and Repair of Seamless and Welded (Without Filler Metal)-Tubular Products and Fittings		Section II MPS + Section III MC 2500	equivalent requirements		
NB 2551: Required examination		MC 2510, MC 2530			B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 2552: Ultrasonic Examination		MC 2530			B2
NB 2553: Radiographic examination		MC 3000			B2
NB 2554: Eddy Current Examination		MC 6000			B2
NB 2555: Magnetic Particle Examination		MC 5000			B2
NB 2556: Liquid Penetrant Examination		MC 4000			B2
NB 2557: Time of examination					B2
NB 2558: Elimination of surface defects					B2
NB 2559: Repair by welding					B2
NB-2560 Examination and Repair of Tubular Products and Fittings Welded With Filler Metal		Section II MPS + Section III MC	equivalent requirements		
NB 2561: Required examination		MC 2510, MC 2530			B2
NB 2562: Ultrasonic Examination		MC 2530			B2
NB 2563: Radiographic examination		MC 3000			B2
NB 2565: Magnetic Particle Examination		MC 5000			B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 2566: Liquid Penetrant Examination		MC 4000			B2
NB 2567: Time of examination					B2
NB 2568: Elimination of surface defects					B2
NB 2569: Repair by welding					B2
NB-2570 Examination and Repair of Statically and Centrifugally Cast Products		Section II MPS + Section III MC	equivalent requirements		
NB 2571: Required examination		MC 2510, MC 2530			B2
NB 2572: Time of non-destructive examination					B2
NB 2573: Provision for Repair of Base Material by Welding	defect removal/ repair by welding/ qualification of welding procedure and welders/ blending of repair areas/ Examination of repair welds/ Heat Treatment after repair/ elimination of surface defects/ material report Describing Defects and Repairs				B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 2574: Ultrasonic examination of Ferritic Steel Castings	Acceptance Standards				B2
NB 2575: Radiographic Examination	Examination/ Extent/ Examination procedure/ Procedure requirements/ Radiographic setup information				B2
NB 2576: Liquid Penetrant Examination					B2
NB 2577: Magnetic Particle Examination (for ferritic steel product only)					B2
NB-2580 Examination of Bolts, Studs, and Nuts		Section II MPS + Section III MC	equivalent requirements		
NB 2581: Required examination		MC 2510, MC 2530			B2
NB 2582: Visual Examination					B2
NB 2583: Magnetic Particle Examination	Examination Procedure/ Evaluation of Indications/ Acceptance Standard	MC 5000			B2
NB 2584: Liquid Penetrant Examination	Examination Procedure/ Evaluation of Indications/ Acceptance Standard	MC 4000			B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 2585: Ultrasonic examination (for size greater than 2")	Ultrasonic Method/ Examination Procedure/ Calibration of Equipment/ Acceptance Standard	MC 2530			B2
NB 2586: Ultrasonic examination (for size over 4")	Ultrasonic Method/ Examination Procedure/ Calibration of Equipment/ Acceptance Standard	MC 2530			B2
NB 2687: Time of examination					B2
NB 2588: Elimination of surface defects					B2
NB 2589: Repair by welding					B2
NB-2600 Material Organizations' Quality System Programs		A 5000 : QA			

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-2610 Documentation and Maintenance of Quality System Programs	requirements of NCA 3800 and NCA 4000 (small product = pipe, tube, pipe fittings and flanges DN50 or less, bolting material nominal diameter 1" or less, bar nominal cross section 1 inch2 or less, pump and valve with inlet pipe DN50 or less, material exempted in NB 2121 (c)		responsibilities defined in ASME NCA 3000 not addressed point by point in RCCM Quality system provisions covered by RCCM A 5000 and the Equipment Specification	Some Mandatory requirements covered by non-mandatory appendices	B2
NB-2700 Dimensional Standards	Reference to NCA 7100-1 (A08) and table NB 3132-1	A 1300 Standards			B2
Article NB-3000 Design		**B 3000**			
NB-3100 General Design		B 3100 + Annexe ZIV			
		B3110 : list of damage covered by RCCM : excessive deformation, plastic instability, buckling, progressive deformation, fatigue, rupture mainly for pressure boundary			B1
		B 3120 : operating condition and transient list classification in 4 categories			B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-3110 Loading Criteria		B 3130 : Loading conditions			
NB 3111: Loading conditions	internal/external pressure, impact loads, weight including static and dynamic head of liquids, superimposed loads, wind, snow, vibration, earthquake, reaction of supports, temperature effects	B 3131			A2
NB 3112: Design loadings	design pressure, design temperature, design mechanical load, design stress intensity values	B 3132			B2
NB 3113: Service conditions	level A, B, C conditions	B 3120, B 3140			B2
NB-3120 Special Considerations	Corrosion, cladding, welding (dissimilar weld, fillet welded attachment), environmental effects, configuration (accessibility in connection with ASME Section XI)	B 3170	- no welding in RCCM B 3170; - no cleaningless requirements, no lamellar tearing, no thermal fluctuation consideration in ASME Code	- emphasis are not put on same points in "special considerations" sub-article- a global equivalence has to be considered	A2
NB 3121: Corrosion					B2
NB 3122: Cladding					B2
NB 3123: Welding					B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 3124: Environmental effects *NB 3125: configuration*					B2 B2
NB-3130 General Design Rules					
NB 3131: Scope					A1
NB 3132: Dimensional Standards for Standard products		B 3611 + A 1300			B2
NB 3133: Component under external pressure	general, nomenclature, cylindrical shells and tubular products, spherical shells, stiffening rings for cylindrical shells, cylinders under axial compression	Annexe ZIV			A2
NB 3134: Leak Tightness		not in RCCM			B1
NB 3135: Attachments		B 3174			B1
NB 3136: Appurtenance		not in RCCM			B1
NB 3137: Reinforcement of openings	NB 3330 (vessel) and NB 3643 (pipe)	C 3300 + annexe ZA			B2
		B 3150 : category to criteria level	RCCM B 3150 out of ASME Scope (NCA 2140)	under discussion for RCCM future edition	B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
		B 3160 : Stress report description	equivalent to ASME NCA 3260		A2
		B 3162 : thickness to consider in analysis			B1
NB-3200 Design by Analysis		B 3200			
NB-3210 Design Criteria		B 3210	equivalent, but ASME open to Design Spec and consider piping in B 3200; not RCCM		B2
NB 3211: requirements for acceptability	protection against non-ductile failure	B 3260 + appendix ZG	protection against non-ductile and ductile failure; no equivalent exemption rules		B2
NB 3212: Basis for Determining Stresses	TRESCA : half of max - min	B 3220	equivalent definitions		A1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 3213: Term related to Stress Analysis	stress intensity, gross structural integrity, local structural Discontinuity, normal stress, shear stress, membrane stress, bending stress, primary stress, load control stress, thermal stress, total stress, operational cycles, stress cycle, fatigue strength reduction factor, free end displacement, expansion stresses, strain, inelasticity, creep, plasticity, plastic analysis, plastic analysis, plastic analysis-collapse load, plasticity instabilities load, limit analysis, limit analysis-collapse load, collapse load-lower bound, plastic hinge, strain limiting load, test collapse load, ratcheting, shakedown, reversing dynamic , nonreversing dynamic l loads	B 3220 - B 3230	equivalent definitions; B 3230 elastic analysis and B 3220 General RCCM definition are more associated to the corresponding potential damage		B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 3214: Stress analysis		B 3230	equivalent definitions		A1
NB 3215: Derivation of stress intensities		B 3230			A1
NB 3216: Derivation of stress différences	constant principal stress direction, varying principal stress directions	B 3230			A1
NB 3217	Classification of stresses: tables NB 3217-1 and 2	no tables in RCCM B 3200			B1
NB-3220 Stress Limits for Other Than Bolts					
NB 3221: Design loadings	general primary membrane stress intensity, local membrane stress intensity, primary membrane + primary bending stress intensity, external pressure	B 3230			A1
		B 3233 : Level 0 service limits	max P and max T reference loading, Pm < Sm; Pm+Pb<1.5Sm		B2
NB 3222: Level A service limits		B 3234	equivalent but no exemption rules as NB 3222.4 d- 1) to 6)		B2
			large differences in fatigue analysis Ke formula (NB3228.5 and B3234.6)		B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 3223: Level B service limits			no level B service limits in RCCM, consider as level A	attached to old French regulation, will be move in the French regulatory requirement appendix in future edition	B1
NB 3224: Level C service limits		B 3235	some differences NB 3224 has alternative primary stress limits, fatigue analysis is never required by NB 3224.5; different alternative values for piping in NB 3224.7		B2
NB 3225: Level D service limits		B 3236	ASME appendix F versus RCCM appendix ZF		A2
NB 3226: Testing limits		B 3237	some differences in particular for Pm+Pb 1,35Sy in B 3237, same in NB 3226 if Pm<0.67Sy but for Pm>0.67Sy NB 3226 : Pm+Pb<2.15Sy-1.2Pm; clear request of 3Sm check for fatigue analysis NB3226 e); an alternative rule for stainless steels in B3237 e)		B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 3227: Special stress limits	bearing load, pure shear, progressive distortion of nonintegral connections, triaxial stresses, nozzle piping transition, applications of elastic analysis for stresses beyond the yield strength requirements for specially designed welded seals	B 3238	bearing load, pure shear, progressive distortion of nonintegral connections, triaxial stresses, nozzle piping transition (more precise in NB3227.5), applications of elastic analysis for stresses beyond the yield strength (possible modification of n between 0.3 and 0.5), requirements for specially designed welded seals		A2
NB 3228: Application of plastic analysis		B 3240	use of Sy instead of 1.5Sm for NB3228, criteria for level C and plastic instability in B3240, not in NB3228		A1
NB 3229: Design stress values		Annexe ZI (material properties) and ZIII (allowable stresses principle)	slightly different principle, but equivalent allowable stress values; possible differences in procurement check for Sy at room temperature (with no consequences on the allowable stress)		A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-3230 Stress Limits for Bolts		B 3250			
NB 3231: Design conditions		B 3251			A1
NB 3232: Level A service limits		B 3252 : fatigue exemption rules NB 3222.4 d,			A2
NB 3233: Level B service limits			no level B service limits in RCCM, all considered as level A		B2
NB 3234: Level C service limits		B 3253			A1
NB 3235: Level D service limits		B 3254			A1
		B 3255 for tests			A1
NB 3236: Design stress intensity values		B 3256			
		B 3260 Fracture resistance	strongly different, all component have to be deep flaw "tolerant" in RCCM		B2
		B 3261 General			
		B 3262 Reference Defect			
		B 3263 Criteria			
		B 3264 Methods			

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
Article NB-4000 Fabrication and Installation		**B 4000**			
NB-4100 General Requirements		B 4100	no technical specific provisions		
NB-4110 Introduction		B 4220			A2
NB-4120 Certification of Materials and Fabrication by Certificate Holder		B 2000 + M 151 + TR B 1200 + B 4220 + B 4230 + F 2000	different rules connected to European and French regulation	- RCCM defines which examinations have to be performed, with which qualification, and corresponding acceptance criteria - Who is responsible is defined by the applicable regulation : RCCM Appendix ZU in France that defines the responsibilities which are closed to international practices - Use of RCCM with Finnish regulation achieves the same goal without, in this case, any needs of specific RCCM Appendix	B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 4121: means of certification	certification of treatments, tests and examinations, repetition of tensile or impact tests, repetition of surface examination after machining	- B 2200 and dedicated MPS - M150	- RCCM B 2200 defines which MPS can be used for each part of components; tests and examinations are defined in MPS - RCCM M150 defines how the test can be satisfactory for heat treatment	- RCCM does not state one general rule for means of certification of material during manufacturing process - each MPS, M150 and RCCM F chapter define which test or examination are required and when	B2
NB 4122: Material identification	marking material	B 4320, B 1300, F 6000, F 2200			B2
NB 4123: examinations	reference to NB 5000		see NB 5000 comparison		
NB 4124: blank					
NB 4125: testing of welding and brazing material		S 2000			B2
NB-4130 Repair of Material		Section II + S 7600			
NB 4131: elimination and repairs of defects		Section II MPS			B2
NB 4132: documentation of repair welds of base material		B 1300, S 7120, S 7420, S 7600			B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-4200 Forming, Fitting, and Aligning		B 4340 + F 4000			
NB-4210 Cutting, Forming, and Bending		F 3000 + F 4100			
NB 4211: Cutting	preheating				B2
NB 4212: Forming and bending process					B2
NB 4213: Qualification of forming process for impact property requirement	exemption procedure qualification test, acceptance criteria for formed material, requalification	F 4000			B2
NB 4214: Minimum thickness for fabricated material					B2
NB-4220 Forming Tolerances		F 4200			
NB 4221: Tolerances for vessel shells	minimum difference in cross-sectional diameters, maximum deviation in cross-sectional diameters, deviation from tolerances, tolerance deviations for pressure vessel parts fabricated from pipe				B2
NB 4222: Tolerances for formed vessel heads	maximum difference in cross-sectional diameters, deviation from specified shape				B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 4223: Tolerances for formed or bent piping	minimum wall thickness, ovality tolerance				B2
NB-4230 Fitting and Aligning		F 4300			
NB 4231: Fitting and aligning methods	tack welds				B2
NB 4232: Alignment requirements when components are welded from 2 sides	fairing offsets				B2
NB-4240 Requirements for Weld Joints in Components		B 3352, B 3660	- weld classifications are different, with few technical differences, but globally equivalent - as an example : only full penetration welds are acceptable by RCCM for low diameters and angle weld of nozzle; partial penetration welds are possible by ASME	globally equivalent	
NB 4241: Cat A weld joints in vessels and longit weld joints in other components					A2
NB 4242: Cat B weld joints in vessels and circumf weld joints in other components					A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 4243: Cat C weld joints in vessels and similar weld joints in other components					A2
NB 4244: Cat D weld joints in vessels and similar weld joints in other components					A2
NB 4245: Complete joint penetration welds					B1
NB 4246: Piping branch connection					B1
NB-4250 Welding End Transitions — Maximum Envelope		B 3683.1c) + B3683.4 + B 3683.5			B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-4300 Welding Qualifications		B 4231 + S 100, S 3000			
NB-4310 General Requirements		B 4231 + S 3120		- ASME III refers to ASMEXI, RCCM to EN 15614 - these 2 specifications do not consider exactly the same parameters, but achieve an equivalent quality level, considering other aspects: welders qualifications, NDE associated, test coupons during manufacturing - RCCM is in line with European industrial approach, with qualification by third parties	A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 4311: Type of processes permitted	stud welding restriction, capacitor discharge welding, inertia and continuous drive friction welding	S 3000	no particular differences specific to this process		B2
NB-4320 Welding Qualifications, Records, and Identifying Stamps		B 4231 + S1000 + A 3500			
NB 4321: Required qualifications					B2
NB 4322: Maintenance and certification of records					B2
NB 4323: Welding prior to qualification					B2
NB 4324: Transferring qualification					B2
NB-4330 General Requirements for Welding Procedure Qualification Tests		Section IV : S 3000 + Appendix SI			
NB 4331: Conformance to section IX requirements			RCCM refers to EN 15614; essential variables are different in Section IX and EN 15614; thickness range validity of qualification is different	no direct link with ISI Code	B2
NB 4332: not used					B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 4333: Heat treatment of qualification welds for ferritic materials					B2
NB 4334: Preparation of test coupons and specimens: representing weld deposit, heat affected zone,			Tests are different in ASME and RCCM (EN 15614) Codes:- RTNDT not for all materials in RCCM (some pressure parts); RTNDT for all materials in ASME- chemical analysis not required in ASME, but required in RCCM- no NDE required in ASME in contrary of to RCCM where all test during production must be performed for qualification		B2
NB 4335: Impact test requirements : of weld metal, of HAZ			- impact test in HAZ are mandatory in RCCM (EN 15614-1)		B2
NB 4336: Qualification requirements for built-up weld deposits			- weld deposits limits are different		B2
NB 4337: Welding of instrument tubing					B2
NB-4340 (not used)					

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-4350 Special Qualification Requirements for Tube-to-Tubesheet Welds		S 3800			B2
NB-4360 Qualification Requirements for Welding Specially Designed Welded Seals		S 3520		Canopy seal	
NB 4361: General requirements					B2
NB 4362: Essential variables for automatic machine, and semi-automatic welding					B2
NB 4363: Essential variables for manual welding			Energy are different in RCCM (EN 15614-1)		B2
NB 4364: not used					
NB 4365: not used					
NB 4366: Test assembly: automatic, manual, machine and semi-automatic welding					B2
NB 4367: Examination of test assembly					B2
NB 4368: Performance qualification tests					B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-4400 Rules Governing Making, Examining, and Repairing Welds					
NB-4410 Precautions to Be Taken Before Welding		B 4420 + S 7200			
NB 4411: Identification, storage and handling of welding material		S 7200			B2
NB 4412: Cleanliness and protection of welding surfaces					B2
NB-4420 Rules for Making Welded Joints		B 4440 + S 1300 + S 7400			
NB 4421: Backing rings					A2
NB 4422: Peening					A2
NB 4423: Miscellaneous welding requirements		S 7300 + MC 4000			A2
NB 4424: Surface of welds: general and preservice examination	general and pre-service examination				B2
NB 4425: Welding items of different diameters	reference to design provisions		equivalent requirements		A2
NB 4426: Reinforcement of welds	thickness of weld reinforcement for vessels, pumps and valves; thickness of weld reinforcement for piping	S 7461	different but globally equivalent		A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 4427: Shape and size of fillet welds		B 3000			B2
NB 4428: Sea welds of threated joints					B1
NB 4429: Welding of clad parts					B1
NB-4430 Welding of Attachments		S 7423	integrated in RCCM design section		
NB 4431: Materials for attachments					B2
NB 4432: Welding of structural attachments					B2
NB 4433: Structural attachments					B2
NB 4434: Welding of internal structural supports to clad components					B2
NB 4435: Welding of nonstructural attachments and their removal		S 7710			B2
NB 4436: Installation of attachments to piping systems after testing					B1
NB-4440 Welding of Appurtenances					B1
NB-4450 Repair of Weld Metal Defects		F 2600 + B 4450 + S 7600			

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 4451: General requirements *NB 4452: Elimination of surface defects* *NB 4453: Requirements for making repairs of welds*	defect removal, welding material, procedures, welders, examination of repair welds, heat treatment of repair welds				A2 B2 B2
NB-4500 Brazing		not cover in RCC M			
NB-4510 Rules for Brazing					B1
NB-4520 Brazing Qualification Requirements *NB 4521: Brazing procedure and performance qualification* *NB 4522: Valve seat rings*					B1 B1
NB 4523: Reheated joints *NB 4524: Maximum temperature limits*					B1 B1
NB-4530 Fitting and Aligning of Parts to Be Brazed					B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-4540 Examination of Brazed Joints					B1
NB-4600 Heat Treatment		S 1300 - F 8000		reference to NF EN 10052 in RCCM (European Standard)	
NB-4610 Welding Preheat Requirements		S 1320			
NB 4611: When preheat is necessary					B2
NB 4612: Preheating methods					B2
NB 4613: Interpass temperature					B2
NB-4620 Postweld Heat Treatment		S 1340 + F 8000 + S 7540 + S 7620			
NB 4621: Heating and cooling methods					B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 4622: PWHT time and temperature requirements	general requirements, time-temperature recording, definition of nominal thickness governing PWHT, holding time at temperature, PWHT requirements when different P-number materials are joined, PWHT for nonpressure retaining parts, exemptions to mandatory requirements, requirements for exempting PWHT of nozzles to component welds and branch to run piping welds, temper bead weld repair, repair welds to cladding after final postweld heat treatment, temper bead weld repair to disequivalent metal welds or buttering		Globally equivalent, only few parameters changed: holding time identical, temperature range more limited in RCCM, equivalence of exemption rules	globally equivalent	A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 4623: PWHT heating and cooling rate requirements,					B2
NB 4624: Methods of PWHT	furnace heating-one heat, furnace heating-more than one heat, local heating, heating items internally				B2
NB-4630 Heat Treatment of Welds Other Than the Final Postweld Heat Treatment					B1
NB-4640 not used					
NB-4650 Heat Treatment After Bending or Forming for Pipes, Pumps, and Valves		F 4123.7			
NB 4651: Conditions requiring heat treatment after bending or forming					B2
NB 4652: Exemptions from heat treatment after bending or forming					B2
NB-4660 Heat Treatment of Electroslag Welds		not used in RCC M			B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-4700 Mechanical Joints		F 7000			
NB-4710 Bolting and Threading					
NB 4711: Thread engagement					B2
NB 4712: Thread lubricants					B2
NB 4713: Removal of thread lubricants					B2
NB-4720 Bolting Flanged Joints					B1
NB-4730 Electrical and Mechanical Penetration Assemblies					B2
Article NB-5000 Examination		**B 4000 + Section II + S 7000**			
NB-5100 General Requirements for Examination		B 4200			
NB-5110 Methods, Nondestructive Examination Procedures, and Cleaning		B 4233, B4460, Section III	pre-service out of RCCM scope personal qualification in MC 8000 cleaning in F 6000		
NB 5111: Methods		MC 2133, MC 3133, MC 3312 MC 2122, MC 3122, MC 4122			A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 5112: NDE procedures		MC 3162			A2
NB 5113: Post-examination cleaning		F 6000			B1
NB-5120 Time of Examination of Welds and Weld Metal Cladding		S 7710, MC 3312, MC 4141	RCCM provisions detailed for each type of welds		B2
NB-5130 Examination of Weld Edge Preparation Surfaces		S 7300			A2
NB-5140 Examination of Welds and Adjacent Base Material		S 7710, MC 3312, MC 4141	RCCM provisions cover ASME provisions		B2
NB-5200 Required Examination of Welds for Fabrication and Pre-service Baseline		B 4430 + B 4460 and S 7000	pre-service out of RCCM Code		
NB-5210 Category A Vessel Welded Joints and Longitudinal Welded Joints in Other Components		S 7710	RCCM provisions detailed for each type of welds		B2
NB-5220 Category B Vessel Welded Joints and Circumferential Welded Joints in Piping, Pumps and Valves		S 7710	RCCM provisions detailed for each type of welds		
NB 5221: Vessel welded joints					B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 5222: Piping , pump and valve circonf welded joints					B2
NB-5230 Category C Vessel Welded Joints and Similar Welded Joints in Other Components		S 7710	RCCM provisions detailed for each type of welds		
NB 5231: General requirements					B2
NB-5240 Category D Vessel Welded Joints and Branch and Piping Connections in Other Components		S 7710	RCCM provisions detailed for each type of welds		
NB 5241: General requirements					B2
NB 5242: Full penetration butt welded nozzles branch and piping connections					B2
NB 5243: Corner welded nozzles, branch and piping connections					B2
NB 5244: Weld metal build up at openings for nozzles, branch and piping connections		MC 2700	RCCM MC 2700 states methodology requirements which are not in ASME NB 5244		B1
NB 5245: Fillet welded and partial penetration welded joints					B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 5246: Oblique full penetration nozzles, branch and piping connections					B1
NB 5250 not used					
NB-5260 Fillet, Partial Penetration, Socket and Attachment Welded Joints		S 7710	RCCM provisions detailed for each type of welds		
NB 5261: Fillet, partial penetration and SW joints					B2
NB 5262: Structural attachment welded joints					B2
NB-5270 Special Welded Joints		S 7710, M 3312	- RCCM provisions detailed for each type of welds - RCCM MC 3312 defines methodology requirements which are not in ASME NB 5271		
NB 5271: Welded joints of specially designed seals					B2
NB 5272: Weld metal cladding		MC 2700	RCCM MC 2700 defines methodology requirements which are not in ASME NB 5244		B2
NB 5273: Hard surfacing		S 8000			B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 5274: Tube-to-tubesheet welded joints *NB 5274: Brazed joints*			 not in RCCM		B2 B1
NB 5276: Inertia and continuous drive friction welds *NB 5277: Electron beam welds* *NB 5278: Electroslag welds* *NB 5279: Special exemptions*					B1 B1 B1 B1
NB-5280 Preservice Examination NB 5281: General requirements NB 5282: Examination requirements NB 5283: Components exempt from preservice examination			not in RCCM		 B1 B1 B1
NB-5300 Acceptance Standards		S 7710			
NB-5320 Radiographic Acceptance Standards		S 7714			B2
NB-5330 Ultrasonic Acceptance Standards		S 7714 + MC 2000	RCCM MC 2000 gives the definition of the indication grouping. It's a complement to RCCM S 7714		

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 5331: Fabrication					B2
NB 5332: Preservice examination			not in RCCM	operation code : RSEM	B1
NB-5340 Magnetic Particle Acceptance Standards		S 7714 + MC 5000	RCCM MC 5000 gives the definition of linear / rounded, it's a complement to RCCM S 7714		B2
NB 5341: Evaluation of indications					B2
NB 5342: Acceptance standards					B2
NB 5343: Preservice examination					B1
NB-5350 Liquid Penetrant Acceptance Standards		S 7714 + MC 4000	RCCM MC 4000 gives the definition of linear / rounded, it's a complement to RCCM S 7714		
NB 5351: Evaluation of indications					B2
NB 5352: Acceptance standards					B2
NB 5353: Preservice examination					B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-5360 Eddy Current Preservice Examination of Installed Nonferromagnetic Steam Generator Heat Exchanger Tubing		S 7714 + MC 6000	RCCM MC 6000 defines requirements for reference tube		B2
NB-5370 Visual Acceptance Standards for Brazed Joints			not in RCCM		B1
NB-5380 Bubble Formation Testing		MC 7400			A2
NB-5400 Final Examination of Vessels		MC 7100			
NB-5410 Examination After Hydrostatic Test					A2
NB-5500 Qualifications and Certification of Nondestructive Examination Personnel		B 4233 + MC 8000	equivalent objectives, but different references	RCCM is in line with European approach and EN 473; third party are mandatory following regulation in force	
NB-5510 General Requirements		MC 2121, MC 3121, MC 4121, MC 5121			A2
NB-5520 Personnel Qualification, Certification and Verification *NB 5521: Qualification procedure*					B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 5522: Certification of personnel *NB 5523: Verification of NDE personnel certification*					B2 B2
NB-5530 Records					B2
Article NB-6000 Testing		**B 5000**			
NB-6100 General Requirements		B 5100			
NB-6110 Pressure Testing of Components, Appurtenances and Systems					
NB 6111: Scope of pressure testing	preferred method : hydrostatic test, bolts, nuts, washers and gaskets exempted from pressure test				A2
NB 6112: Pneumatic testing: limitations, precautions	limitations, precautions		not applicable for class 1 components	non-mandatory appendix ZU might be used under cover of interpretation sheet	B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 6113: Witnessing of pressure test	system pressure test, component and appurtenance pressure test, material pressure test	B 5211 : individual pressure test B 5212: assemblies (or system) pressure test	witnessing by inspector is required; inspector is defined in A 2100	witnessing under safety authority for class 1 components is defined in regulation in force (Appendix ZU for France)	B2
NB 6114: Time of pressure testing : system pressure test, component and appurtenance pressure test, material pressure test *NB 6115: Machining after pressure test*		B 5211	no un-scheduled machining acceptance , RCCM more general than ASME		B2
NB-6120 Preparation for testing *NB 6121: Exposure of joints* *NB 6122: Addition of temporary support* *NB 6123: Restraint or isolation of expansion joints* *NB 6124:Isolation of equipment not subjected to pressure test*		B 5240	more detailed in RCCM		B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 6125: Treatment of flanged joints containing blanks *NB 6126: Precautions against test medium expansion*					
NB 6127: Check of test equipment before applying pressure					
NB-6200 Hydrostatic Tests		B 5200			
NB-6210 Hydrostatic Test Procedure					
NB 6211: Venting during fill operation		B 5240	equivalent requirement		A2
NB 6212: Test medium and test temperature		B 5240	RTNDT +30°C in RCCM		A2
NB-6220 Hydrostatic Test Pressure Requirements					
NB 6221: Minimum hydrostatic test pressure		B 5220	RCCM 2007 more stringent than ASME (higher pressure)	European regulatory requirement, RCCM 2008 equivalent to ASME with specific requirement from French regulation in Appendix ZU	B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 6222: Maximum permissible test pressure			equivalent stress limits		A2
		B 5223 Individual test pressure for valve B 5225 Test pressure for safety device	not in ASME	reference to EN 12266-1 standard	B1
		B 5230 Documents to be drawn up before the hydrostatic test	not in ASME	covers in particular test procedure	B1
NB 6223: Hydrostatic test pressure holding time *NB 6224: Examination of leakage after application of pressure*		B 5240 e) B 5250 Acceptance criteria	more general requirement in RCCM		B2 B2
		B 5260 Document to bee drawn up after the test B 5300 Additional test on valves	covered in particular test certificate not in ASME	reference to EN 12666-1	A2 B1
NB-6300 Pneumatic Tests		not covered in RCCM			
NB-6310 Pneumatic Testing Procedures *NB 6311: General requirements* *NB 6312: Test medium and test pressure* *NB 6313: Procedure for applying pressure*					B1 B1 B1
NB-6320 Pneumatic Test Pressure Requirements					

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 6321: Minimum required pneumatic test pressure *NB 6322: Maximum permissible test pressure*					B1 B1
NB 6323: Test pressure holding time *NB 6324: Examination for leakage after application of pressure*					B1 B1
NB-6400 Pressure Test Gages		B 5240		RCCM and ASME do not cover same range of measure (3 or 4 times Pt)	
NB 6411: Type of gages to be used and their location *NB 6412: Range of indicating pressure gages* *NB 6413: Calibration of pressure test gages*					B2 B2 B2
NB-6500 not used					
NB-6600 Special Test Pressure Situations					
NB-6610 Components Designed for External Pressure		Appendix Z IV			B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-6620 Pressure Testing of Combination Units *NB 6221: Pressure chambers designated to operate independently*			not in RCCM		B1
NB 6222: Common elements designed for a max differential pressure	test condition derived from ΔP used in Design		not in RCCM		B1
Article NB-7000 Overpressure Protection		**B 6000**			
NB-7100 General Requirements					
NB-7110 Scope		B 6112 Scope of application	Equivalent provisions		
NB-7111 Definitions		B 6113 Terms and definitions	Equivalent provisions. ASME refers to ASME PTC 25-2001 whereas RCC-M refers to EN-ISO 4126-1		A2
NB-7120 Integrated Overpressure Protection		B 6120 Integrated overpressure protection	Equivalent provisions		A2
NB-7130 Verification of the Operation of Reclosing Pressure Relief Devices		B 6130 Verification of pressure relief valve reclosing	Equivalent provisions		A2
NB-7131 Construction		B 6131 Construction			
NB-7140 Installation		B 6140 Installation	Equivalent provisions		A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB 7141 Pressure Relieve Devices		B 6141 Direct Pressure Limit action Devices	RCC-M refers to EN 764-7		A2
NB-7142 Stop valves		B 6142 Stop valves	Equivalent provisions with EN 764-7 recognized as acceptable		A2
NB-7143 Draining of pressure relieve devices		B 6143 Draining of pressure relief devices	Equivalent provisions		A2
NB-7150 Acceptable Pressure Relief Devices		B 6150 Acceptable pressure relief devices			
NB-7151 Pressure relief valves	Reference to NB-7170 and NB-7500	B 6151 Pressure relief valves	Equivalent provisions		A2
NB-7152 Non-reclosing pressure relief devices	Reference to NB-7170 and NB-7600	B 6152 Non-reclosing pressure relief devices	Equivalent provisions		A2
NB-7160 Unacceptable Pressure Relief Devices		B 7160 Unacceptable pressure relief devices	RCC-M includes ASME limitation		
NB-7161 Deadweight pressure relief valves					A1
NB-7170 Permitted Use of Pressure Relief Devices		B 6170 Permitted use of direct pressure limitation devices			
NB-7171 Safety valves		B 6171 Direct-operated pressure relief valves	RCC-M B 6171 covers ASME NB-7171, NB-7172 and NB-7173		A2
NB-7172 Safety relief valves					B1
NB-7173 Relief valves					B1
NB-7174 Pilot operated pressure relief valves		B 6172 Pilot-operated pressure relief valves	Equivalent provisions		A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-7175 Power actuated pressure relief valves		B 6173 Power-actuated pressure relief valves	Equivalent provisions		A2
NB-7176 Safety valves with auxiliary actuating devices		B 6174 Pressure relief valves with auxiliary actuating devices	Equivalent provisions		A2
NB-7177 Pilot operated pressure relief valves with auxiliary actuating devices		B 6175 Pilot-operated pressure relief valves with auxiliary actuating devices	Equivalent provisions		A2
NB-7178 Non-reclosing devices		B 6176 Non-reclosing pressure relief devices	Equivalent provisions		A2
		B 6180 Additional requirements regarding safety accessories	Reliability, independence, redundancy, diversity and self-diagnosis principles according to European regulation	self-diagnosis principles according to European standardization (EN 764-7)	B1
NB-7200 Overpressure Protection Report		B 6200 Overpressure protection report			
NB-7210 Responsibility for Report		B 6210 Responsibility	Equivalent provisions		A2
NB-7220 Content of Report		B 6220 Content of report	RCC-M less detailed, but links to equipment hazards analysis and operating instructions for consistency		A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-7230 Certification of Report		B 6230 Presentation of the overpressure protection report	No strict correspondence ASME refers to RPE activity, RCC-M refers to Safety report	Regulations define who have to assess the safety report, the hazard analysis (overpressure protection which is included in), the operating instructions; RCCM appendix ZU in France	B2
NB-7240 Review of Report After Installation		B 6240 Overpressure protection report updates	ASME provisions related to ASME organization		B1
NB-7250 Filing of Report		A 3100, Appendices ZU and ZT			B1
NB-7300 Relieving Capacity					
NB-7310 Expected System Pressure Transient Conditions		B 6310 Normal, upset and emergency conditions	RCC-M requirements explicitly applicable to emergency conditions.	RCC-M 2007 integrates French 1999 regulation, grouped in RCCM appendix ZU for future RCCM edition	B2
NB 7311 Relieving capacity of Pressure Relief Devices		B 6311 Relieving Capacity for Direct Pressure Limitation Devices	120% limit shall be met with one device considered unavailable (2 if 4 or more devices used)	Covers ASME NB-7311 to NB-7314	A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-7312 Relieving capacity of pressure relief devices used with pressure-reducing devices					B1
NB-7313 Required number and capacity of pressure relief devices					B1
NB-7314 Required number and capacity of pressure relief devices for isolatable components		B 6312 Simultaneous isolation of direct pressure limitation devices and of pressure source	Equivalent provisions. RCC-M refers to EN 764-7	RCC-M refers to EN 764-7	B2
NB-7320 Unexpected System Excess Pressure Transient Conditions		B 6320 Faulted conditions			A2
NB-7321 Relieving capacity of pressure relief devices		B 6321 Relieving capacity for direct pressure limitation devices	ASME provisions dedicated to conditions for which level C service limits are specified. Those are covered in RCC-M B 6310. RCC-M provisions go beyond		B2
NB-7400 Set Pressures of Pressure Relief Devices		B 6400 Set pressure for direct pressure limitation devices			

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-7410 Set Pressure Limitations for Expected System Pressure Transient Conditions		B 6410 Set pressure limitation for normal, upset and emergency conditions	RCC-M provisions also applicable to emergency conditions and more severe than ASME	RCC-M integrates French regulation, as a basis in this case	B2
NB-7420 Set Pressure Limitation for Unexpected System Excess Pressure Transient Conditions		B 6420 Set pressure limitation for faulted conditions	Examples given in ASME for unexpected conditions do not correspond to faulted conditions, and are covered in RCC-M B 6410.		A2
NB-7500 Operating and Design Requirements for Pressure Relief Valves		B 6500 Design and operating specifications for pressure relief valves			
NB-7510 Safety, Safety Relief and Relief Valves		B 6510 Direct-operated pressure relief valves			
NB-7511 General requirements		B 6511 General	Reference made to EN ISO 4126-1 in RCC-M		B2
NB-7512 Safety valve operating requirements		B 6512 Operating specifications	B 6512 covers ASME NB-7512 and NB-7513. Reference made to EN ISO 4126-1		B2
NB-7513 Safety relief and relief valve operating requirements					B1
NB-7514 Credited relieving capacity	Reference to NB-7700	B 6513 Credited relieving capacity	Equivalent provisions		A2
NB-7515 Sealing of adjustments		B 6514 Sealing settings	Equivalent provisions		A2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-7520 Pilot Operated Pressure Relief Valves		B 6520 Pilot-operated pressure relief valves			
NB-7521 General requirements		B 6521 General requirements	Equivalent provisions, plus reference to EN ISO 4126-4 in RCC-M		B2
NB-7522 Operating requirements		B 6522 Operating specifications	Equivalent provisions		A2
NB-7523 Credited relieving capacity		B 6523 Credited relieving capacity	Equivalent provisions		A2
NB-7524 Sealing of adjustments		B 6524 Sealing settings	Equivalent provisions		A2
NB-7530 Power Actuated Pressure Relief Valves		B 6530 Power-actuated pressure relief valves			
NB-7531 General requirements		B 6531 General	Equivalent provisions		A2
NB-7532 Operating requirements		B 6532 Operating requirements	Equivalent provisions		A2
NB-7533 Certified relieving capacity		B 6533 Certified relieving capacity	Equivalent provisions		A2
NB-7534 Credited relieving capacity		B 653 Credited relieving capacity	Equivalent provisions		A2
NB-7535 Sealing of adjustments		B 6535 Sealing settings	Equivalent provisions		A2
NB-7540 Safety Valves and Pilot Operated Pressure Relief Valves With Auxiliary Actuating Devices		B 6540 Pressure relief valves and pilot-operated pressure-relief valves with auxiliary actuating devices	Reference to EN ISO 4126-1 in RCC-M		B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-7541 General requirements					B2
NB-7542 Construction					B2
NB-7543 Auxiliary device sensors and controls					B2
NB-7544 Relieving capacity					B2
NB-7545 Response time					B2
NB-7550 Alternative Test Media		B 6550 Alternative test media			
NB-7551 General requirements		B 6551 General			B1
NB-7552 Correlation		B 6552 Correlation			B1
NB-7553 Verification of correlation procedure		B 6553 Verification of the correlation parameters			B1
NB-7554 Procedure		B 6554 Procedure			B1
		B 6560 Acceptance tests	Tests to be performed according to EN ISO 4126 in addition to B 5000	no pressure test or leaktightness test in ASME	B2
NB-7600 Non-reclosing Pressure Relief Devices		B 6600 Non-reclosing pressure-relief devices	No specific provisions in RCC-M as these devices are not used for class 1 equipments		

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-7610 Rupture Disk Devices				no specific provisions in RCCM as these devices are not uses for class 1 equipment	
NB-7611 Burst pressure tolerance					B1
NB-7612 Tests to establish stamped burst pressure					B1
NB-7620 Installation				no specific provisions in RCCM as these devices are not uses for class 1 equipment	
NB-7621 Provisions for venting or draining					B1
NB-7622 Systems obstructions					B1
NB-7623 Rupture disk devices at the outset side of pressure relief valves					B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-7700 Certification		B 6700 Determination of flow capacity	Two approaches acceptable in RCC-M either ASME NB-7700 or EN ISO 4126, parts 1 to 6	- RCCM considers regulation in force for safety devices - in France, as in Europe, RCCM appendix ZU defines the requirements, which include non-reclosing pressure relief devices (bursting disks)	
NB-7710 Responsibility for Certification of Pressure Relief Valves					B2
NB-7720 Responsibility for Certification of Non-reclosing Pressure Relief Devices					B2
NB-7730 Capacity Certification Pressure Relief Valves — Compressible Fluids					
NB-7731 General requirements					B2
NB-7732 Flow model test method					B2
NB-7733 Slope method					B2
NB-7734 Coefficient of discharge method					B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-7735 Single valve method					B2
NB-7736 Proration of capacity					B2
NB-7737 Capacity conversions					B2
NB-7738 Laboratory acceptance of pressure relieving capacity tests					B2
NB-7739 Laboratory acceptance of demonstration of function tests					B2
NB-7740 Capacity Certification of Pressure Relief Valves — Incompressible Fluids					
NB-7741 General requirements					B2
NB-7742 Valve designs in excess of test facility limits					B2
NB-7743 Slope method					B2
NB-7744 Coefficient of discharge method					B2
NB-7745 Single valve method					B2
NB-7746 Laboratory acceptance of pressure relieving capacity tests					B2

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
NB-7747 Proration of capacity *NB-7748 Capacity conversions* *NB-7749 Laboratory acceptance of demonstration of function tests*					B2 B2 B2
NB-7800 Marking, Stamping and Data Reports		B 1300, A 3000 (A 3804), non-mandatory appendices ZU, ZZ, ZT, ZY	- certificate of compliance with RCCM does not involve third party like MDR - stamping, marking are context-dependent	RCCM considers that marking w/o stamping are related to particular regulation	
NB-7810 Pressure Relief Valves *NB-7811 Marking and stamping* *NB-7812 Report form for pressure relief valves*					*B1* *B1*
NB-7820 Rupture Disk Devices *NB-7821 Rupture disks* *NB-7822 Disk holders (if used)*					B1 B1
NB-7830 Certificate of Authorization to Use Code Symbol Stamp					B1

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
Article NB-8000 Nameplates, Stamping and Reports					
NB-8100 General Requirements	Reference to NCA 8000	B 1300, A 3800		RCCM considers that marking w/o stamping are related to particular regulation	B1
Appendices		**Annexes Z**			**NC**
Mandatory appendices		**Mandatory annexes**			
Appendix I : Design Stress Intensity Values, allowable stresses, material properties and design curves		Annex ZI : Material properties to be used in design	Equivalent provisions		
Appendix II :Experimental stress analysis		Annex ZII : Experimental stress analysis	Equivalent provisions		
Appendix III : Basis for establishing design stress intensity values and allowable stress values		Annex ZIII : Determination of allowable stress	Technically equivalent provisions		
Appendix IV : Approval of new materials under the ASME Boiler and Pressure Vessel Code		M 113 New methods of manufacturing parts, new materials: qualification	ASME appendix only applicable within ASME framework	no need in RCCM	

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
Appendix V : Certificate holders' data report forms, instructions, and application forms for certificates of authorization for use of Code symbol stamps		No correspondence	ASME appendix only applicable within ASME framework	no need in RCCM	
Appendix VI : Rounded indications		S 7714	RCC-M provisions adequate, but less detailed		
Appendix VII : Charts and tables for determining shell thickness of cylindrical and spherical components under external pressure		Annex ZIV : Design rules for components subjected to external pressure	Technically equivalent provisions		
Appendix XI : Rules for bolted flange connections for class 2 and 3 components and class MC vessels		Annex ZV : Design of circular bolted flange connections	Technically equivalent provisions		
Appendix XII : Design considerations for bolted flange connections		No correspondence	ASME provisions are more explanations than provisions to be met		
Appendix XIII : Design based on stress analysis for vessels designed in accordance with NC-3200		Integrated in RCC-M C.3200	Technically equivalent		

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
Appendix XIV : Design based on fatigue analysis for vessels designed in accordance with NC-3200		Integrated in RCC-M C.3200	Technically equivalent		
Appendix XVIII : Capacity conversions for pressure relief valves		No correspondence			
Appendix XIX : Integral flat head with a large opening		No correspondence			
Appendix XX : Submittal of technical inquiries to the boiler and pressure vessel committee		No correspondence	ASME appendix only applicable within ASME framework	no need in RCCM	
Appendix XXI : Adhesive attachment of nameplates		No correspondence	non-mandatory requirements in RCCM within the scope of third party assessment	regulation in force, RCCM Appendices ZT and ZY in France	
Appendix XXII : Design of reinforcement for cone-to-cylinder junction under external pressure		No correspondence			
Appendix XXIII : Qualifications and duties of specialized professional Engineers		No correspondence	ASME appendix only applicable within ASME framework	no need in RCCM	
		Annex ZVI : Design rules for linear support	RCC-M rules covered in ASME NF subsection		
Non-mandatory Appendices		**Non-Mandatory Annexes**			

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
Appendix A : Stress analysis methods		No correspondence			
Appendix B : Owner's design specification		No correspondence		no need in RCCM	
Appendix C : Certificate holder's design report		No correspondence		no need in RCCM	
Appendix D : Non-mandatory preheat procedures		Covered in RCC-M F.8000			
Appendix E : Minimum bolt cross-sectional area		No direct correspondence			
Appendix F : Rules for evaluation of service loadings with level D service limits		Annex ZF : Rules associated with level D criteria			
Appendix G : Protection against non-ductile failure		Annex ZG : Fast fracture analysis			
Appendix J : Owner's design specification for Core Support Structures		No correspondence			
Appendix K : Tolerances		No correspondence			
Appendix L : Class FF flange design for class 2 and 3 components and class MC vessels		No correspondence			

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
Appendix M : Recommendations for control of welding, post-weld heat treatment and nondestructive examination of welds		Integrated in RCC-M S.7000	RCC-M provisions more self-contained		
Appendix N : Dynamic analysis methods		No correspondence			
Appendix O : Rules for design of safety valve installations		No correspondence			
Appendix P : Contents of certified material test reports		No correspondence			
Appendix Q : Design rules for clamp connections		No correspondence			
Appendix R : Determination of permissible lowest service metal temperature from TNDT for classes 2 and MC construction		No direct correspondence			
Appendix S : Pump shaft design methods		No correspondence			
Appendix T : Recommended tolerances for reconciliation of piping systems		No correspondence			

Appendix A: RCC-M vs ASME Comparison Table (cont.)

ASME NB Paragraphs	Brief Description of Paragraph Content	RCCM Corresponding Paragraphs	Brief Description of Differences	Comments	A B
Appendix U : Rules for pump internals		No correspondence			
Appendix W : Environmental effects on components		No correspondence			
Appendix X : Evaluation of the design of rectangular and hollow circular cross section welded attachments on class 1, 2 and 3 piping		No correspondence			
Appendix Y : Interruption of Code work		No direct correspondence			
		Annex ZA : Rules for determination of reinforcements of openings in class 1 vessel	Integrated in ASME NB-3300		
		Annex ZD : Fatigue Analysis of geometric discontinuities	No direct correspondence in ASME NB-3200		
		Annex ZE : Alternative rules for piping under level A requirements	Equivalent provisions to those in RCC-M B.3600 or ASME NB-3600		
		Annex ZH : Alternative rules for usage factor evaluation	Equivalent provisions to those in RCC-M B.3200 or ASME NB-3200		
		Annex ZS : Constructive requirements linked to in-service inspection	No direct correspondence in ASME code		

APPENDIX B: JSME VERSUS ASME SECTION III DETAILED COMPARISON TABLE

Appendix B: JSME vs ASME Comparison Table

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-1100 SCOPE		
NB-1110 ASPECTS OF CONSTRUCTION COVERED BY THESE RULES	PVB-1110 does not contain rules for marking, stamping and preparation of report by Certificate Holder. Not required by MITI.	B-2
NB-1120 TEMPERATURE LIMITS	PVB-1120	A-2
NB-1130 BOUNDARIES OF JURISDICTION APPLICABLE TO THIS SUBSSECTION		
NB-1131 Boundary of Components	GNR-1230 does not require that the Design Specification define the boundary of a component. JSME does not define the first threaded joint in screwed connections as the boundary of a component, as does NB-1131(c). Not required by MITI.	B-2
NB-1132.Boundary Between Components and Attachments NB-1132.1 Attachments NB-1132.2 Jurisdictional Boundary	GNR-1230 does not distinguish between different types of attachments. It treats all attachments the same, regardless of their function. JSME does not address fasteners used for attachment or optional expansion of the component boundary. Other Japanese standards are used to impose welding qualification and NDE requirements for important attachments, such as what ASME calls structural attachments.	B-2
NB-1140 ELECTRICAL AND MECHANICAL PENETRATION ASSEMBLIES	GNR-1110 is equivalent.	A-2
NB-2100 GENERAL REQUIREMENTS FOR MATERIAL		
NB-2110 Scope of Principal Terms Employed	JSME does not define these terms in detail compared to ASME.	B-1
NB-2120 Pressure-Retaining Material NB-2121 Permitted Material Specifications	PVB-2110 (For weld metal, see NB-2400.) Based on MITI Ordinance.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-2122 Special Requirements Conflicting with Permitted Material Specifications	JSME does not have similar provisions. Such provisions are assumed.	B-1
NB-2124 Size Ranges	JSME does not have similar provisions. Not required by MITI.	B-1
NB-2125 Fabricated Hubbed Flanges	JSME does not have similar provisions. Such provisions are assumed.	B-1
NB-2126 Finned Tubes NB-2126.1 Integrally Finned Tubes NB-2126.2 Welded Finned Tubes	Not applicable to Class 1 vessels.	–
NB-2127 Seal Membrane Material	JSME does not have similar provisions. Such provisions are assumed.	B-1
NB-2128 Bolting Material	PVB-2110 does not specify requirements for washers. Such provisions are assumed.	B-2
NB-2130 Certification of Material	JSME Code does address material certification. Other Japanese Standards (JIS) apply.	B-1
NB-2140 Welding Material	PVB-2500 requires only that weld metals have strength not less than the base materials. Based on MITI Ordinance.	B-2
NB-2150 Material Identification	Only ISO-9001 applies.	B-1
NB-2160 Deterioration of Material in Service	JSME does not have this provision. Code Case NC-CC-002 addresses prevention of SCC. Other Japanese Codes address irradiation embrittlement.	B-1
NB-2170 Heat Treatment to Enhance Impact Properties	PVB-2112 is equivalent.	A-2
NB-2180 Procedures for Heat Treatment of Material	Only ISO-9001 applies.	B-1
NB-2190 Non-Pressure-Retaining Material	PVB-2110 is the same except for weld repair of structural steel rolled shapes to SA-6.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-2200 MATERIAL TEST COUPONS AND SPECIMENS FOR FERRITIC STEEL MATERIAL		
NB-2210 Heat Treatment Requirements NB-2211 Test Coupon Heat Treatment for Ferritic Material	PVB-2210, -2221 are equivalent.	A-2
NB-2212 Test Coupon Heat Treatment for Quenched and Tempered Material NB-2212.1 Cooling Rates NB-2212.2 General Procedures	PVB-2210, -2221 are equivalent.	A-2
NB-2220 Procedure for Obtaining Test Coupons and Specimens for Quenched and Tempered Material NB-2221 General Requirements NB-2222 Plates NB-2222.1 Number of Tension Test Coupons NB-2222.2 Orientation and Location of Coupons NB-2222.3 Requirements for Separate Test Coupons NB-2223 Forgings NB-2223.1 Location of Coupons Nb-2223.2 Very Thick and Complex Forgings NB-2223.3 Coupons from Separately Test Forgings NB-2223.4 Test Specimens for Forgings NB-2224 Bar and Bolting Material NB-2225 Tubular Products and Fittings NB-2225.1 Location of Coupons NB-2225.2 Separately Produced Coupons Representing Fittings NB-2226 Tensile Test Specimen Location(for Quenched and Tempered Ferritic Steel Castings)	PVB-2221, -2222 are equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-2300 Fracture Toughness Requirements for Material		
NB-2310 Material to be Impact Tested NB-2311 Material for Which Impact Testing is Required NB-2320 Impact Test Procedures NB-2321 Types of Tests NB-2321.1 Drop Weight Tests NB-2321.2 Charpy V-Notch Tests NB-2322 Test Specimens NB-2322.1 Location of Test Specimens NB-2322.2 Orientation of Impact Specimens NB-2330 Test Requirements and Acceptance Standards NB-2331 Material for Vessels NB-2332 Material for Piping、Pumps、and Valves、Excluding Bolting Material NB-2333 Bolting Material NB-2340 Number of Impact Tests Required NB-2341 Plates NB-2342 Forging and Castings NB-2343 Bars NB-2344 Tubular Products and Fittings NB-2345 Bolting Material NB-2346 Test Definitions NB-2350 Retests NB-2360 Calibration of Instruments and Equipment	PVB-2310, -2311, -2321, -2322, -2330, -2331, -2331.1, -2332, -2333, -2333.1, -2333.2 are equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-2400 Welding Material NB-2410 General Requirements NB-2420 Required Tests NB-2430 Weld Material Tests NB-2431 Mechanical Properties Test NB-2431.1 General Test Requirements NB-2431.2 Standard Test Requirements NB-2432 Chemical Analysis Test NB-2432.1 Test Method NB-2432.2 Requirements for Chemical Analysis NB-2433 Delta Ferrite Determination NB-2433.1 Method NB-2433.2 Acceptance Standards NB-2440 Storage and Handling of Welding Material	PVB-2510 requires only that weld metals have strength not less than the base materials, and adequate fracture toughness, as stipulated in N-1110 of JSME S NB1-2007. Based on MITI Ordinance. [N-1040 (JSME Rules on Welding, Part 1)] As in NB-2400, welding material is qualified based on qualification of WPS. In accordance with performance requirement of Part 2 of JSME S NB1-2007, "Rules on Welding for Nuclear Power Plants." MITI Notification No. 501 that is a basis for the JSME Code for Design refers to ASME Sec. III. However MITI Ordinance No. 81 that is a basis for the JSME Code for Welding does not refer to ASME Sec. III; is based on Japanese industry experience. The structure of MITI Ordinance No. 81 is different from that of ASME Sec. III.	B-1 other than NB-2410 NB-2410: B-2
NB-2500 Examination and Repair of Pressure-Retaining Material		
NB-2510 Examination of Pressure-Retaining Material	GTN-2000, -3000, -4000, -5000, -6000, -7000, -8000 are equivalent.	A-2
NB-2520 Examination after Quenching and Tempering	Not Specified in JSME. Not required by MITI.	B-1
[NB-2530 Examination and Repair of Plate] NB-2531 Required Examination	PVB-2411, -2412 are equivalent for vessels.	B-2
[NB-2532 Examination Procedures] NB-2532.1 Straight Beam Examination NB-2532.2 Angle Beam Examination	GTN-2000, -3000 are equivalent for vessels.	NB-2532.1:A-2 NB-2532.2:B-1
NB-2537 Time of Examination	ASME requires UT of plate, and RT/MT/PT of repair welds, after heat treatment. PVB-2413 allows UT/RT before heat treatment and does not require RT/MT/PT of repair welds.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-2538 Elimination of Surface Defects	Not specified in JSME. JIS standards apply.	B-1
NB-2539 Repair by Welding NB-2539.1 Defect Removal	PVB-2411, -2412 are equivalent.	A-2
NB-2539.2 Qualification of Welding procedures and Welders NB-2539.3 Blending of Repaired Areas	(For welding qualifications, see NB-4300.) For blending of repair areas, JIS standards apply.	B-1
NB-2539.4 Examination of Repair Welds NB-2539.5 Heat Treatment After Repairs NB-2539.6 Material Report Describing Defects and Repairs	PVB-2411, -2412 are equivalent.	A-2
NB-2539.7 Repair of Cladding by Welding	Not Specified in JSME; base metal requirements are applied.	B-1
[NB-2540 Examination and Repair of Forging and Bars] NB-2541 Required Examination	ASME requires UT and MT/PT for all bars. PVB-2411 same, except no UT for bars ≤ 50 mm diameter.	B-2
[NB-2542 Ultrasonic Examination] NB-2542.1 Examination Procedure NB-2542.2 Acceptance Standards	GTN-2260, -2265, -3260 & PVB-2412 For bars, ASME requires straight UT. JSME requires no UT for bars ≤ 50 mm diameter, straight UT for bars < 50 mm and < 100 mm; and for > 100 mm, straight UT in axial and radial directions. For forgings, NB-2542.2 is less restrictive than PVB-2412 or -2421 (for vessel shell sections), because it applies the acceptance criteria of NB-2532.1 to the straight UT. Non-cylindrical bars are not specifically addressed in PVB-2411.	B-2
[NB-2545 Magnetic Particle Examination] NB-2545.1 Examination Procedure	GTN-5000 & PVB-2412 are equivalent.	A-2
NB-2545.2 Evaluation of Indications	GTN-5000 is equivalent.	A-2
NB-2545.3 Acceptance Standards	GTN-6320 & PVB-2425 are almost equivalent.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-2546 Liquid Penetrant Examination] NB-2546.1 Examination Procedure NB-4526.2 Evaluation of Indications	GTN-7311 is equivalent.	A-2
NB-2546.3 Acceptance Standards	GTN-7320 & PVB-2426 are almost equivalent.	B-2
NB-2547 Time of Examination	PVB-2413 does not require hollow forgings or bars to be examined after boring. Not required by MITI.	B-2
NB-2548 Elimination of Surface Defects	Not specified in JSME. JIS standards apply.	B-1
NB-2549 Repair by Welding	PVB-2412 is equivalent.	A-2
[NB-2550 Examination and Repair of Seamless and Welded(Without Filler Metal)Tubular Products and Fittings] NB-2551 Required Examination NB-2552 Ultrasonic Examination NB-2553 Radiographic Examination NB-2554 Eddy Current Examination	GTN-2000, -3000, -4000, PVB-2400 For pipe or tube, PVB-2411 is equivalent, except that, for pipe and tubing 2-1/2 in. (37 mm) OD and larger, NB-2551 requires angle UT in four directions. PVB-2411 permits substitution of ET for UT. JSME does not have a category for fittings; therefore, forging requirements are applied to fittings. For fittings up to NPS 6 (DN 150), PVB-2411 requires UT; NB-2551 does not require UT. For fittings over DN 150, NB-2552 requires straight and angle UT; PVB-2411 requires either but not both. ASME permits RT in lieu of UT; JSME does not. Required by MITI Notification 501. NB-2552(c) requires reference specimens of the same heat-treated condition; JSME does not. NB-2552(d) requires UT calibration checks every 4 hr; JSME does not.	B-2
NB-2555 Magnetic Particle Examination NB-2556 Liquid Penetrant Examination	GTN-6000 & GTN-7000 are equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-2557 Time of Examination	NB-2557 requires examination after final heat treatment, especially including quenching and tempering, and after boring. GTN-5130 & PVB-2413 do not stipulate time of examination in relationship to boring or heat treatment, except that both ASME and JSME require MT and PT after machining.	B-2
NB-2558 Elimination of Surface Defects NB-2559 Repair by Welding	Not specified in JSME. JIS standards apply.	B-1
[NB-2560 Examination and Repair of Tubular Products and Fittings Welded with Filler Metal] NB-2561 Required Examinations NB-2562 Ultrasonic Examination NB-2563 Radiographic Examination	NB-2560 requires straight UT of plate or 4-way angle UT after forming. PVB-2411 requires straight UT. Similar differences shown under NB-2552 and -2553 apply to NB-2562 and -2563. Otherwise equivalent.	B-2
NB-2565 Magnetic Particle Examination NB-2566 Liquid Penetrant Examination	PVB-2411 is equivalent.	A-2
NB-2567 Time of Examination	NB-2567 generally requires examination after final heat treatment, especially including quenching and tempering and after boring. PVB-2411 does not stipulate time of examination in relationship to boring or heat treatment, except that both ASME and JSME require MT and PT after machining. NB-2567 permits RT of pipe fabrication welds before PWHT; JSME requires RT after PWHT. Both require MT or PT after PWHT.	B-2
NB-2568 Elimination of Surface Defects NB-2569 Repair of Welding	Not specified in JSME. JIS standards apply.	B-1
NB-2570 Examination and Repair of Statically and Centrifugally Cast Products	Equivalent	A-2
NB-2571 Required Examinations	PVB-2411 is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-2572 Time of Nondestructive Examination] NB-2572.1 Acceptance Examination NB-2573 Provisions for Repair of Base Material by Welding NB-2573.1 Defect Removal NB-2573.2 Repair of Welding	PVB-2413 is equivalent.	A-2
NB-2573.3 Qualification of Welding Procedures and Welders NB-2573.4 Blending of Repaired Areas	(For welding qualifications, see NB-4300.) For blending of repair areas, JIS standards apply.	B-1
NB-2573.5 Examination of Repair Welds NB-2573.6 Heat Treatment After Repairs NB-2573.7 Elimination of Surface Defects	PVB-2413 is equivalent	A-2
NB-2573.8 Material Report Describing Defects and Repairs	Not specified in JSME. JIS standards require documentation of repair welds.	B-1
NB-2574 Ultrasonic Examination of Ferritic Steel Castings NB-2574.1 Acceptance Standards	If UT is performed in lieu of RT, NB-2574 requires straight UT if possible, otherwise angle UT. PVB-2421, -2422 require straight or angle UT.	B-2
[NB-2575 Radiographic Examinations] NB-2575.1 Examination	GTN-4000, -4180 are equivalent.	A-2
NB-2575.2 Extent	PVB-2411 is equivalent.	A-2
NB-2575.3 Examination Procedure	GTN-4142, -4153, -4200, -4231, -4240, -4311, -4312 are equivalent.	A-2
NB-2575.4 Procedure Requirements	Not specified in JSME. JIS standards apply.	B-1
NB-2575.5 Radiographic Setup Information	GTN-4000 is equivalent.	A-2
NB-2575.6 Acceptance Criteria	GTN-4400, -4410, -4500, -4510 are equivalent.	A-2
NB-2576 Liquid Penetrant Examination	GTN-7000 is equivalent.	A-2
NB-2577 Magnetic Particle Examination (for Ferritic Steel Products Only)	GTN-6000 is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-2580 EXAMINATION OF BOLTS, STUDS, AND NUTS NB-2581 Required Examination NB-2582 Visual Examination	NB-2581, -2582 require visual examination; PVB-2411 does not. NB-2581 thru -2584 require MT or PT of bolting over 1 in. (25 mm); PVB-2411 requires MT or PT of all sizes. Both require straight UT in the radial direction from 50 mm to 100 mm and straight UT in both the radial and axial directions over 100 mm.	NB-2581: B-2 NB-2582: B-1
NB-2583 Magnetic Particle Examination (for Ferritic Steel Bolting Material Only) NB-2583.1 Examination Procedure NB-2583.2 Evaluation of Indications NB-2583.3 Acceptance Standard NB-2584 Liquid Penetrant Examination NB-2584.1 Examination Procedure NB-2584.2 Evaluation of Indications NB-2584.3 Acceptance Standard	NB-2583.2 permits surface conditioning and reexamination, or use of alternative methods to better characterize an indication. GTN-6000 does not permit reexamination for MT; GTN-7000 permits reexamination for PT; alternative methods are not addressed. NB-2583.3, -2584.3 permit linear axial indications up to 25 mm long. PVB-2426 permits the same indications, provided they are determined (subjectively by the examiner) to not be cracks.	B-2 other than NB-2584.2 NB-2584.2:A-2
NB-2585 Ultrasonic Examination for Sizes Greater Than 2 in. (50 mm) NB-2585.1 Ultrasonic Method	GTN-2000, -3000 are equivalent.	A-2
NB-2585.2 Examination Procedure	ASME requires 2.25MHz and 1 in.^{2} (650 mm^2) transducer; GTN-2000, -3000 require 0.4-15MHz and do not specify transducer size.	B-2
NB-2585.3 Calibration of Equipment NB-2585.4 Acceptance Standard	GTN-2000, -3000 are equivalent.	A-2
NB-2586 Ultrasonic Examination for Sizes Over 4 in. (100 mm) NB-2586.1 Ultrasonic Method	GTN-2000, -3000 are equivalent.	A-2
NB-2586.2 Examination Procedure	NB-2586.2 requires 2.25MHz and ½ to 1-1/8 in. (13-29 mm) dia. transducer; GTN-2000, -3000 require 0.4-15MHz and do not specify transducer size.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-2586.3 Calibration of Equipment	NB-2586.3 requires one test bar at least ½ of length of production part. GTN-2241 requires three test bars of different lengths (1/4L+75mm, 1/2L+75mm, 150mm), due to MITI Notification 501.	B-2
NB-2586.4 Acceptance Standard	GTN-2000, -3000 are equivalent.	A-2
NB-2587 Time of Examination	NB-2587 requires examination after final material spec. heat treatment and visual exam after machining. PVB-2413 requires UT in bar form and MT or PT after machining, without regard for heat treatment condition.	B-2
NB-2588 Elimination of Surface Defects	Not specified in JSME. NB-2588 is redundant and unnecessary.	B-1
NB-2589 Repair by Welding	PVB-2412 is equivalent.	A-2
NB-2600 MATERIAL ORGANIZATIONS' QUALITY SYSTEM PROGRAMS NB-2610 DOCUMENTATION AND MAINTENANCE OF QUALITY SYSTEM PROGRAMS	MO quality program is not addressed by JSME.	B-1
NB-2700 DIMENSIONAL STANDARDS	Not Specified in JSME; other standards are used without being mandated.	B-1
[NB-3100 General Requirements] [NB-3110 Loading Criteria] NB-3111 Loading Conditions	Design Loadings not specified in JSME; must be specified in Design Specification.	B-1
NB-3112 Design Loadings NB-3112.1 Design Pressure NB-3112.2 Design Temperature NB-3112.3 Design Mechanical Loads	GNR-2120 is equivalent.	A-2
NB-3112.4 Design Stress Intensity Values	PVA-3000, PVB-1120 are equivalent.	A-2
NB-3113 Service Conditions	GNR-2110 is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-3120 Special Considerations] NB-3121 Corrosion	PVB-3410 is equivalent.	A-2
NB-3122 Cladding NB-3122-1 Primary Stresses NB-3122-2 Design Dimensions NB-3122-3 Secondary and Peak Stresses NB-3122-4 Bearing Stresses	PVB-3420 is equivalent.	A-2
NB-3123 Welding NB-3123.1 Dissimilar Welds NB-3123.2 Fillet Welded Attachments	JSME does not address thermal expansion effects of dissimilar metal welds or fillet welded attachments.	B-1
NB-3124 Environmental Effects	JSME does not address property changes due to environmental effects.	B-1
NB-3125 Configuration	JSME does not address design for accessibility for in-service inspection.	B-1
NB-3130 General Design Rules NB-3131 Scope NB-3132 Dimensional Standards for Standard Products	Dimensional standards are not specified in JSME; other standards are used without being mandated.	B-1
NB-3133 Components Under External Pressure NB-3133.1 General	PVB-3200, -3210, -3220 are equivalent.	A-2
NB-3133.2 Nomenclature	JSME specifies nomenclature in location of use.	B-1
NB-3133.3 Cylindrical Shells and Tubular Products	PVB-3210 is equivalent.	A-2
NB-3133.4 Spherical Shells	PVB-3220 is equivalent.	A-2
NB-3133.5 Stiffening Rings for Cylindrical Shells	JSME does not address stiffening rings for Class 1 vessels. NB-3133.5 is probably never used.	B-1
NB-3133.6 Cylinders Under Axial Compression.	PVB-3117 is equivalent.	A-2
NB-3134 Leak Tightness	PHT-1000 does not address this requirement. NB-3134 is probably not necessary for Class 1 vessels.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-3135 Attachments	Guideline to GNR-1230 is equivalent.	A-2
NB-3136 Appurtenances	Not addressed by JSME.	B-1
NB-3137 Reinforcement for Openings	PVB-3500; See NB-3330.	–
[NB-3200 Design by Analysis] NB-3210 Design Criteria NB-3211 Requirements for Acceptability	PVB-3110, -3120, -2300, -2310 are equivalent.	A-2
NB-3212 Basis for Determining Stresses	GNR-2130 is equivalent.	A-2
[NB-3213 Terms Relating to Stress Analysis] NB-3213.1 Stress Intensity	GNR-2130 is equivalent.	A-2
NB-3213.2 Gross Structural Discontinuity NB-3213.3 Local Structural Discontinuity NB-3213.4 Normal Stress NB-3213.5 Shear Stress	These terms are not defined by JSME.	B-1
NB-3213.6 Membrane Stress NB-3213.7 Bending Stress NB-3213.8 Primary Stress NB-3213.9 Secondary Stress NB-3213.10 Local Primary Membrane Stress NB-3213.11 Peak Stress	GNR-2130 is equivalent.	A-2
NB-3213.12 Load Controlled Stresses	Definition of term not used by JSME.	B-1
NB-3213.13 Thermal Stress	GNR-2130 is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-3213.14 Total Stress NB-3213.15 Operational Cycle NB-3213.16 Stress Cycle NB-3213.17 Fatigue Strength Reduction Factor NB-3213.18 Free End Displacement NB-3213.19 Expansion Stresses NB-3213.20 Deformation NB-3213.21 Inelasticity NB-3213.22 Creep NB-3213.23 Plasticity NB-3213.24 Plastic Analysis NB-3213.25 Plastic Analysis – Collapse Load A NB-3213.26 Plastic Instability Load NB-3213.27 Limit Analysis NB-3213.28 Limit Analysis – Collapse Load NB-3213.29 Collapse Load – Lower Bound NB-3213.30 Plastic Hinge NB-3213.31 Stain Limiting Load NB-3213.32 Test Collapse Load NB-3213.33 Ratcheting NB-3213.34 Shakedown NB-3213.35 Reversing Dynamic Loads NB-3213.36 Non-reversing Dynamic Loads NB-3214 Stress Analysis	These terms are not defined by JSME.	B-1
NB-3215 Derivation of Stress Intensities	PVA-3100 & GNR-2130 are equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-3216 Derivation of Stress Differences NB-3216.1 Constant Principal Stress Direction	Explanation for GNR-2130 is equivalent.	A-2
NB-3216.2 Varying Principal Stress Direction	Variation of principal stress direction is not considered in JSME Code. NB-3216.2 probably never applies and is therefore probably unnecessary.	B-1
NB-3217 Classification of Stresses	PVA-3100 is equivalent.	A-2
[NB-3220 STRESS LIMITS FOR OTHER THAN BOLTS] NB-3221 Design Loadings	PVB-3110 is equivalent.	A-2
NB-3221.1 General Primary Membrane Stress Intensity NB-3221.2 Local Membrane Stress Intensity NB-3221.3 Primary Membrane (General or Local) Plus Primary Bending Stress Intensity	PVB-3111 is equivalent.	A-2
NB-3221.4 External Pressure	PVB-3210 is equivalent.	A-2
NB-3222 Level A Service Limits	PVB-3111, -3112, -3113, -3114 are equivalent.	A-2
NB-3222.1 Primary Membrane Plus Bending Stress Intensity	PVB-3111 is equivalent.	A-2
NB-3222.2 Primary Plus Secondary Stress Intensity	PVB-3112 is equivalent.	A-2
NB-3222.3 Expansion Stress Intensity	Not applicable to vessels.	B-1
NB-3222.4 Analysis for Cyclic Operation	PVB-3140, PVB-3114 are equivalent.	A-2
NB-3222.5 Thermal Stress Ratchet	PVB-3113 is equivalent.	A-2
NB-3222.6 Deformation Limits	Not addressed by JSME; NB-3222.6 is superfluous.	B-1
NB-3223 Level B Service Limits	PVB-3111, -3112, -3113, -3114 are equivalent.	A-2
NB-3224 Level C Service Limits	PVB-3111 is equivalent.	A-2
NB-3224.1 Primary Stress Limits	PVB-3111 is equivalent.	A-2
NB-3224.2 External Pressure	PVB-3210, -3220 are equivalent.	A-2
NB-3224.3 Special Stress Limits	PVB-3160, -3300 are equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-3224.4 Secondary and Peak Stresses NB-3224.5 Fatigue Requirements	Equivalent	A-2
NB-3224.6 Deformation Limits NB-3224.7 Piping Requirements	Not addressed by JSME; NB-3224.6 is superfluous.	B-1
NB-3225 Level D Service Limits	PVB-3111, -3200, -3210, -3220 are equivalent.	A-2
NB-3226 Testing Limits	PVB-3111, -3200, -3210, -3220 are equivalent.	A-2
NB-3227 Special Stress Limits NB-3227.1 Bearing Loads NB-3227.2 Pure Shear	 PVB-3116 is equivalent. PVB-3115 is equivalent.	A-2
NB-3227.3 Progressive Distortion of Non-integral Connections	Not considered in JSME Code. NB-3227.3 probably never applies.	B-1
NB-3227.4 Triaxial Stresses	Not considered in JSME Code. NB-3227.4 probably never applies.	B-1
NB-3227.5 Nozzle Piping Transition	Within the limits of reinforcement, NB-3227.5 requires all external loads and moments (combining mechanical and thermal external loads), including those attributable to restrained free end displacement of the attached pipe, are combined into Pm. In PVA-3100 guideline, "Classification of Stress Intensity in Vessels for Some Typical Cases," mechanical external loads are distinguished from thermal external loads, and only mechanical external loads are included in Pm. The additional conservatism of NB-3227.5 is not required by MITI.	B-2
NB-3227.6 Applications of Elastic Analysis for Stresses Beyond the Yield Strength	Not addressed by JSME. NB-3227.6 probably adds no value to Class 1 vessel analysis.	B-1
NB-3227.7 Requirements for Specially Designed Welded Seals	PVB-3150, -3151, -3152 are equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-3228 Applications of Plastic Analysis NB-3228.1 Limit Analysis	PVB-3160 does not impose the requirements for minimum thickness and strain limit of NB-3228.1. For the Test Condition, PVB-3160 also requires $P_c \leq 0.8P_{cr}$ and Yield Strength = S_y	B-2
NB-3228.2 Experimental Analysis NB-3228.3 Plastic Analysis	JSME does not permit use of Experimental Analysis or Plastic Analysis.	B-1
NB-3228.4 Shakedown Analysis	JSME Code Case NC-CC-005 "Alternative Structural Evaluation Criteria for Class 1 Vessels Based on Elastic-Plastic Finite Element Analysis" permits evaluation of shakedown by applying elastic-plastic FEM analysis, assuming elastic-perfectly-plastic solid.	B-2
NB-3228.5 Simplified Elastic-Plastic Analysis	PVB-3300 is equivalent, except that it provides K_e values for evaluation of fatigue for S_n values above $3S_m$ that are about 50% lower than the ASME values. The basis for the lower JSME values is documented in, "Evaluation of Conservatism in the Simplified Elastic-Plastic Analysis Using Analysis Results," PVP-Vol.407, Pressure Vessel and Piping Code and Standards, ASME, 2000, p. 255, Asada S., Nakamura T., Asada Y.	B-2
NB-3229 Design Stress Values	JSME S NJ1-2008, "Rules on Materials for Nuclear Facilities," is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-3230 STRESS LIMITS FOR BOLTS] NB-3231 Design Conditions NB-3232 Level A Service Limits NB-3232.1 Average Stress NB-3232.2 Maximum Stress NB-3232.3 Fatigue Analysis of Bolts NB-3233 Level B Service Limits NB-3234 Level C Service Limits NB-3235 Level D Service Limits NB-3236 Design Stress Intensity Values	PVB-3120, -3121, -3122, -3130 are equivalent.	A-2
[NB-3300 VESSEL DESIGN] [NB-3310 GENERAL REQUIREMENTS] [NB-3311 Acceptability] [NB-3320 DESIGN CONSIDERATIONS] NB-3321 Design and Service Loadings NB-3322 Special Considerations NB-3323 General Design Rules [NB-3324 Tentative Pressure Thickness] NB-3324.1 Cylindrical Shells NB-3324.2 Spherical Shells	Not addressed by JSME. JSME treats these explanatory provisions as unnecessary.	B-1
[NB-3330 OPENINGS AND REINFORCEMENT] NB-3331 General Requirements for Openings	ASME permits any type of opening; PVB-3510 permits only circular or ellipsoidal openings. Based on MITI Notification 501.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-3332 Reinforcement Requirements for Openings in Shells and Formed Heads] NB-3332.1 Openings Not Requiring Reinforcement	NB-3332(b) allows some unreinforced openings with less separation than does PVB-3650, which requires that openings whose centers are farther apart than $1.5(d_1+d_2)$ must also be farther than $2.5\sqrt{(Rt)}+0.5(d_1+d_2)$ to be unreinforced. PVB-3650 requires that the unreinforced openings be farther apart than does NB-3332, by the sum of their radii. Based on MITI Notification 501.	B-2
NB-3332.2 Required Area of Reinforcement	PVB-3511(3) is equivalent.	A-2
NB-3333 Reinforcement Required for Openings in Flat Heads	PVB-3511(3)C is equivalent.	A-2
NB-3334 Limits of Reinforcement NB-3334.1 Limit of Reinforcement Along the Vessel Wall	PVB-3511, -3513 are equivalent.	A-2
NB-3342.2 Limit of Reinforcement Normal to the Vessel Wall	PVB-3511(1)b is equivalent.	A-2
[NB-3335 Metal Available for Reinforcement	PVB-3511(2), PVB-3514(1) are equivalent.	A-2
NB-3336 Strength of Reinforcing Material	PVB-3514 is equivalent.	A-2
[NB-3337 Attachment of Nozzles and Other Connections NB-3337.1 General Requirements. NB-3337.2 Full Penetration Welded Nozzles. NB-3337.3 Partial Penetration Welded Nozzles	Refer to NB-4244.	—
[NB-3338 Fatigue Evaluation of Stresses in Openings] NB-3338.1 General.	NB-3338.1 allows Experimental Stress Analysis, and JSME does not. Based on MITI Notification 501.	B-1
NB-3338.2 Stress Index Method	PVB-3510(4), -3540, -3541, -3542.1 have slightly different dimensional ratio limits than does NB-3338.2. These differences probably have no effect on Class 1 vessel design. Based on MITI Notification 501.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-3339 Alternative Rules for Nozzle Design] NB-3339.1 Limitations NB-3339.2 Nomenclature NB-3339.3 Required Reinforcement Area NB-3339.4 Limits of Reinforcing Zone NB-3339.5 Strength of Reinforcing Material Requirements NB-3339.6 Transition Details NB-3339.7 Stress Indices	PVB-3550, -3551, -3352, -3553, -3554, -3555, -3556 limit these provisions to nozzles in cylindrical shells, whereas NB-3339.1 includes nozzles in spherical shells and formed heads. PVB-3552 generally requires more area reinforcement for values of $d/\sqrt{(Rt_r)}$ between 0.2 and 0.4 than does NB-3339.3, based on use of the formula in WRC Bulletin 133. The following formulas produce nearly-identical results. ASME — $A_r = [4.05(d/\sqrt{(Rt_r)})^{1/2}-1.81]dt_r$ JSME — $A_r = [3.75(d/\sqrt{(Rt_r)})-0.75]dt_r$ Based on MITI Notification 501.	B-2
NB-3340 ANALYSIS OF VESSELS	Refers reader to NB-3214.	—
[NB-3350 DESIGN OF WELDED CONSTRUCTION] NB-3351 Welded Joint Category NB-3351.1 Category A NB-3351.2 Category B NB-3351.3 Category C NB-3351.4 Category D	[JSME Rules on Welding, Part 1], N-0020 is equivalent.	A-2
NB-3352 Permissible Types of Welded Joints NB-3352.1 Joints of Category A NB-3352.2 Joints of Category B NB-3352.3 Joints of Category C NB-3352.4 Joints of Category D	PVB-4211 - See NB-4241 PVB-4212 - See NB-4242 PVB-4213 - See NB-4243 PVB-4214 - See NB-4244 All are equivalent.	A-2
—	PVB-4215 Other Joints - Only specified in JSME.	B-1

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-3354 Structural Attachment Welds	See NB-4430	–
NB-3355 Welding Grooves	PVB-4211, -4212, -4213, -4214, -4215 - See NB-4240	–
NB-3357 Thermal Treatment	See NB-4620	–
[NB-3360 SPECIAL VESSEL REQUIREMENTS [NB-3361 Category A or B Joints Between Sections of Unequal Thickness	NB-3361 requires a tapered transition if the thickness difference exceeds ¼ of the thickness of the thinner section, with no limit on the transition length. N-1060, -1070 [JSME Rules on Welding, Part 1] and PVB-4231, -4232 specify a minimum 3-to-1 taper, with minimum radii of at least ½ of the thickness of the thinner section.	B-2
[NB-3362 Bolted Flange Connections]	NB-3362 recommendation is not in JSME.	B-1
[NB-3363 Access Openings]	Not addressed in JSME.	B-1
[NB-3364 Attachments]	Refers reader to NB-3135.	B-1
[NB-3365 Supports]	General statement requires designer to consider support loads. JSME expects this subject to be addressed in the Design Specification.	B-1
–	Non-mandatory Appendix 4-B, Fluid-elastic Vibration Evaluation of U-bend Tubes in Steam Generators (JSME Standard S 016-2002, Guideline for Fluid-elastic Vibration Evaluation of U-bend Tubes in Steam Generators) - JSME established this non-mandatory standard to prevent hydroelastic vibration of U-shaped steam generator tubes, based on service experience. – Not addressed in ASME Section III	B-1

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
–	Non-mandatory Appendix 5-A, Evaluation of Flow-Induced Vibration (JSME Standard S 012-1998, Guide Line for Evaluation of Flow-Induced Vibration of a Cylindrical Structure in a Pipe) - JSME established this nonmandatory standard to prevent fatigue damage of a cylindrical structure in a pipe due to flow-induced vibration, based on service experience. – Not addressed in ASME Section III	B-1
–	Non-mandatory Appendix 5-B, Evaluation of High-Cycle Thermal Fatigue (JSME Standard S 017-2003, Guide Line for Evaluation of High-Cycle Thermal Fatigue of a Pipe) - JSME established this non-mandatory standard to prevent high-cycle thermal fatigue damage of pipe due to thermal striping or mixture of different-temperature water, based on service experience. – Not addressed in ASME Section III	B-1
[NB-4100 General Requirements] NB-4110 Introduction	PVB-1110 is equivalent.	A-2
[NB-4120 Certification of Material and Fabrication by Certificate Holder] NB-4121 Means of Certification	Material certification and accreditation of fabricators are not addressed by JSME. Only ISO-9001 applies.	B-1
NB-4122 Material Identification	Material certification and accreditation of fabricators are not addressed by JSME. Only ISO-9001 applies.	B-1
NB-4123 Examinations	JIS Z2305 requires qualification and certification of all examination personnel, including those performing workmanship examinations. ASME exempts workmanship examinations from similar requirements.	B-1
NB-4125 Testing of Welding and Brazing Material	See NB-2400.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-4130 Repair of Material] NB-4131 Elimination and Repair of Defects	PVB-2412 is similar to NB-4131. However, PVB-2412 always requires MT or PT of a defect removal cavity, while NB-2558, -2658 require use of the method that found the defect. Required by MITI Notification 501. NB-2500 requires RT of major repairs, while PVB-2412 requires RT for plate or pipe, or UT for castings, forgings, bars, or bolts.	B-2
NB-4132 Documentation of Repair Welds of Base Material	Not addressed by JSME.	B-1
[NB-4200 Forming, Fitting and Aligning] NB-4210 Cutting, Forming and Bending NB-4211 Cutting NB-4212 Forming and Bending Processes NB-4213 Qualification of Forming Processes for Impact Property Requirements	NB-4213 permits qualification of forming processes, rather than testing the formed material. JSME PVB-2222 and PVB-2310 require testing of cold-formed or hot-formed material, respectively, after forming.	B-1 other than NB-4213 NB-4213: B-2
NB-4214 Minimum Thickness of Fabricated Material	Refers user to NB-4130.	B-1
[NB-4220 Forming Tolerances] NB-4221 Tolerance for Vessel Shells	PVB-4110 has the same requirement for deviation from theoretical form, but does not have a requirement applicable to external pressure.	B-2
NB-4222 Tolerances for Formed Vessel Heads	JSME does not address tolerances for formed heads.	B-2
NB-4223 Tolerances for Formed or Bent Piping	Not applicable to Class 1 vessels.	B-1
[NB-4230 Fitting and Aligning] NB-4231 Fitting and Aligning Methods	Not addressed by JSME.	B-1
NB-4232 Alignment Requirements When Components Are Welded From Two Sides	PVB-4231 (JSME Rules on JSME Rules on Welding, Part 1: N-1060) requires slightly smaller offsets than those permitted by NB-4232. Based on the former regulatory requirement of MITI Ordinance 81.	B-2
NB-4233 Alignment Requirements When Inside Surfaces Are Inaccessible	Not addressed by JSME.	B-1

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-4240 Requirements For Weld Joints in Components] NB-4241 Category A Weld Joints In Vessels and Longitudinal Weld Joints in Other Components	PVB-4211 is equivalent.	A-2
NB-4242 Category B Weld Joints in Vessels and Circumferential weld Joints in Other Components	PVB-4212, PPB-4010 are equivalent.	A-2
NB-4243 Category C Weld Joints in Vessels and Similar Weld Joints in Other Components	PVB-4213 is equivalent.	A-2
NB-4244 Category D Weld Joints in Vessels and Similar Weld Joints in Other Components	PVB-4214, -4215 are equivalent, except that JSME does not provide examples of oblique connections.	B-2
NB-4245 Complete Joint Penetration Welds	Not explicitly stated in JSME, but JSME is equivalent.	B-1
NB-4246 Piping Branch Connections	Not applicable to Class 1 vessels.	B-2
NB-4250 Welding End Transitions-Maximum Envelope	PPB-4010 is equivalent, except that it does not address configuration requirements for pre-service inspection.	B-2
[NB-4300 Welding Qualifications] [NB-4310 General Requirements] NB-4311 Types of Processes Permitted	[JSME Rules on Welding, Part 2] Article 2 – JSME does not address or permit stud welding, capacitor discharge welding, and inertia and continuous drive friction welding. Regulatory approval is required for their use.	B-2
NB-4320 Welding Qualifications, Records and Identifying Stamps NB-4321 Required Qualifications NB-4322 Maintenance and Certification of Record NB-4323 Welding Prior to Qualifications NB-4324 Transferring Qualifications	[JSME Rules on Welding, Part 2] Article 1 - Accreditation of fabricators is not addressed by JSME. Only ISO-9001 applies.	B-2
[NB-4330 General Requirements for Welding Procedure Qualification Tests] NB-4331 Conformance to Section IX Requirements	[JSME Rules on Welding, Part 2] Article 1 is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-4333 Heat Treatment of Qualification Welds for Ferritic Materials	NB-4333 requires simulated PWHT at 80% of production time. [JSME Rules on Welding, Part 2] Article 3 requires 100%. Based on MITI Notification 501.	B-2
NB-4334 Preparation of Test Coupons and Specimens	[JSME Rules on Welding, Part 2] Article 5 is equivalent.	A-2
NB-4335 Impact Test Requirements	[JSME Rules on Welding, Part 2] Article 3(22), 4(2) [JSME Rules on Welding, Part 1] Table 11, Notes (5) Equivalent except as follows. JSME permits use of subsize specimens for thin material; ASME does not. JSME specifies use of -33C for the impact tests.	B-2
NB-4336 Qualification Requirements for Built-Up Weld Deposits	JSME Rules on Welding is equivalent.	B-1
NB-4337 Welding of Instrument Tubing	Not applicable to Class 1 vessels.	B-1
NB-4350 Special Qualification requirements for Tube-to-Tubesheet Welds	[JSME Rules on Welding, Part 2] Article 5(2)c is equivalent.	A-2
[NB-4360 Qualification Requirements for Welding Specially designed Welds Seals] NB-4361 General Requirements NB-4362 Essential Variables for Automatic, Machine and Semiautomatic Welding NB-4363 Essential Variables for Manual Welding NB-4366 Test Assembly NB-4367 Examination of Test Assembly NB-4368 Performance Qualification Test	JSME requires welding of seals of tube-to-tube sheet to be qualified as demonstration mockup of tube-to-tube sheet. Qualified welding procedure for butt weld may be used to specially designed seals.	B-1
[NB-4400 Rules Governing Making, Examining and Repairing Welds] [NB-4410 Precautions to be Taken Before Welding] NB-4411 Identification, Storage, and Handling of Welding Material	Accreditation of fabricators is not addressed by JSME. Only ISO-9001 applies.	B-1
NB-4412 Cleanliness and Protection of Welding Surfaces	[JSME Rules on Welding, Part 1] N-1030 is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-4420 Rules for Making Welded Joints] NB-4421 Backing Rings	PVB-4211(2) is equivalent.	A-2
NB-4422 Peening	Peening is not controlled or otherwise addressed by JSME.	B-1
NB-4423 Miscellaneous Welding Requirements	JSME does not address these welding precautions.	B-1
NB-4424 Surfaces of Welds	NB-4424 permits limited undercut or concavity; [JSME Rules on Welding, Part 1] N-1080 does not. Based on the former regulatory requirement of MITI Ordinance 81.	B-2
NB-4425 Welding Items of Different diameters	PPB-4010(2) is equivalent.	A-2
NB-4426 Reinforcement of Welds	[JSME Rules on Welding, Part 1] N-1080, N-5140 permits less weld reinforcement than ASME, especially for very thin and very thick welds. Based on the former regulatory requirement of MITI Ordinance 81. Note: ASME weld reinforcement is further limited by Section XI performance demonstration requirements for pre-service and in-service inspection.	B-2
NB-4427 Shape and Size of Fillet Welds	PPB-4010(1)b [JSME Rules on Welding, Part 4] No.4-1-23 requires a minimum fillet throat of 0.85tn. NB-4427 requires 0.77tn. Based on the former regulatory requirement of MITI Ordinance 81. Note: generally applicable only to piping connections.	B-2
NB-4428 Seal Welds of Threaded Joints	Qualified welding procedure for butt weld may be used to specially designed seals.	B-1
NB-4429 Welding of Clad Parts	JSME does not address this welding precaution.	B-1
[NB-4430 Welding of Attachments] NB-4431 Materials for Attachments	PVB-2110 is equivalent.	A-2
NB-4432 Welding of Structural Attachments	PVB-4215(5) is equivalent.	A-2
NB-4433 Structural Attachments	PVB-4215(5) is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-4434 Welding of Internal Structural Supports to Clad Components	JSME does not address this provision. It is probably rarely applicable.	B-1
NB-4435 Welding of Nonstructural Attachments and Their Removal	PVB-4215(5) requires continuous fillet attachment welds. NB-4435 permits continuous or intermittent fillet or partial penetration attachment welds. Based on MITI Notification 501. JSME does not address application or removal of nonstructural temporary attachments. Not required by MITI.	B-2
NB-4436 Installation of Attachments to Piping Systems After Testing	Not applicable to Class 1 vessels.	B-1
NB-4440 Welding of Appurtenances	JSME does not specify similar weld joint details. JSME requires use of a welding procedure appropriate to a Category C or D joint.	B-1
NB-4450 Repair of Weld Metal Defects NB-4451 General Requirements NB-4452 Elimination of Surface Defects NB-4453 Requirements for Making Repairs of Welds	JSME does not address repair of welds, based on the assumption that it will be done properly.	B-1
NB-4500 Brazing NB-4510 Rules for Brazing NB-4511 Where Brazing May Be Used NB-4512 Brazing Material NB-4520 Brazing Qualification Requirements NB-4521 Brazing Procedure and Performance Qualification NB-4522 Valve Seat Rings NB-4523 Reheated Joints NB-4524 Maximum Temperature Limits NB-4530 Fitting and Aligning of Parts to Be Brazed NB-4540 Examination of Brazed Joints	Not addressed by JSME. Not addressed by MITI. Brazing is probably never used in a Class 1 vessel (or any other Class 1 application).	B-1

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-4600 Heat Treatment] [NB-4610 Welding Preheat Requirements] NB-4611 When Preheat Is Necessary	[JSME Rules on Welding, Part 2] Article 3 (5) is equivalent.	A-2
NB-4612 Preheating Methods NB-4613 Interpass Temperature	JSME does not address these general precautions.	B-1
[NB-4620 Postweld Heat Treatment] NB-4621 Heating and Cooling Methods	[JSME Rules on Welding, Part 1] N-1090 is equivalent.	A-2
NB-4622 PWHT Time and Temperature Requirements	[JSME Rules on Welding, Part 1] N-1090 does not specify time-temperature recordings, however those are necessary to evaluate PWHT time and temperature requirements. JSME requires all points on an item being heat treated to be within a 50°C range. For heat treatment at lower temperatures, JSME is less conservative than ASME, resulting in JSME heat treatment times as much as 70% less than those of Table NB-4622.4(c)-1. JSME also permits heat treatment of P-No. 1 materials as much as 60°C lower than does ASME. Based on MITI Ordinance 81. NB-4622.5 requires heat treatment of dissimilar metal welds at the higher of the required temperatures. JSME permits use of either temperature. Based on MITI Ordinance 81. JSME does not address some of the PWHT exemptions in NB-4622, so could be more conservative in this regard. The exemptions would rarely, if ever, be used for a Class 1 vessel.	B-2
NB-4623 PWHT Heating and Cooling Rate Requirements	[JSME Rules on Welding, Part 1] Table 5 is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-4624 Methods of Postweld Heat Treatment	[JSME Rules on Welding, Part 1] Table 5 imposes a maximum limit on furnace temperature (300°C) when an item is inserted. NB-4624 does not have a similar limit, but relies on the heatup rate limitation of NB-4623. JSME requires the temperature-controlled band to include 3T on each side of the weld, where NB-4624 requires the lesser of 1T or 50 mm. Based on MITI Ordinance 81.	B-2
NB-4630 Heat Treatment of Welds Other Than The Final Postweld Heat Treatment	Not specified in JSME, but similar in principle.	B-1
[NB-4650 Heat Treatment After Bending or Forming for Pipes, Pumps and Valves] NB-4651 Conditions Requiring Heat Treatment After Bending or Forming NB-4652 Exemptions From Heat Treatment After Bending or Forming	Not applicable to Class 1 vessels.	B-1
NB-4660 Heat Treatment of Electroslag Welds	The JSME Code does not have provisions for heat treatment of electroslag welds.	B-1
NB-4700 Mechanical Joints NB-4710 Bolting and Threading NB-4711 Thread Engagement NB-4712 Thread Lubricants NB-4713 Removal of Thread Lubricants NB-4720 Bolting Flanged Joints NB-4730 Electrical and Mechanical Penetration Assemblies	The JSME Code does not have requirements for mechanical joints.	B-1
[NB-5100 General Requirements for Examination] [NB-5110 Methods, Nondestructive Examination Procedures and Cleaning] NB-5111 Methods	[JSME Rules on Welding, Part 1] N-1100 is equivalent.	A-2
NB-5112 Nondestructive Examination Procedures	Not addressed by JSME. These provisions are mostly administrative.	B-1

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-5113 Post-Examination Cleaning	Not addressed by JSME, based on the assumption that it will be done properly.	B-1
NB-5120 Time of Examination of Welds and Weld Metal Cladding	Not addressed by JSME. Not required by MITI.	B-1
NB-5130 Examination of Weld Edge Preparation Surfaces	[JSME Rules on Welding, Part 1] N-1030(3), Tables 9 & 10 are more restrictive than NB-5130. They require examination of thinner materials and are generally more restrictive regarding acceptance of linear indications. Based on former METI Ordinance 81.	B-2
NB-5140 Examination of Welds and Adjacent Base Material [NB-5200 Required Examination of Welds for Fabrication and Pre-service Baseline] NB-5210 Category A Vessel Welded Joints and Longitudinal Welded Joints in Other Components [NB-5220 Category B Vessel Welded Joints and Circumferential Welded Joints in Piping, Pumps and Valves] NB-5221 Vessel Welded Joints NB-5222 Piping, Pump and Valve Circumferential Welded Joints [NB-5230 Category C Vessel Welded Joints and Similar Welded Joints in Other Components] NB-5231 General requirements [NB-5240 Category D Vessel Welded Joints and Branch and Piping Connections in Other Components] NB-5241 General Requirements NB-5242 Full Penetration Butt Welded Nozzles, Branch and Piping Connections NB-5243 Corner Welded Nozzles, Branch and Piping Connections NB-5244 Weld metal Buildup at Openings for Nozzles, Branch and Piping Connections NB-5245 Fillet Welded and Partial Penetration Welded Joints	[JSME Rules on Welding, Part 1] Table 2 is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-5246 Oblique Full Penetration Nozzles, Branch and Piping Connections	JSME does not address oblique full-penetration nozzles.	B-1
[NB-5260 Fillet, Partial Penetration, Socket and Attachment Welded Joints] NB-5261 Fillet, Partial Penetration, and Socket Welded Joints NB-5262 Structural Attachment Welded Joints [NB-5270 Special Welded Joints] NB-5271 Welded Joints of Specially Designed Seals NB-5272 Welded Metal Cladding	[JSME Rules on Welding, Part 1] Table 2 is equivalent.	A-2
NB-5273 Hard Surfacing	Not applicable to Class 1 vessels.	B-1
NB-5274 Tube-to-Tubesheet Welded Joints	[JSME Rules on Welding, Part 1] Table 2 is equivalent.	A-2
NB-5275 Brazed Joints	Not applicable to Class 1 vessels.	B-1
NB-5276 Inertia and Continuous Drive Friction Welds NB-5277 Electron Beam Welds NB-5278 Electroslag Welds	Not addressed by JSME.	B-1
NB-5279 Special Exceptions	[JSME Rules on Welding, Part 1] Table 2 specifies similar alternative examination requirements, but for specific weld joint configurations. Based on former MITI Ordinance 81.	B-2
[NB-5280 Preservice Examination] NB-5281 General Requirements NB-5282 Examination Requirements NB-5283 Components Exempt From Preservice Examination	[JSME Rules on Fitness-for- Service, Part I] IA-2100 is equivalent.	A-2
[NB-5300 Acceptance Standards] NB-5320 Radiographic Acceptance Standards	[JSME Rules on Welding, Part 1] Table 7 is slightly more restrictive. Based on MITI Ordinance 81.	B-2
[NB-5330 Ultrasonic Acceptance Standards] NB-5331 Fabrication	[JSME Rules on Welding, Part 1] Table 8 is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-5332 Preservice Examination	The JSME Fitness-for- Service Code requires preservice examination, but that does not have acceptance standards, because the objective of preservice examination is to document the baseline condition, and not to evaluate flaws. This is identical to ASME Section XI, but less restrictive than ASME Section III.	B-1
[NB-5340 Magnetic Particle Acceptance Standards] NB-5341 Evaluation of Indications	[JSME Rules on Welding, Part 1] Table 9 requires use of JIS G 0565. Based on MITI Ordinance 81. Examination methodologies and characterization of indications are equivalent.	B-2
NB-5342 Acceptance Standards	[JSME Rules on Welding, Part 1] Table 9 specifies slightly more restrictive acceptance criteria. Based on MITI Ordinance 81.	B-2
NB-5343 Preservice Examination	See comparison to NB-5332.	B-1
[NB-5350 Liquid Penetrant Acceptance Standards] NB-5351 Evaluation of Indications NB-5352 Acceptance Standards	[JSME Rules on Welding, Part 1] Table 10 specifies slightly more restrictive acceptance criteria. Based on MITI Ordinance 81.	B-2
NB-5353 Preservice Examination	See comparison to NB-5332.	B-1
NB-5360 Eddy Current Preservice Examination of Installed Nonferromagnetic Steam Generator Heat Exchanger Tubing	PVB-2424 specifies acceptance criteria, based on Japanese research results. NB-5360 defers to the Owner.	B-2
NB-5370 Visual Acceptance Standards for Brazed Joints	Not applicable to Class 1 vessels.	B-1
NB-5380 Bubble Formation Testing	PHT-6012 is equivalent.	A-2
[NB-5400 Final Examination of Vessels] NB-5410 Examination After Hydrostatic Test	Not required by JSME. Not required by MITI.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
[NB-5500 Qualifications and Certification of Nondestructive Examination Personnel] NB-5510 General Requirements [NB-5520 Personnel Qualification, Certification and Verification] NB-5521 Qualification Procedure NB-5522 Certification of Personnel NB-5523 Verification of Nondestructive Examination Personnel Certification NB-5530 Records	GTN-2130, 3130, 5140 requirements are similar to applicable portions of ISO-9001. JSME does not address accreditation of fabricators or NDE personnel qualification requirements.	B-1 other than NB-5510 NB-5510: B-2
[NB-6100 GENERAL REQUIREMENTS] [NB-6110 PRESSURE TESTING OF COMPONENTS, APPURTENANCES, AND SYSTEMS]		
NB-6111 Scope of Pressure Testing	PHT-1020 is equivalent.	A-2
NB-6112 Pneumatic Testing NB-6112.1 Pneumatic Test Limitations	PHT-1111.1 does not have the permissive statement of NB-6112.1(b) regarding low-pressure air leak testing.	NB-6112.1(a): A-2 NB-6112.1(b): B-1
NB-6112.2 Precautions to be Employed in Pneumatic Testing	PHT-1111.2 is equivalent.	A-2
NB-6113 Witnessing of Pressure Tests	JSME does not address the ANI.	B-1
NB-6114 Time of Pressure Testing NB-6114.1 System Pressure Test	PHT-1112.1 is equivalent.	A-2
NB-6114.2 Component and Appurtenance Pressure Test	PHT-1112.2 permits substitution of the system pressure test for the component pressure test, without imposing limitations similar to those in NB-6114.2.	B-2
NB-6114.3 Material Pressure Test	PHT-1112.3 is equivalent.	A-2
NB-6115 Machining After Pressure Test	JSME does not address machining after the pressure test.	B-1
[NB-6120 PREPARATION FOR TESTING] NB-6121 Exposure of Joints	PHT-1121 is equivalent.	A-2
NB-6122 Addition of Temporary Supports	PHT-1122 is equivalent.	A-2

Appendix B: JSME vs ASME Comparison Table (cont.)
Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-6123 Restraint or Isolation of Expansion Joints	PHT-1123 is equivalent.	A-2
NB-6124 Isolation of Equipment Not Subjected to Pressure Test	PHT-1124 is equivalent.	A-2
NB-6125 Treatment of Flanged Joints Containing Blanks	PHT-1125 is equivalent.	A-2
NB-6126 Precautions Against Test Medium Expansion	PHT-1126 is equivalent.	A-2
NB-6127 Check of Test Equipment Before Applying Pressure	PHT-1127 is equivalent.	A-2
[NB-6200 HYDROSTATIC TESTS] [NB-6210 HYDROSTATIC TEST PROCEDURE] NB-6211 Venting During Fill Operation	JSME does not address this requirement.	B-1
NB-6212 Test Medium and Test Temperature	Appendix 4-1 contains similar provisions for protection against brittle failure during the hydrostatic test. JSME does not address venting or alternative liquids.	B-1
[NB-6220 HYDROSTATIC TEST PRESSURE REQUIREMENTS] NB-6221 Minimum Hydrostatic Test Pressure	PHT-2111, PHT-2121 are equivalent.	B-2
NB-6222 Maximum Permissible Test Pressure	PHT-2130 requires stress evaluation only if test pressure exceeds 106% of minimum test pressure.	B-2
NB-6223 Hydrostatic Test Pressure Holding Time	PHT-4010 requires 3 minute test for valves vs. 10 minutes of NB-6223.	B-2
NB-6224 Examination for Leakage After Application of Pressure	PHT-5010 does not address use of the ANI, or leakage through temporary seals. Based on MITI Ordinance 81.	B-2
[NB-6300 PNEUMATIC TESTS] [NB-6310 PNEUMATIC TESTING PROCEDURES] NB-6311 General Requirements	References NB-6100.	B-1
NB-6312 Test Medium and Test Temperature	Appendix 4-1 contains similar provisions for protection against brittle failure during the hydrostatic test.	B-1
NB-6313 Procedure for Applying Pressure	Not addressed by JSME.	B-1
[NB-6320 PNEUMATIC TEST PRESSURE REQUIREMENTS] NB-6321 Minimum Required Pneumatic Test Pressure	PHT-2112 is equivalent. PHT-2122 does not have separate provisions for valves.	B-2

Appendix B: JSME vs ASME Comparison Table (cont.)

Summary Table of Difference on Technical Requirements between JSME and ASME

ASME B&PV Code 2007 Edition	JSME Code 2008 Edition	Classification
NB-6322 Maximum Permissible Test Pressure	PHT-2130 requires stress evaluation only if test pressure exceeds 106% of minimum test pressure.	B-2
NB-6323 Test Pressure Holding Time	PHT-4010 requires 3 minute test for valves vs. 10 minutes of NB-6223.	B-2
NB-6324 Examination for Leakage After Application of Pressure	PHT-5010 is equivalent.	B-2
[NB-6400 PRESSURE TEST GAGES] NB-6411 Types of Gages to Be Used and Their Location NB-6412 Range of Indicating Pressure Gages NB-6413 Calibration of Pressure Test Gages	No equivalent JSME requirements; other standards are applied.	B-1
[NB-6600 SPECIAL TEST PRESSURE SITUATIONS] [NB-6610 COMPONENTS DESIGNED FOR EXTERNAL PRESSURE]	PHT-3000, -3010, -3011, -3012, -3020 allow 1.1 DP pneumatic test in lieu of 1.25 DP hydrotest.	B-2
[NB-6620 PRESSURE TESTING OF COMBINATION UNITS] NB-6621 Pressure Chambers Designed to Operate Independently NB-6622 Common Elements Designed for a Maximum Differential Pressure	Not addressed by JSME. Not required by MITI.	B-1
NB-7000 OVERPRESSURE PROTECTION	These requirements are system-related and not related to Class 1 vessels.	–

APPENDIX C: KEPIC VERSUS ASME SECTION III DETAILED COMPARISON TABLE

Appendix C1: KEPIC MNB Versus ASME Section III NB
Appendix C2: KEPIC MNA Versus ASME Section III NCA

Appendix C KEPIC-MNB 2008 2nd Addendum vs. ASME BPVC Sec. III Div.1 NB 2007 edition

ASME paragraphs	Contents	KEPIC paragraphs	Differences	Categorization with comments
NB-1110	ASPECTS OF CONSTRUCTION COVERED BY THESE RULES	MNB 1110	Only numbering system (e.g., NB-1110(a) is same as MNB 1110(1)) through entire MNB	A1 (We will not comment on this difference, hereinafter.)
NB-1120	TEMPERATURE LIMITS	MNB 1120	ASME : the temperature limit in the applicability column shown in Section II, Part D, Subpart 1, Tables 2A, 2B and 4 KEPIC : the temperature limit in the applicability column shown in KEPIC-MDP, Appendices IIA, IIB, and IV (KEPIC-MDP is equivalent to ASME Sec. II Part D) ASME : 700°F (370°C), 800°F (425°C) KEPIC : 700°F (371°C), 800°F (427°C) (Difference of numerical value for SI unit in due to soft conversion policy) ASME : Figs. I-9.2 and I-9.3 KEPIC : <u>KEPIC-MNZ</u> Figs. I-9.2 and I-9.3 (KEPIC-MNZ is equivalent to ASME Sec.III Appendices)	A1 (ASME NB's original reference was substitute with equivalent code or standard such as KEPIC, Korean Law, collective standard, etc. If the substitute has a difference in technical or administrative requirement, we will comment for the difference. However, we will comment to **'Reference Substitution (R/S)'** on this difference, hereinafter.) (KEPIC was applied soft conversion policy between British Unit and SI unit. Therefore we will

				comment to **'Soft Conversion (S/C)'** on this difference, hereinafter. However the values for US Customary Unit are the same as ASME Section III Div.1 NB.)
NB-1131	Boundary of Components	MNB 1131		A1
NB-1132	Boundary Between Components and Attachments	MNB 1132		A1
NB-1132.1	Attachments	MNB 1132.1		A1
NB-1132.2	Jurisdictional Boundary	MNB 1132.2	ASME : Figures NB-1132.2-1 through NB-1132.2-3 KEPIC : Figures MNB 1132.2-1 through MNB 1132.2-4	A1 (It seems to editorial error for figure number)
FIG. NB-1132.2-1	ATTACHMENTS IN THE COMPONENT SUPPORT LOAD PATH THAT DO NOT PERFORM A PRESSURE-RETAINING FUNCTION	FIG MNB 1132.2-1	ASME : NF KEPIC : KEPIC-MNF (KEPIC-MNF is equivalent to ASME Sec.III NF)	A1(R/S)
FIG. NB-1132.2-4	ATTACHMENTS WITHIN THE REACTOR PRESSURE VESSEL (CORE SUPPORT STRUCTURES) THAT DO NOT PERFORM A PRESSURE-RETAINING FUNCTION	FIG MNB 1132.2-4	ASME : NG KEPIC : KEPIC-MNG (KEPIC-MNG is equivalent to ASME Sec.III NG)	A1(R/S)
NB-1140	ELECTRICAL AND MECHANICAL PENETRATION ASSEMBLIES	MNB 1140		A1
NB-	SCOPE OF PRINCIPAL TERMS	MNB	ASME : The term *material* as used in this	A1(R/S)

2110(1)	EMPLOYED (1)	2110(1)	Subsection is defined in NCA-1220. The term *Material Organization* is defined in NCA-9000 KEPIC : The term material as used in this Subsection is defined in KEPIC-MNA 1220. The term Material Organization is defined in MNA 1340	Although KEPIC-MNA is developed equivalently with NCA, there are some different cases from ASME NCA, such as contents. Detailed comparison between ASME NCA and KEPIC-MNA is submitted in 'Comparison Table between ASME Section III NCA (2007) and KEPIC MNA (2008)' in last year.
NB-2110(2)	SCOPE OF PRINCIPAL TERMS EMPLOYED (2)	MNB 2110(2)		A1
NB-2110(3)	SCOPE OF PRINCIPAL TERMS EMPLOYED (3)	MNB 2110(3)		A1(S/C)
NB-2121	Permitted Material Specifications	MNB 2121	ASME : an SFA specification in Section II, Part C, except as otherwise permitted in Section IX KEPIC : a KEPIC-MDW specification in KEPIC-MQ, except as otherwise permitted in KEPIC-MDW (KEPIC-MDW is equivalent to ASME Sec. II, Part C and KEPIC-MQ is equivalent to ASME Sec.IX)	A1(R/S)
NB-2122	Special Requirements Conflicting With Permitted Material Specifications	MNB 2122	ASME : the material specification requirements (NCA-3856) KEPIC : the material specification requirements (KEPIC-MNA 4350)	A1(R/S)

NB-2124	Size Ranges	MNB 2124	ASME : the composition and mechanical properties shown for the nearest specified range (NCA-3856) KEPIC : the composition and mechanical properties shown for the nearest specified range (KEPIC-MNA 4350)	A1(R/S)
NB-2125	Fabricated Hubbed Flanges	MNB 2125	ASME : Appendix XI-3130 KEPIC : KEPIC-MNZ, Appendix XI 3130	A1(R/S) KEPIC MNZ is the subsection for Appendices of KEPIC-MN.
NB-2126.1	Integrally Finned Tubes	MNB 2126.1	ASME : Section II, Part D, Subpart 1, Tables 2A and 2B, and Subpart 2, Tables Y-1, Y-2 and U, KEPIC : KEPIC-MDP, Appendices IIA and IIB, V, VI, and VII	A1(R/S)
NB-2126.2	Welded Finned Tubes	MNB 2126.2		A1(R/S)
NB-2127	Seal Membrane Material	MNB 2127		A1(R/S)
NB-2128	Bolting Material	MNB 2128	ASME : Section II, Part D, Subpart 1, Table 4. Material for nuts shall conform to SA-194 or to the requirements of one of the specifications for nuts or bolting listed in Section II, Part D, Subpart 1, Table 4 KEPIC : KEPIC-MDP, Appendices IV. Material for nuts shall conform to MDF A194 or to the requirements of one of the specifications for nuts or bolting listed in KEPIC-MDP, Appendices IV	A1(R/S)
NB-2130	CERTIFICATION OF MATERIAL	MNB 2130	ASME : All material used in construction of components shall be certified as required in NCA-	A1(R/S)

			3861 and NCA-3862. Certified Material Test Reports are required for pressure-retaining material except as provided by NCA-3861. KEPIC : All material used in construction of components shall be certified as required in KEPIC-MNA 4390, MNA 6410, MNA 6420 and MNA 6430. Certified Material Test Reports are required for pressure-retaining material except as provided by MNA 4390.	
NB-2140	WELDING MATERIAL	MNB 2140		A1
NB-2150	MATERIAL IDENTIFICATION	MNB 2150	ASME : the requirements of NCA-3856 KEPIC : the requirements of KEPIC-MNA 4350	A1(R/S)
NB-2160	DETERIORATION OF MATERIAL IN SERVICE	MNB 2160	ASME : It is the responsibility of the Owner to select material suitable for the conditions stated in the Design Specifications (NCA-3250), KEPIC : It is the responsibility of the Owner to select material suitable for the conditions stated in the Design Specifications (KEPIC-MNA 3240 and MNA 6110), ASME : Any special requirement shall be specified in the Design Specifications (NCA-3252 and NB-3124). KEPIC : Any special requirement shall be	A1(R/S) The Contents of NCA-3250 is separated with KEPIC-MNA 3240 and 6110, and the requirements for Div.2 of NCA are separated to KEPIC-SNA which is the subsection of general requirements for Concrete Containment. A1(R/S)

			specified in the Design Specifications (KEPIC-MNA 6111 and MNB 3124).	
NB-2170	Seal Membrane Material	MNB 2170		A1(S/C)
NB-2180	PROCEDURES FOR HEAT TREATMENT OF MATERIAL	MNB 2180		A1
NB-2190	NONPRESSURE-RETAINING MATERIAL	MNB 2190	ASME : SA-6 KEPIC : MDF A 6	A1(R/S)
NB-2211	Test Coupon Heat Treatment for Ferritic Material	MNB 2211		A1(S/C)
NB-2212.1	Cooling Rates	MNB 2212.1		A1
NB-2212.2	General Procedures	MNB 2212.2		A1
NB-2221	General Requirements	MNB 2221		A1
NB-2222.1	Number of Tension Test Coupons	MNB 2222.1	ASME : SA-20, except that from carbon steel plates weighing 42,000 lb (19,000 kg) and over and alloy steel plates weighing 40,000 lb (18,000 kg) KEPIC : MDF A 20, except that from carbon steel plates weighing 42,000 lb (19,051 kg) and over and alloy steel plates weighing 40,000 lb (18,144 kg)	A1(R/S, S/C)
NB-2222.2	Orientation and Location of Coupons	MNB 2222.2		A1
NB-2222.3	Requirements for Separate Test Coupons	MNB 2222.3		A1
NB-2223.1	Location of Coupons	MNB 2223.1		A1
NB-2223.2	Very Thick and Complex Forgings	MNB 2223.2		A1

NB-2223.3	Coupons From Separately Produced Test Forgings	MNB 2223.3		A1
NB-2223.4	Test Specimens for Forgings	MNB 2223.4		A1
NB-2224	Bar and Bolting Material	MNB 2224		A1
NB-2225.1	Location of Coupons	MNB 2225.1		A1
NB-2225.2	Separately Produced Coupons Representing Fittings	MNB 2225.2		A1
NB-2226	Tensile Test Specimen Location (for Quenched and Tempered Ferritic Steel Castings)	MNB 2226		A1(S/C)
NB-2311	Material for Which Impact Testing Is Required	MNB 2311		A1(S/C)
NB-2321.1	Drop Weight Tests	MNB 2321.1		A1
NB-2321.2	Charpy V-Notch Tests	MNB 2321.2	ASME : SA-370 KEPIC : KEPIC-MDF A 370	A1(R/S)
NB-2322.1	Location of Test Specimens	MNB 2322.1		A1
NB-2322.2	Orientation of Impact Test Specimens	MNB 2322.2		A1
NB-2331	Material for Vessels	MNB 2331	ASME : Section XI KEPIC : KEPIC-MI (KEPIC-MI is equivalent to ASME section XI in the case of this requirement. For reference, KEPIC-MI selectively adopted the requirements for PWR and the Examination Category B of ASME Sec. XI. Furthermore, IWP and IWW of	A1(R/S)

			ASME Sec. XI Div.1 are excluded from KEPIC-MI.)	
NB-2332	Material for Piping, Pumps, and Valves, Excluding Bolting Material	MNB 2332		A1
NB-2333	Bolting Material	MNB 2333		A1
NB-2341	Plates	MNB 2341		A1
NB-2342	Forgings and Castings	MNB 2342		A1(S/C)
NB-2343	Bars	MNB 2343		A1(S/C)
NB-2344	Tubular Products and Fittings	MNB 2344		A1
NB-2345	Bolting Material	MNB 2345		A1(S/C)
NB-2346	Test Definitions	MNB 2346		A1
NB-2350	RETESTS	MNB 2350		A1(S/C)
NB-2360(1)	CALIBRATION OF INSTRUMENTS AND EQUIPMENT (1)	MNB 2360(1)	ASME : the requirements of NCA-3858.2 KEPIC : the requirements of KEPIC-MNA 4370	A1(R/S)
NB-2360(2)	CALIBRATION OF INSTRUMENTS AND EQUIPMENT (2)	MNB 2360(2)	ASME : Cv impact test machines shall be calibrated and the results recorded to meet the requirements of NCA-3858.2. The calibrations shall be performed using the frequency and methods outlined in ASTM E 23-02a and employing standard specimens obtained from the National Institute of Standards and Technology. KEPIC : Cv impact test machines shall be calibrated and the results recorded to meet the requirements of KEPIC-MNA 4370. The calibrations shall be performed using the	B2 KASTO 93-21102-094 (Charpy Impact Tester for Metals) is equivalent to ASTM E23-93. KASTO means Korea Association of Standards & Testing Organization based on the Korean Law. KRISS uses standard

			frequency and methods outlined in KASTO 93-21102-094 and employing standard specimens obtained from the Korea Research Institute of Standards and Science (KRISS).	specimens purchased from NIST. For reference, the calibration procedure of KRISS is developed under ISO quality assurance system and is based on the ASTM E23 but, the requirements are defined more tightly than requirements of ASTM E23.
NB-2410	GENERAL REQUIREMENTS	MNB 2410	ASME : Section IX, SFA specification KEPIC : KEPIC-MQ, KEPIC-MDW	A1(R/S)
NB-2420	REQUIRED TESTS	MNB 2420	ASME : Section IX, QW-492, SFA or user’s material specification KEPIC : KEPIC-MQW 1720, KEPIC-MDW or user's material specification	A1(R/S, S/C)
NB-2431	Mechanical Properties Test	MNB 2431		A1
NB-2431.1	General Test Requirements	MNB 2431.1	ASME : Section IX, QW-403.1 or QW-403.4, SFA-5.1 KEPIC : KEPIC-MQW 2822.1 or MQW 2822.4, KEPIC-MDW 5.1	A1(R/S)
NB-2431.2	Standard Test Requirements	MNB 2431.2	ASME : SFA-5.1 or SFA-5.5, SFA Specification KEPIC : KEPIC-MDW 5.1 or MDW 5.5, KEPIC-MDW	A1(R/S)
NB-2432	Chemical Analysis Test	MNB 2432		A1

NB-2432.1	Test Method	MNB 2432.1	ASME : SFA Specification, Section IX, QW-214.1, QW-453 and QW-462.5(a) KEPIC : KEPIC-MDW, KEPIC-MQW 2740(1), Table MQW 2740 and FIG. MQW 2740-1	A1(R/S)
NB-2432.2	Requirements for Chemical Analysis	MNB 2432.2	ASME : Section IX, QW-442, SFA or other referenced welding material specifications KEPIC : KEPIC-MQW 2330, KEPIC-MDW or other referenced welding material specifications ASME : The results of the chemical analysis shall be reported in accordance with NCA-3867 KEPIC : The results of the chemical analysis shall be reported in accordance with KEPIC-MNA 4370	A1(R/S)
NB-2433	Delta Ferrite Determination	MNB 2433	ASME : Section IX, QW-442, SFA-5.9 and SFA-5.4, KEPIC : KEPIC-MQW 2330, KEPIC-MDW 5.9 and MDW-5.4	A1(R/S)
NB-2433.1	Method	MNB 2433.1		A1
NB-2433.2	Acceptance Standards	MNB 2433.2		A1
NB-2440	STORAGE AND HANDLING OF WELDING MATERIAL	MNB 2440		A1
NB-2510	EXAMINATION OF PRESSURERETAINING MATERIAL	MNB 2510		A1
NB-2520	EXAMINATION AFTER QUENCHING AND TEMPERING	MNB 2520		A1

NB-2531	Required Examination	MNB 2531		A1(S/C)
NB-2532.1	Straight Beam Examination	MNB 2532.1	ASME : Section V, SA-578, 3 in. (75 mm) KEPIC : KEPIC-MEN, KEPIC-MEN 3204, 3 in. (76.2 mm) KEPIC-MEN is technically equivalent to ASME Section V but, its composition of contents is different from the general requirement & the specific standards of section V. KEPIC-MEN, unlike ASME, is composited as the categorization based on the NDE method. Moreover, some articles of ASME Section V are not adopted in KEPIC. However, KEPIC-MEN 2010 ed. will be published as the same structure with ASME Section V. (See the '**KEPIC-MEN vs ASME Sec V.doc**' file, for detailed comparison of KEPIC-MEN with ASME Section V. In general requirements, KEPIC-MEN demands the national license based on the Korean law in addition to the requirement of ASME Section V for NDE personnel.)	A1(S/C, R/S)
NB-2532.2	Angle Beam Examination	MNB 2532.2	ASME : Section V SA-577 KEPIC : KEPIC-MEN 3203	A1(R/S)
NB-2537	Time of Examination	MNB 2537		A1(S/C)
NB-2538	Elimination of Surface Defects	MNB 2538		A1
NB-2539	Repair by Welding	MNB 2539		A1

NB-2539.1	Defect Removal	MNB 2539.1		A1
NB-2539.2	Qualification of Welding Procedures and Welders	MNB 2539.2	ASME : Section IX KEPIC : KEPIC-MQW	A1(R/S)
NB-2539.3	Blending of Repaired Areas	MNB 2539.3		A1
NB-2539.4	Examination of Repair Welds	MNB 2539.4		A1
NB-2539.5	Heat Treatment After Repairs	MNB 2539.5		A1
NB-2539.6	Material Report Describing Defects and Repairs	MNB 2539.6		A1
NB-2539.7	Repair of Cladding by Welding	MNB 2539.7		A1(R/S)
NB-2541	Required Examinations	MNB 2541	ASME : Section V, Article 2 KEPIC : KEPIC-MEN 2101	A1(R/S)
NB-2542.1	Examination Procedure	MNB 2542.1	ASME : Article 5 of Section V KEPIC : KEPIC-MEN 3101	A1(R/S)
NB-2542.2	Acceptance Standards	MNB 2542.2		A1(S/C)
NB-2545.1	Examination Procedure	MNB 2545.1	ASME : Article 7, Section V KEPIC : KEPIC-MEN 5101	A1(R/S)
NB-2545.2	Evaluation of Indications	MNB 2545.2		A1
NB-2545.3	Acceptance Standards	MNB 2545.3		A1(S/C)
NB-2546.1	Examination Procedure	MNB 2546.1	ASME : Section V, Article 6 KEPIC : KEPIC-MEN 4101	A1(R/S)
NB-2546.2	Evaluation of Indications	MNB 2546.2		A1

NB-2546.3	Acceptance Standards	MNB 2546.3		A1(S/C)
NB-2547	Time of Examination	MNB 2547		A1(S/C)
NB-2548	Elimination of Surface Defects	MNB 2548		A1
NB-2549	Repair by Welding	MNB 2549		A1
NB-2551	Required Examination	MNB 2551		A1(S/C)
NB-2552	Ultrasonic Examination	MNB 2552	ASME : SE-213, SA-388 KEPIC : KEPIC-MEN 3208, KEPIC-MEN 3201	A1(R/S, S/C)
NB-2553	Radiographic Examination	MNB 2553	ASME : Article 2 of Section V KEPIC : KEPIC-MEN 2101	A1(R/S)
NB-2554	Eddy Current Examination	MNB 2554	ASME : SE-426 or SE-571 KEPIC : KEPIC-MEN 6202 or ASME Sec.V SE-571	A1 (R/S, S/C) KEPIC-MEN was not developed for Sec.V SE-571
NB-2555	Magnetic Particle Examination	MNB 2555		A1
NB-2556	Liquid Penetrant Examination	MNB 2556		A1
NB-2557	Time of Examination	MNB 2557		A1(R/S, S/C)
NB-2558	Elimination of Surface Defects	MNB 2558		A1
NB-2559	Repair by Welding	MNB 2559		A1
NB-2561	Required Examinations	MNB 2561	ASME : SA-358, SA-409, SA-671, SA-672, and SA-691, and fittings made in accordance with the WPW grades of SA-234, SA-403, and SA- 420, which are made by welding with filler metal, shall be treated as material; however, inspection by an Inspector and stamping with an NPT symbol shall	A1 for R/S A2 for code symbol (KEPIC has different code

			be in accordance with Section III requirements. In addition to the NPT symbol, a numeral 1 shall be stamped below and outside the official Code Symbol. KEPIC : KEPIC-MDF A 358, A 671, A 672, and A 691, and fittings made in accordance with the WPW grades of KEPIC-MDF A 234, A 403, and A 420, which are made by welding with filler metal, shall be treated as material; however, inspection by an Inspector and stamping with an KEPIC Symbol shall be in accordance with KEPIC-MN requirements.	symbol system with ASME symbol. See the previous documents submitted in 2009)
NB-2562	Ultrasonic Examination	MNB 2562		A1
NB-2563	Radiographic Examination	MNB 2563		A1
NB-2565	Magnetic Particle Examination	MNB 2565		A1
NB-2566	Liquid Penetrant Examination	MNB 2566		A1
NB-2567	Time of Examination	MNB 2567		A1(R/S)
NB-2568	Elimination of Surface Defects	MNB 2568		A1
NB-2569	Repair by Welding	MNB 2569		A1
NB-2570	EXAMINATION AND REPAIR OF STATICALLY AND CENTRIFUGALLY CAST PRODUCTS	MNB 2570		A1
NB-2571	Required Examination	MNB 2571		A1
NB-2572.1	Acceptance Examinations	MNB 2572.1		A1(S/C, R/S)
NB-2573	Provisions for Repair of Base Material by Welding	MNB 2573		A1

NB-2573.1	Defect Removal	MNB 2573.1		A1
NB-2573.2	Repair by Welding	MNB 2573.2		A1
NB-2573.3	Qualification of Welding Procedures and Welders	MNB 2573.3		A1(R/S)
NB-2573.4	Blending of Repaired Areas	MNB 2573.4		A1
NB-2573.5	Examination of Repair Welds	MNB 2573.5		A1
NB-2573.6	Heat Treatment After Repairs	MNB 2573.6		A1
NB-2573.7	Elimination of Surface Defects	MNB 2573.7		A1
NB-2573.8	Material Report Describing Defects and Repairs	MNB 2573.8		A1
NB-2574	Ultrasonic Examination of Ferritic Steel Castings	MNB 2574	ASME : T-571.4 of Article 5 of Section V KEPIC : 7.1.4 of KEPIC-MEN 3102	A1(R/S)
NB-2574.1	Acceptance Standards	MNB 2574.1	ASME : SA-609 in Section V KEPIC : KEPIC-MEN 3205	A1(R/S, S/C)
NB-2575.1	Examination	MNB 2575.1		A1
NB-2575.2	Extent	MNB 2575.2		A1
NB-2575.3	Examination Procedure	MNB 2575.3	ASME : Article 2 of Section V, T-274 and T-285 of Article 2 of Section V, SE-142, SE-94 KEPIC : KEPIC-MEN 2101, KEPIC-MEN 2101, 7.4 and 8.5, KEPIC-MEN 2202, KEPIC-MEN 2201	A1(R/S)
NB-2575.4	Procedure Requirements	MNB 2575.4		A1
NB-2575.5	Radiographic Setup Information	MNB 2575.5		

NB-2575.6	Acceptance Criteria	MNB 2575.6		A1(S/C)
NB-2576	Liquid Penetrant Examination	MNB 2576		A1(R/S, S/C)
NB-2577	Magnetic Particle Examination (for Ferritic Steel Products Only)	MNB 2577		A1(R/S, S/C)
NB-2581	Required Examination	MNB 2581		A1(S/C)
NB-2582	Visual Examination	MNB 2582		A1
NB-2583.1	Examination Procedure	MNB 2583.1		A1
NB-2583.2	Evaluation of Indications	MNB 2583.2		A1(S/C)
NB-2583.3	Acceptance Standard	MNB 2583.3		A1
NB-2584.1	Examination Procedure	MNB 2584.1	ASME : Article 6, Section V KEPIC : KEPIC-MEN 4101	A1(R/S)
NB-2584.2	Evaluation of Indications	MNB 2584.2		A1(S/C)
NB-2584.3	Acceptance Standard	MNB 2584.3		A1
NB-2585	Ultrasonic Examination for Sizes Greater Than 2 in. (50 mm)	MNB 2585		A1(S/C)
NB-2585.1	Ultrasonic Method	MNB 2585.1	ASME : SA-388 of Article 23 of Section V KEPIC : KEPIC-MEN 3201	A1(R/S)
NB-2585.2	Examination Procedure	MNB 2585.2		A1(S/C)
NB-2585.3	Calibration of Equipment	MNB 2585.3		A1
NB-2585.4	Acceptance Standard	MNB 2585.4		A1

NB-2586	Ultrasonic Examination for Sizes Over 4 in. (100 mm)	MNB 2586		A1(S/C)
NB-2586.1	Ultrasonic Method	MNB 2586.1		A1
NB-2586.2	Examination Procedure	MNB 2586.2		A1
NB-2586.3	Calibration of Equipment	MNB 2586.3		A1(S/C)
NB-2586.4	Acceptance Standard	MNB 2586.4		A1
NB-2587	Time of Examination	MNB 2587		A1
NB-2588	Elimination of Surface Defects	MNB 2588		A1
NB-2589	Repair by Welding	MNB 2589		A1
NB-2610	DOCUMENTATION AND MAINTENANCE OF QUALITY SYSTEM PROGRAMS	MNB 2610	ASME : Material Organizations shall have a Quality System Program or an Identification and Verification Program, as applicable, which meets the requirements of NCA-3800 KEPIC : Material Organizations shall have a Quality System Program or an Identification and Verification Program, as applicable, which meets the requirements of KEPIC-MNA 3500 and MNA 4300 ASME : requirements of NCA-3862 and NCA-3856 KEPIC : requirements of KEPIC-MNA 6420 and MNA 4350	B1 for the Remarks A1 for S/C

			Remarks : For NCA-3841, the requirements are identical except for the substitution of the Society to KEA. For NCA-3855, Instead of alternative requirement for testing and calibration laboratory in NCA-3855.3(c), KEPIC uses the organization accredited by Korea Laboratory Accreditation Scheme (KOLAS) in accordance with ISO/IEC 17025, which is not required to survey or audit. This requirement is described in MNA 3732(3). The others are identical.	
NB-2700	DIMENSIONAL STANDARDS	MNB 2700		A1
NB-3111	Loading Conditions	MNB 3111		A1
NB-3112	Design Loadings	MNB 3112	ASME : The Design Loadings shall be established in accordance with NCA-2142.1 ~ KEPIC : The Design Loadings shall be established in accordance with KEPIC-MNA 2321.1 ~	A1(R/S)
NB-3112.1	Design Pressure	MNB 3112.1	ASME : NCA-2142.1 (a) KEPIC : KEPIC-MNA 2321.1 (1)	A1(R/S)
NB-3112.2	Design Temperature	MNB 3112.2	ASME : NCA-2142.1 (b) KEPIC : KEPIC-MNA 2321.1 (2)	A1(R/S)
NB-3112.3	Design Mechanical Loads	MNB 3112.3	ASME : NCA-2142.1 (c) KEPIC : KEPIC-MNA 2321.1 (3)	A1(R/S)
NB-3112.4	Design Stress Intensity Values	MNB 3112.4		A1(R/S)
NB-3113	Service Conditions	MNB 3113	ASME : NCA-2142, NCA-2142.4(b), Figs. I-9.0	A1(R/S)

			KEPIC : KEPIC-MNA 2320, KEPIC-MNA 2322.2, KEPIC-MNZ Figs. I-9.0	
NB-3121	Corrosion	MNB 3121		A1(R/S)
NB-3122	Cladding	MNB 3122		A1(R/S)
NB-3122.1	Primary Stresses	MNB 3122.1		A1
NB-3122.2	Design Dimensions	MNB 3122.2		A1
NB-3122.3	Secondary and Peak Stresses	MNB 3122.3		A1
NB-3122.4	Bearing Stresses	MNB 3122.4		A1
NB-3123.1	Dissimilar Welds	MNB 3123.1		A1
NB-3123.2	Fillet Welded Attachments	MNB 3123.2		A1
NB-3124	Environmental Effects	MNB 3124		A1
NB-3125	Configuration	MNB 3125		A1(R/S)
NB-3131	Scope	MNB 3131		A1
NB-3132	Dimensional Standards for Standard Products	MNB 3132		A1
NB-3133.1	General	MNB 3133.1		A1(R/S)
Table NB-3132-1	DIMENSIONAL STANDARDS	Table MNB 3132	ASME : ASME B16.34a-1998, SA or SB Material KEPIC : KEPIC-MGG(2001), MDF or MDN Material (KEPIC-MGG 2001 addendum is equivalent to ASME B16.34a-1998. KEPIC-MGG is technically identical but, its composition is modified.	A1(R/S)

			However KEPIC-MGG 2010 edition will be published identically to have the same composition with ASME B16.34.)	
NB-3133.2	Nomenclature	MNB 3133.2	ASME : Section II, Part D, Subpart 1, Tables 2A and 2B, Table Y-1 KEPIC : KEPIC-MDP, Appendices ⅡA and ⅡB, Appendices Ⅵ (For reference, KEPIC-MDP adopted ASME Section II, Part D except Subpart 2.)	A1(R/S)
NB-3133.3	Cylindrical Shells and Tubular Products	MNB 3133.3		A1(R/S)
NB-3133.4	Spherical Shells	MNB 3133.4		A1(R/S)
NB-3133.5	Stiffening Rings for Cylindrical Shells	MNB 3133.5		A1(R/S)
NB-3133.6	Cylinders Under Axial Compression	MNB 3133.6		A1(R/S)
NB-3134	Leak Tightness	MNB 3134		A1
NB-3135	Attachments	MNB 3135		A1(R/S)
NB-3136	Appurtenances	MNB 3136		A1(R/S)
NB-3137	Reinforcement for Openings	MNB 3137		A1
NB-3211	Requirements for Acceptability	MNB 3211		A1(R/S)
NB-3212	Basis for Determining Stresses	MNB 3212		A1
NB-3213	Terms Relating to Stress Analysis	MNB 3213		A1
NB-3213.1	Stress Intensity	MNB 3213.1		A1

NB-3213.2	Gross Structural Discontinuity	MNB 3213.2		A1
NB-3213.3	Local Structural Discontinuity	MNB 3213.3		A1
NB-3213.4	Normal Stress	MNB 3213.4		A1
NB-3213.5	Shear Stress	MNB 3213.5		A1
NB-3213.6	Membrane Stress	MNB 3213.6		A1
NB-3213.7	Bending Stress	MNB 3213.7		A1
NB-3213.8	Primary Stress	MNB 3213.8		A1
NB-3213.9	Secondary Stress	MNB 3213.9		A1
NB-3213.10	Local Primary Membrane Stress	MNB 3213.10		A1
NB-3213.11	Peak Stress	MNB 3213.11		A1
NB-3213.12	Load Controlled Stresses	MNB 3213.12		A1
NB-3213.13	Thermal Stress	MNB 3213.13		A1
NB-3213.14	Total Stress	MNB 3213.14		A1
NB-3213.15	Operational Cycle	MNB 3213.15		A1
NB-3213.16	Stress Cycle	MNB 3213.16		A1
NB-3213.17	Fatigue Strength Reduction Factor	MNB 3213.17		A1

NB-3213.18	Free End Displacement	MNB 3213.18		A1
NB-3213.19	Expansion Stresses	MNB 3213.19		A1
NB-3213.20	Deformation	MNB 3213.20		A1
NB-3213.21	Inelasticity	MNB 3213.21		A1
NB-3213.22	Creep	MNB 3213.22		A1
NB-3213.23	Plasticity	MNB 3213.23		A1
NB-3213.24	Plastic Analysis	MNB 3213.24		A1
NB-3213.25	Plastic Analysis — Collapse Load	MNB 3213.25		A1
NB-3213.26	Plastic Instability Load	MNB 3213.26		A1
NB-3213.27	Limit Analysis	MNB 3213.27		A1
NB-3213.28	Limit Analysis — Collapse Load	MNB 3213.28		A1
NB-3213.29	Collapse Load — Lower Bound	MNB 3213.29		A1
NB-3213.30	Plastic Hinge	MNB 3213.30		A1

NB-3213.31	Strain Limiting Load	MNB 3213.31		A1
NB-3213.32	Test Collapse Load	MNB 3213.32		A1
NB-3213.33	Ratcheting	MNB 3213.33		A1
NB-3213.34	Shakedown	MNB 3213.34		A1
NB-3213.35	Reversing Dynamic Loads	MNB 3213.35		A1
NB-3213.36	Non-reversing Dynamic Loads	MNB 3213.36		A1
NB-3214	Stress Analysis	MNB 3214		A1
NB-3215	Derivation of Stress Intensities	MNB 3215		A1
NB-3216	Derivation of Stress Differences	MNB 3216		A1
NB-3216.1	Constant Principal Stress Direction	MNB 3216.1		A1
NB-3216.2	Varying Principal Stress Direction	MNB 3216.2		A1
NB-3217	Classification of Stresses	MNB 3217		A1
NB-3221	Design Loadings	MNB 3221		A1
NB-3221.1	General Primary Membrane Stress Intensity	MNB 3221.1		A1
NB-3221.2	Local Membrane Stress Intensity	MNB 3221.2		A1
NB-3221.3	Primary Membrane (General or Local) Plus Primary Bending Stress Intensity	MNB 3221.3		A1

NB-3221.4	External Pressure	MNB 3221.4		A1
NB-3222	Level A Service Limits	MNB 3222	ASME : NCA-2142.4(b)(1) KEPIC : KEPIC-NNA 2322.2(1) KEPIC-MNA 2300 is identical to ASME NCA-2140, except for addition of the requirements for Division 3 items, and separation of the requirements for Concrete Containments to KEPIC-SNA.	A1(R/S)
NB-3222.1	Primary Membrane and Bending Stress Intensities	MNB 3222.1		A1
NB-3222.2	Primary Plus Secondary Stress Intensity	MNB 3222.2		A1
NB-3222.3	Expansion Stress Intensity	MNB 3222.3		A1
NB-3222.4	Analysis for Cyclic Operation	MNB 3222.4		A1(R/S)
NB-3222.5	Thermal Stress Ratchet	MNB 3222.5		A1
NB-3222.6	Deformation Limits	MNB 3222.6		A1
NB-3223	Level B Service Limits	MNB 3223		A1
NB-3224	Level C Service Limits	MNB 3224		A1
NB-3224.1	Primary Stress Limits	MNB 3224.1		A1
NB-3224.2	External Pressure	MNB 3224.2		A1
NB-3224.3	Special Stress Limits	MNB 3224.3		A1
NB-3224.4	Secondary and Peak Stresses	MNB 3224.4		A1
NB-3224.5	Fatigue Requirements	MNB 3224.5		A1

NB-3224.6	Deformation Limits	MNB 3224.6		A1
NB-3224.7	Piping Requirements	MNB 3224.7		A1
NB-3225	Level D Service Limits	MNB 3225	ASME: NCA-2142(b)(4) KEPIC : KEPIC-MNA 2322.2(4)	A1(R/S)
NB-3226	Testing Limits	MNB 3226		A1(R/S)
NB-3227	Special Stress Limits	MNB 3227		A1
NB-3227.1	Bearing Loads	MNB 3227.1		A1
NB-3227.2	Pure Shear	MNB 3227.2		A1
NB-3227.3	Progressive Distortion of Non-integral Connections	MNB 3227.3		A1(R/S)
NB-3227.4	Triaxial Stresses	MNB 3227.4		A1
NB-3227.5	Nozzle Piping Transition	MNB 3227.5		A1
NB-3227.6	Applications of Elastic Analysis for Stresses Beyond the Yield Strength	MNB 3227.6		A1
NB-3227.7	Requirements for Specially Designed Welded Seals	MNB 3227.7		A1
NB-3228	Applications of Plastic Analysis	MNB 3228		A1
NB-3228.1	Limit Analysis	MNB 3228.1		A1(R/S)
NB-3228.2	Experimental Analysis.	MNB 3228.2		A1
NB-3228.3	Plastic Analysis	MNB 3228.3		A1
NB-3228.4	Shakedown Analysis	MNB 3228.4		A1(R/S)
NB-3228.5	Simplified Elastic–Plastic Analysis	MNB 3228.5		A1

NB-3229	Design Stress Values	MNB 3229		A1(R/S)
NB-3231	Design Conditions	MNB 3231		A1(R/S)
NB-3232	Level A Service Limits	MNB 3232		A1(R/S)
NB-3232.1	Average Stress	MNB 3232.1		A1(R/S)
NB-3232.2	Maximum Stress	MNB 3232.2		A1(R/S)
NB-3232.3	Fatigue Analysis of Bolts	MNB 3232.3		A1(R/S, S/C)
NB-3233	Level B Service Limits	MNB 3233		A1
NB-3234	Level C Service Limits	MNB 3234		A1
NB-3235	Level D Service Limits	MNB 3235		A1(R/S)
NB-3236	Design Stress Intensity Values	MNB 3236		A1(R/S)
NB-3311	Acceptability	MNB 3311		A1
NB-3321	Design and Service Loadings	MNB 3321		A1
NB-3322	Special Considerations	MNB 3322		A1
NB-3323	General Design Rules	MNB 3323		A1
NB-3324	Tentative Pressure Thickness	MNB 3324		A1(R/S)
NB-3324.1	Cylindrical Shells	MNB 3324.1		A1
NB-3324.2	Spherical Shells	MNB 3324.2		A1
NB-3331	General Requirements for Openings	MNB 3331		A1
NB-3332.1	Openings Not Requiring Reinforcement	MNB 3332.1		A1
NB-3332.2	Required Area of Reinforcement	MNB 3332.2		A1

NB-3333	Reinforcement Required for Openings in Flat Heads	MNB 3333		A1
NB-3334	Limits of Reinforcement	MNB 3334		A1
NB-3334.1	Limit of Reinforcement Along the Vessel Wall	MNB 3334.1		A1
NB-3334.2	Limit of Reinforcement Normal to the Vessel Wall	MNB 3334.2		A1
NB-3335	Metal Available for Reinforcement	MNB 3335		A1
NB-3336	Strength of Reinforcing Material	MNB 3336		A1
NB-3337.1	General Requirements	MNB 3337.1		A1
NB-3337.2	Full Penetration Welded Nozzles	MNB 3337.2		A1
NB-3337.3	Partial Penetration Welded Nozzles	MNB 3337.3		A1(S/C)
NB-3338.1	General	MNB 3338.1		A1
NB-3338.2	Stress Index Method	MNB 3338.2		A1
NB-3339	Alternative Rules for Nozzle Design	MNB 3339		A1
NB-3339.1	Limitations	MNB 3339.1		A1
NB-3339.2	Nomenclature	MNB 3339.2		A1
NB-3339.3	Required Reinforcement Area	MNB 3339.3		A1
NB-3339.4	Limits of Reinforcing Zone	MNB 3339.4		A1
NB-3339.5	Strength of Reinforcing Material Requirements	MNB 3339.5		A1
NB-3339.6	Transition Details	MNB 3339.6		A1

NB-3339.7	Stress Indices	MNB 3339.7		A1
NB-3340	ANALYSIS OF VESSELS	MNB 3340		A1
NB-3351	Welded Joint Category	MNB 3351		A1
NB-3351.1	Category A	MNB 335.1		A1
NB-3351.2	Category B	MNB 3351.2		A1
NB-3351.3	Category C	MNB 3351.3		A1
NB-3351.4	Category D	MNB 3351.4		A1
NB-3352	Permissible Types of Welded Joints	MNB 3352		A1
NB-3352.1	Joints of Category A	MNB 3352.1		A1
NB-3352.2	Joints of Category B	MNB 3352.2		A1
NB-3352.3	Joints of Category C	MNB 3352.3		A1
NB-3352.4	Joints of Category D	MNB 3352.4		A1
NB-3354	Structural Attachment Welds	MNB 3354		A1
NB-3355	Welding Grooves	MNB 3355		A1
NB-3357	Thermal Treatment	MNB 3357		A1
NB-3361	Category A or B Joints Between Sections of Unequal Thickness	MNB 3361		A1
NB-3362	Bolted Flange Connections	MNB 3362		A1
NB-3363	Access Openings	MNB 3363		A1
NB-3364	Attachments	MNB 3364		A1
NB-3365	Supports	MNB 3365	ASME : NCA-3240	A1(R/S)

			KEPIC : KEPIC-MNA 3230	
NB-3411.1	Applicability	MNB 3411.1		A1
NB-3411.2	Exemptions	MNB 3411.2		A1(R/S)
NB-3412.1	Acceptability of Large Pumps	MNB 3412.1		A1
NB-3412.2	Acceptability of Small Pumps	MNB 3412.2		A1
NB-3414	Design and Service Conditions	MNB 3414		A1
NB-3415	Loads From Connected Piping	MNB 3415		A1
NB-3417	Earthquake Loadings	MNB 3417		A1
NB-3418	Corrosion	MNB 3418		A1
NB-3419	Cladding	MNB 3419		A1
NB-3421	Radially Split Casing	MNB 3421		A1
NB-3422	Axially Split Casing	MNB 3422		A1
NB-3423	Single and Double Volute Casings	MNB 3423		A1
NB-3424	Seal Housing	MNB 3424		A1
NB-3425	Typical Examples of Pump Types	MNB 3425		A1
NB-3431	Design of Welding	MNB 3431		A1
NB-3432	Cutwater Tip Stresses	MNB 3432		A1
NB-3433.1	Axially Oriented Inlets and Outlets	MNB 3433.1		A1
NB-3433.2	Radially Oriented Inlets and Outlets	MNB 3433.2		A1
NB-3433.3	Tangential Inlets and Outlets	MNB 3433.3		A1

NB-3433.4	Minimum Inlet and Outlet Wall Thicknesses	MNB 3433.4		A1
NB-3434	Bolting	MNB 3434		A1
NB-3435.1	Piping Under External Pressure	MNB 3435.1		A1
NB-3435.2	Piping Under Internal Pressure	MNB 3435.2		A1
NB-3436	Attachments	MNB 3436		A1
NB-3437	Pump Covers	MNB 3437		A1
NB-3438	Supports	MNB 3438		A1(R/S)
NB-3441.1	Design of Type A Pumps	MNB 3441.1		A1
NB-3441.2	Design of Type B Pumps	MNB 3441.2		A1
NB-3441.3	Design of Type C Pumps	MNB 3441.3		A1
NB-3441.4	Design of Type D Pumps	MNB 3441.4		A1
NB-3441.5	Design of Type E Pumps	MNB 3441.5		A1
NB-3441.6	Design of Type F Pumps	MNB 3441.6		A1
NB-3442	Special Pump Types — Type J Pumps	MNB 3442		A1
NB-3511	General Requirements	MNB 3511	ASME : NCA-3254 KEPIC : KEPIC-MNA 6112 (KEPIC MNA 6112 is identical to ASME NCA-3254 except the requirements for Division 2 are separated to KEPIC-SNA.)	A1(R/S)
NB-3512	Acceptability of Large Valves	MNB 3512		A1

NB-3512.1	Standard Design Rules	MNB 3512.1		A1
NB-3512.2	Alternative Design Rules	MNB 3512.2	ASME : NCA-3252(a)(6) KEPIC : KEPIC-MNA 6111.(6) KEPIC-MNA 6111 is identical to ASME NCA-3252(a) except additional fracture mechanics data is not contained in the contents.	A1(R/S)
NB-3513	Acceptability of Small Valves	MNB 3513		A1
NB-3513.1	Standard Design Rules	MNB 3513.1	ASME : ANSI B16.34 KEPIC : KEPIC-MGG	A1(R/S)
NB-3513.2	Alternative Design Rules	MNB 3513.2		A1
NB-3515	Acceptability of Metal Bellows and Metal Diaphragm Stem Sealed Valves	MNB 3515		A1
NB-3521	Design and Service Loadings	MNB 3521		A1
NB-3524	Earthquake	MNB 3524		A1
NB-3525	Levels A and B Service Limits	MNB 3525		A1(R/S)
NB-3526	Level C Service Limits	MNB 3526		A1
NB-3526.1	Pressure–Temperature Ratings	MNB 3526.1		A1
NB-3526.2	Pipe Reaction Stress	MNB 3526.2		A1
NB-3526.3	Primary Stress and Secondary Stress	MNB 3526.3		A1
NB-3526.4	Secondary and Peak Stresses	MNB 3526.4		A1
NB-3527	Level D Service Limits	MNB 3527		A1
NB-3531.1	Pressure–Temperature Ratings	MNB 3531.1	ASME ANSI B16.34, Tables 2-1.1A to 2-2.7A	A1(R/S)

			KEPIC : KEPIC-MGG, Tables 3111-1 to 3111-21	
NB-3531.2	Hydrostatic Tests	MNB 3531.2		A1(R/S)
NB-3531.3	Allowance for Variation From Design Loadings	MNB 3531.3		A1(R/S)
NB-3532	Design Stress Intensity Values	MNB 3532		A1(R/S)
NB-3533	Marking	MNB 3533		A1(R/S)
NB-3534	Nomenclature	MNB 3534	ASME : °F/in2(℃/ mm2) for C1 KEPIC : °F/in2(0.556 ℃/0.645×10-3 m2) for C1	A1(S/C)
NB-3541	General Requirements for Body Wall Thickness	MNB 3541		A1
NB-3542	Minimum Wall Thickness of Listed Pressure Rated Valves	MNB 3542		A1(R/S)
NB-3543	Minimum Wall Thickness of Valves of Nonlisted Pressure Rating	MNB 3543		A1(R/S)
NB-3544	Body Shape Rules	MNB 3544		A1
NB-3544.1	Fillets for External and Internal Intersections and Surfaces	MNB 3544.1		A1
NB-3544.2	Penetrations of Pressure-Retaining Boundary	MNB 3544.2		A1
NB-3544.3	Attachments	MNB 3544.3		A1
NB-3544.4	Body Internal Contours	MNB 3544.4		A1
NB-3544.5	Out-of-Roundness	MNB 3544.5		A1
NB-3544.6	Doubly Curved Sections	MNB 3544.6		A1

NB-3544.7	Flat Sections	MNB 3544.7		A1
NB-3544.8	Body End Dimensions	MNB 3544.8		A1(R/S)
NB-3544.9	Openings for Auxiliary Connections	MNB 3544.9		A1(R/S)
NB-3545	Body Primary and Secondary Stress Limits	MNB 3545		A1
NB-3545.1	Primary Membrane Stress Due to Internal Pressure	MNB 3545.1		A1(R/S)
NB-3545.2	Secondary Stresses	MNB 3545.2		A1(S/C)
NB-3545.3	Fatigue Requirements	MNB 3545.3		A1(R/S)
NB-3546.1	Body-to-Bonnet Joints	MNB 3546.1		A1(R/S)
NB-3546.2	Valve Disk	MNB 3546.2		A1
NB-3546.3	Other Valve Parts	MNB 3546.3		A1(R/S)
NB-3546.4	Fatigue Evaluation	MNB 3546.4		A1
NB-3551	Verification of Adequacy for Cyclic Conditions	MNB 3551		A1
NB-3552	Excluded Cycles	MNB 3552		A1
NB-3553	Fatigue Usage	MNB 3553		A1(R/S)
NB-3554	Cyclic Stress Calculations	MNB 3554		A1(R/S)
NB-3561	General Requirements	MNB 3561	ASME : NCA-3550 KEPIC : KEPIC MNA-3340 and MNA-6200	A1(R/S)
NB-3562	Design Report for Valves Larger Than NPS 4 (DN 100)	MNB 3562		A1

NB-3563	Design Report Requirements for NPS 4 and Smaller (≤DN 100) Valves	MNB 3563		A1
NB-3591.1	General	MNB 3591.1		A1
NB-3591.2	Definitions	MNB 3591.2		A1
NB-3591.3	Acceptability of Small Liquid Relief Valves	MNB 3591.3		A1
NB-3591.4	Acceptability of Safety and Safety Relief Valves	MNB 3591.4		A1
NB-3592.1	Design Conditions	MNB 3592.1		A1
NB-3592.2	Stress Limits for Specified Service Loadings	MNB 3592.2		A1(R/S)
NB-3592.3	Earthquake	MNB 3592.3		A1
NB-3593.1	Hydrostatic Test	MNB 3593.1		A1
NB-3593.2	Marking	MNB 3593.2		A1
NB-3594.1	Body	MNB 3594.1		A1
NB-3594.2	Bonnet (Yoke)	MNB 3594.2		A1
NB-3594.3	Nozzle	MNB 3594.3		A1
NB-3594.4	Body-to-Bonnet Joint	MNB 3594.4		A1
NB-3594.5	Disk	MNB 3594.5		A1
NB-3594.6	Spring Washer	MNB 3594.6		A1
NB-3594.7	Spindle (Stem)	MNB 3594.7		A1
NB-3594.8	Adjusting Screw	MNB 3594.8		A1

NB-3594.9	Spring	MNB 3594.9		A1
NB-3595.1	General Requirements	MNB 3595.1		A1
NB-3611	Acceptability	MNB 3611		A1
NB-3611.1	Stress Limits	MNB 3611.1		A1
NB-3611.2	Acceptability When Stresses Exceed Stress Limits	MNB 3611.2	This requirement is omitted in KEPIC, not intentionally. It's an error.	A1 (It will be issued as Errata)
NB-3611.3	Conformance to NB-3600	MNB 3611.3		A1
NB-3611.4	Dimensional Standards	MNB 3611.4		A1
NB-3611.5	Prevention of Nonductile Fracture	MNB 3611.5		A1
NB-3612.1	Standard Piping Products	MNB 3612.1		A1
NB-3612.2	Piping Products Without Specific Ratings	MNB 3612.2		A1
NB-3612.4	Considerations for Local Conditions and Transients	MNB 3612.4		A1(S/C)
NB-3613.1	Corrosion or Erosion	MNB 3613.1		A1
NB-3613.2	Threading and Grooving	MNB 3613.2		A1
NB-3613.3	Mechanical Strength	MNB 3613.3		A1
NB-3621	Design and Service Loadings	MNB 3621		A1
NB-3622.1	Impact	MNB 3622.1		A1
NB-3622.2	Reversing Dynamic Loads	MNB 3622.2		A1
NB-3622.3	Vibration	MNB 3622.3		A1

NB-3622.4	Nonreversing Dynamic Loads	MNB 3622.4		A1
NB-3623	Weight Effects	MNB 3623		A1
NB-3623.1	Live Weight	MNB 3623.1		A1
NB-3623.2	Dead Weight	MNB 3623.2		A1
NB-3624.1	Loadings, Displacements and Restraints	MNB 3624.1		A1
NB-3624.2	Analysis of Thermal Expansion and Contraction Effects	MNB 3624.2		A1
NB-3624.3	Provision for Rapid Temperature Fluctuation Effects	MNB 3624.3		A1
NB-3625	Stress Analysis	MNB 3625		A1
NB-3630	PIPING DESIGN AND ANALYSIS CRITERIA	MNB 3630		A1(R/S)
NB-3641.1	Straight Pipe Under Internal Pressure	MNB 3641.1		A1(R/S)
NB-3641.2	Straight Pipe Under External Pressure	MNB 3641.2		A1
NB-3642.1	Pipe Bends	MNB 3642.1		A1
NB-3642.2	Elbows	MNB 3642.2		A1
NB-3643.1	General Requirements	MNB 3643.1		A1
NB-3643.2	Branch Connections	MNB 3643.2		A1
NB-3643.3	Reinforcement for Openings	MNB 3643.3		A1(S/C)
NB-3644	Miters	MNB 3644		A1
NB-3646	Closures	MNB 3646		A1(R/S)

NB-3647.1	Flanged Joints	MNB 3647.1		A1(R/S)
NB-3647.2	Permanent Blanks	MNB 3647.2		A1
NB-3647.3	Temporary Blanks	MNB 3647.3		A1(R/S)
NB-3648	Reducers	MNB 3648		A1
NB-3649	Pressure Design of Other Piping Products	MNB 3649		A1
NB-3649.1	Expansion Joints	MNB 3649.1		A1
NB-3651.1	Piping Products for Which Stress Indices Are Given	MNB 3651.1		A1
NB-3651.2	Piping Products for Which Stress Indices Are Not Available	MNB 3651.2		A1
NB-3651.3	Attachments	MNB 3651.3		A1
NB-3652	Consideration of Design Conditions	MNB 3652		A1(R/S)
NB-3653	Consideration of Level A Service Limits	MNB 3653		A1
NB-3653.1	Satisfaction of Primary Plus Secondary Stress Intensity Range	MNB 3653.1		A1(R/S)
NB-3653.2	Satisfaction of Peak Stress Intensity Range	MNB 3653.2		A1
NB-3653.3	Alternating Stress Intensity	MNB 3653.3		A1
NB-3653.4	Use of Design Fatigue Curve	MNB 3653.4		A1(R/S)
NB-3653.5	Cumulative Damage	MNB 3653.5		A1
NB-3653.6	Simplified Elastic–Plastic Discontinuity Analysis	MNB 3653.6		A1

NB-3653.7	Thermal Stress Ratchet	MNB 3653.7		A1
NB-3654	Consideration of Level B Service Limits	MNB 3654		A1
NB-3654.1	Permissible Pressure	MNB 3564.1		A1
NB-3654.2	Analysis of Piping Components	MNB 3654.2		A1
NB-3655.1	Permissible Pressure	MNB 3655.1		A1
NB-3655.2	Analysis of Piping Components	MNB 3655.2		A1
NB-3655.3	Deformation Limits	MNB 3655.3		A1
NB-3656	Consideration of Level D Service Limits	MNB 3656	ASME : NCA-2142.2(b)(4) KEPIC : KEPIC-MNA 2322.2(4)	A1(R/S)
NB-3657	Test Loadings	MNB 3657		A1
NB-3658	Analysis of Flanged Joints	MNB 3658		A1
NB-3658.1	Design Limits, Levels A and B Service Limits	MNB 3658.1		A1(R/S)
NB-3658.2	Level C Service Limits	MNB 3658.2		A1
NB-3658.3	Level D Service Limits	MNB 3658.3		A1
NB-3658.4	Test Loadings	MNB 3658.4		A1
NB-3661.1	General Requirements	MNB 3661.1		A1
NB-3661.2	Socket Welds	MNB 3661.2		A1
NB-3661.3	Fillet Welds and Partial Penetration Welds for Branch Connections	MNB 3661.3		A1
NB-3671	Selection and Limitation of Nonwelded Piping Joints	MNB 3671		A1

NB-3671.1	Flanged Joints	MNB 3671.1		A1
NB-3671.2	Expanded Joints	MNB 3671.2		A1
NB-3671.3	Threaded Joints	MNB 3671.3		A1
NB-3671.4	Flared, Flareless and Compression Joints	MNB 3671.4		A1
NB-3671.5	Caulked Joints	MNB 3671.5		A1
NB-3671.6	Brazed and Soldered Joints	MNB 3671.6		A1
NB-3671.7	Sleeve Coupled and Other Patented Joints	MNB 3671.7		A1
NB-3672	Expansion and Flexibility	MNB 3672		A1
NB-3672.1	Properties	MNB 3672.1		A1(R/S)
NB-3672.2	Unit Thermal Expansion Range	MNB 3672.2		A1(R/S)
NB-3672.3	Moduli of Elasticity	MNB 3672.3		A1(R/S)
NB-3672.4	Poisson's Ratio	MNB 3672.4		A1
NB-3672.5	Stresses	MNB 3672.5		A1(R/S)
NB-3672.6	Method of Analysis	MNB 3672.6		A1
NB-3672.7	Basic Assumptions and Requirements	MNB 3672.7		A1
NB-3672.8	Cold Springing	MNB 3672.8		A1
NB-3674	Design of Pipe Supporting Elements	MNB 3674		A1(R/S)
NB-3677.1	General Requirements	MNB 3677.1		A1
NB-3677.2	Piping to Pressure Relieving Safety Devices	MNB 3677.2		A1
NB-3677.3	Discharge Piping From Pressure Relieving	MNB 3677.3		A1

	Safety Devices			
NB-3681	Scope	MNB 3681		A1
NB-3682	Definitions of Stress Indices and Flexibility Factors	MNB 3682		A1
NB-3683	Stress Indices for Use With NB-3650	MNB 3683		A1
NB-3683.1	Nomenclature	MNB 3683.1		A1(R/S)
NB-3683.2	Applicability of Indices—General	MNB 3683.2		A1
NB-3683.3	Straight Pipe Remote From Welds	MNB 3683.3		A1
NB-3683.4	Welds	MNB 3683.4		A1
NB-3683.5	Welded Transitions	MNB 3683.5		A1
NB-3683.6	Concentric and Eccentric Reducers	MNB 3683.6		A1
NB-3683.7	Curved Pipe or Butt Welding Elbows	MNB 3683.7		A1
NB-3683.8	Branch Connections per NB-3643	MNB 3683.8		A1
NB-3683.9	Butt Welding Tees	MNB 3683.9		A1
NB-3684	Stress Indices for Detailed Analysis	MNB 3684		A1
NB-3685.1	Applicability of Indices	MNB 3685.1		A1
NB-3685.2	Nomenclature (Fig. NB-3685.2-1)	MNB 3685.2		A1(R/S)
NB-3685.3	Stress From Stress Indices	MNB 3685.3		A1
NB-3685.4	Classification of Stresses	MNB 3685.4		A1
NB-3686.1	Straight Pipe	MNB 3686.1		A1
NB-3686.2	Curved Pipe and Welding Elbows	MNB 3686.2		A1

NB-3686.3	Miter Bends	MNB 3686.3		A1
NB-3686.4	Welding Tee or Branch Connections	MNB 3686.4		A1
NB-3686.5	Branch Connections in Straight Pipe	MNB 3686.5		A1
NB-3691	Standard Piping Products	MNB 3691		A1
NB-3692	Nonstandard Piping Products	MNB 3692		A1
NB-4110	INTRODUCTION	MNB 4110		A1
NB-4121	Means of Certification	MNB 4121	ASME : The Certificate Holder for an item shall certify, by application of the appropriate Code Symbol and completion of the appropriate Data Report in accordance with NCA-8000, KEPIC : The Certificate Holder for an item shall certify, by application of the appropriate KEPIC Symbol and completion of the appropriate Data Report in accordance with KEPIC-MNA 6000 and MNA-8000. Description / ASME Sec.III, Div.1 / KEPIC-MN Components / N 1, NV 1 / kepic 1N Parts & Appurtenances / N PT 3 / kepic 3NP Installation / NA 2 / kepic 2NC	B1 Code symbol stamping is not adopted in KEPIC. KEPIC symbol, which shapes different from those of ASME, application takes place of stamping. See the figures of left side column.
NB-4121.1	Certification of Treatments, Tests, and Examinations	MNB 4121.1	ASME : NCA-3862 KEPIC : KEPIC-MNA 6420	A1(R/S)

NB-4121.2	Repetition of Tensile or Impact Tests	MNB 4121.2		A1
NB-4121.3	Repetition of Surface Examination After Machining	MNB 4121.2		A1
NB-4122	Material Identification	MNB 4122		A1
NB-4122.1	Marking Material	MNB 4122.1		A1
NB-4123	Examinations	MNB 4123		A1
NB-4125	Testing of Welding and Brazing Material	MNB 4125		A1
NB-4131	Elimination and Repair of Defects	MNB 4131		A1
NB-4132	Documentation of Repair Welds of Base Material	MNB 4132		A1
NB-4211	Cutting	MNB 4211		A1
NB-4211.1	Preheating Before Thermal Cutting	MNB 4211.1		A1
NB-4212	Forming and Bending Processes	MNB 4212		A1
NB-4213	Qualification of Forming Processes for Impact Property Requirements	MNB 4213		A1
NB-4213.1	Exemptions	MNB 4213.1		A1
NB-4213.2	Procedure Qualification Test	MNB 4213.2		A1
NB-4213.3	Acceptance Criteria for Formed Material	MNB 4213.3		A1
NB-4213.4	Requalification	MNB 4213.4		A1(C/S)
NB-4214	Minimum Thickness of Fabricated Material	MNB 4214		A1
NB-4221	Tolerance for Vessel Shells	MNB 4221		A1

NB-4221.1	Maximum Difference in Cross-Sectional Diameters	MNB 4221.1		A1
NB-4221.2	Maximum Deviation From True Theoretical Form for External Pressure	MNB 4221.2		A1
NB-4221.3	Deviations From Tolerances	MNB 4221.3	ASME : NCA-3551 KEPIC : KEPIC-MNA 6200	A1(R/S)
NB-4221.4	Tolerance Deviations for Vessel Parts Fabricated From Pipe	MNB 4221.4		A1
NB-4222	Tolerances for Formed Vessel Heads	MNB 4222		A1
NB-4222.1	Maximum Difference in Cross-Sectional Diameters	MNB 4222.1		A1
NB-4222.2	Deviation From Specified Shape	MNB 4222.2		A1
NB-4223	Tolerances for Formed or Bent Piping	MNB 4223		A1
NB-4223.1	Minimum Wall Thickness	MNB 4223.1		A1
NB-4223.2	Ovality Tolerance	MNB 4223.2		A1
NB-4231	Fitting and Aligning Methods	MNB 4231		A1
NB-4231.1	Tack Welds	MNB 4231.1		A1
NB-4232	Alignment Requirements When Components Are Welded From Two Sides	MNB 4232		A1
NB-4232.1	Fairing of Offsets	MNB 4232.1		A1
NB-4233	Alignment Requirements When Inside Surfaces Are Inaccessible	MNB 4233		A1(C/S)
NB-4241	Category A Weld Joints in Vessels and	MNB 4241		A1

	Longitudinal Weld Joints in Other Components			
NB-4242	Category B Weld Joints in Vessels and Circumferential Weld Joints in Other Components	MNB 4242		A1
NB-4243	Category C Weld Joints in Vessels and Similar Weld Joints in Other Components	MNB 4243		A1
NB-4244	Category D Weld Joints in Vessels and Similar Weld Joints in Other Components	MNB 4244		A1
NB-4245	Complete Joint Penetration Welds	MNB 4245		A1
NB-4246	Piping Branch Connections	MNB 4246		A1
NB-4250	WELDING END TRANSITIONS — MAXIMUM ENVELOPE	MNB 4250	ASME : *(c)* if the weld is subject to preservice inspection, the length of the counterbore shall be 2*t*min for pipe and *t* min for components and fittings, KEPIC : KEPIC-MNB has the same requirement for the above. *(But, KEPIC allows 0.5 in. length of countbore for fittings such as elbows through KEPIC Code Case in the year 2009 based on the construction experience of NPPs. However, It needs permission for usage by regulation body.)*	A1 (Discussion is required for KEPIC Code Case. I wonder whether Code Case is one of object of code comparison work or not)
NB-4311	Types of Processes Permitted	MNB 4311		A1(R/S)
NB-4311.1	Stud Welding Restrictions	MNB 4311.1		A1(R/S)
NB-4311.2	Capacitor Discharge Welding	MNB 4311.2		A1(C/S)

NB-4311.3	Inertia and Continuous Drive Friction Welding	MNB 4311.3		A1
NB-4321	Required Qualifications	MNB 4321		A1(R/S, S/C)
NB-4322	Maintenance and Certification of Records	MNB 4322		A1
NB-4322.1	Identification of Joints by Welder or Welding Operator	MNB 4322.1		A1(S/C)
NB-4323	Welding Prior to Qualifications	MNB 4323		A1(R/S)
NB-4324	Transferring Qualifications	MNB 4324	ASME : Section IX, QW-201 and QW-300.2 KEPIC : KEPIC-MQW 2200 and MQW 3120	A1(R/S)
NB-4331	Conformance to Section IX Requirements	MNB 4331		A1(R/S)
NB-4333	Heat Treatment of Qualification Welds for Ferritic Materials	MNB 4333		A1 (R/S)
NB-4334	Preparation of Test Coupons and Specimens	MNB 4334		A1(R/S)
NB-4334.1	Coupons Representing the Weld Deposit	MNB 4334.1		A1
NB-4334.2	Coupons Representing the Heat Affected Zone	MNB 4334.2		A1
NB-4335	Impact Test Requirements	MNB 4335		A1
NB-4335.1	Impact Tests of Weld Metal	MNB 4335.1		A1(R/S)
NB-4335.2	Impact Tests of Heat Affected Zone	MNB 4335.2		A1(S/C)
NB-4336	Qualification Requirements for Built-Up Weld Deposits	MNB 4336		A1
NB-4337	Welding of Instrument Tubing	MNB 4337		A1(R/S, S/C)

NB-4350	SPECIAL QUALIFICATION REQUIREMENTS FOR TUBE-TOTUBESHEET WELDS	MNB 4350	ASME : Section IX, QW-202.6, QW-193, QW-303.5 KEPIC : KEPIC-MQW, MQW 3632, MQW 3255	A1(R/S)
NB-4361	General Requirements	MNB 4361		A1(R/S)
NB-4362	Essential Variables for Automatic, Machine and Semiautomatic Welding	MNB 4362		A1(R/S)
NB-4363	Essential Variables for Manual Welding	MNB 4363		A1
NB-4366	Test Assembly	MNB 4366		A1(S/C)
NB-4366.1	Automatic Welding	MNB 4366.1		A1
NB-4366.2	Manual, Machine and Semiautomatic Welding	MNB 4366.2		A1
NB-4367	Examination of Test Assembly	MNB 4367		A1
NB-4368	Performance Qualification Test	MNB 4368		A1
NB-4411	Identification, Storage and Handling of Welding Material	MNB 4411		A1
NB-4412	Cleanliness and Protection of Welding Surfaces	MNB 4412		A1
NB-4421	Backing Rings	MNB 4421		A1
NB-4422	Peening	MNB 4422		A1
NB-4423	Miscellaneous Welding Requirements	MNB 4423		A1
NB-4424.1	General	MNB 4424.1		A1
NB-4424.2	Preservice Examination	MNB 4424.2		A1(S/C)

NB-4425	Welding Items of Different Diameters	MNB 4425		A1
NB-4426.1	Thickness of Weld Reinforcement for Vessels, Pumps and Valves	MNB 4426.1		A1(S/C)
NB-4426.2	Thickness of Weld Reinforcement for Piping	MNB 4426.2		A1(S/C)
NB-4427	Shape and Size of Fillet Welds	MNB 4427		A1(S/C)
NB-4428	Seal Welds of Threaded Joints	MNB 4428		A1
NB-4429	Welding of Clad Parts	MNB 4429		A1
NB-4431	Materials for Attachments	MNB 4431		A1
NB-4432	Welding of Structural Attachments	MNB 4432		A1
NB-4433	Structural Attachments	MNB 4433		A1
NB-4434	Welding of Internal Structural Supports to Clad Components	MNB 4434		A1
NB-4435	Welding of Nonstructural Attachments and Their Removal	MNB 4435		A1
NB-4436	Installation of Attachments to Piping Systems After Testing	MNB 4436		A1(S/C)
NB-4440	WELDING OF APPURTENANCES	MNB 4440		A1
NB-4451	General Requirements	MNB 4451		A1
NB-4452	Elimination of Surface Defects	MNB 4452		A1
NB-4453	Requirements for Making Repairs of Welds	MNB 4453		A1
NB-4453.1	Defect Removal	MNB 4453.1		A1

NB-4453.2	Requirements for Welding Material, Procedures and Welders	MNB 4453.2		A1
NB-4453.3	Blending of Repaired Areas	MNB 4453.3		A1
NB-4453.4	Examination of Repair Welds	MNB 4453.4		A1(R/S)
NB-4453.5	Heat Treatment of Repaired Areas	MNB 4453.5		A1
NB-4511	Where Brazing May Be Used	MNB 4511		A1
NB-4512	Brazing Material	MNB 4512		A1(R/S)
NB-4521	Brazing Procedure and Performance Qualification	MNB 4521		A1(R/S)
NB-4522	Valve Seat Rings	MNB 4522		A1
NB-4523	Reheated Joints	MNB 4523		A1(R/S, S/C)
NB-4524	Maximum Temperature Limits	MNB 4524		A1(R/S)
NB-4530	FITTING AND ALIGNING OF PARTS TO BE BRAZED	MNB 4530		A1
NB-4540	EXAMINATION OF BRAZED JOINTS	MNB 4540		A1
NB-4611	When Preheat Is Necessary	MNB 4611		A1(R/S)
NB-4612	Preheating Methods	MNB 4612		A1
NB-4613	Interpass Temperature	MNB 4613		A1
NB-4621	Heating and Cooling Methods	MNB 4621		A1
NB-4622.1	General Requirements	MNB 4622.1		A1(R/S)
NB-4622.2	Time-Temperature Recordings	MNB 4622.2	ASME : NCA-4134.17 KEPIC : KEPIC-MNA 4200.17	A1(R/S)

			(This is identical with NCA-4134.17, except for addition of the records for Division 3, and separation of the records for Division 2 to KEPIC-SNA.)	
NB-4622.3	Definition of Nominal Thickness Governing PWHT	MNB 4622.3		A1(S/C)
NB-4622.4	Holding Times at Temperature	MNB 4622.4		A1
NB-4622.5	PWHT Requirements When Different P-Number Materials Are Joined	MNB 4622.5		A1
NB-4622.6	PWHT Requirements for Nonpressure-Retaining Parts	MNB 4622.6		A1
NB-4622.7	Exemptions to Mandatory Requirements	MNB 4622.7		A1(R/S)
NB-4622.8	Requirements for Exempting PWHT of Nozzles to Component Welds and Branch to Run Piping Welds	MNB 4622.8		A1(S/C)
NB-4622.9	Temper Bead Weld Repair	MNB 4622.9		A1(R/S, S/C)
NB-4622.10	Repair Welds to Cladding After Final Postweld Heat Treatment	MNB 4622.10		A1(R/S, S/C)
NB-4622.11	Temper Bead Weld Repair to Dissimilar Metal Welds or Buttering	MNB 4622.11		A1(R/S, S/C)
NB-4623	PWHT Heating and Cooling Rate Requirements	MNB 4623		A1(S/C)
NB-4624	Methods of Postweld Heat Treatment	MNB 4624		A1
NB-4624.1	Furnace Heating - One Heat	MNB 4624.1		A1
NB-4624.2	Furnace Heating - More Than One Heat	MNB 4624.2		A1

NB-4624.3	Local Heating	MNB 4624.3		A1(R/S)
NB-4624.4	Heating Items Internally	MNB 4624.4		A1
NB-4630	HEAT TREATMENT OF WELDS OTHER THAN THE FINAL POSTWELD HEAT TREATMENT	MNB 4630		A1
NB-4651	Conditions Requiring Heat Treatment After Bending or Forming	MNB 4651		A1(R/S, S/C)
NB-4652	Exemptions From Heat Treatment After Bending or Forming	MNB 4652		A1
NB-4660	HEAT TREATMENT OF ELECTROSLAG WELDS	MNB 4660		A1
NB-4711	Thread Engagement	MNB 4711		A1
NB-4712	Thread Lubricants	MNB 4712		A1
NB-4713	Removal of Thread Lubricants	MNB 4713		A1
NB-4720	BOLTING FLANGED JOINTS	MNB 4720		A1
NB-4730	ELECTRICAL AND MECHANICAL PENETRATION ASSEMBLIES	MNB 4730		A1
NB-5111	Methods	MNB 5111		A1(R/S)
NB-5112	Nondestructive Examination Procedures	MNB 5112		A1(R/S)
NB-5113	Post-Examination Cleaning	MNB 5113		A1
NB-5120	TIME OF EXAMINATION OF WELDS AND WELD METAL CLADDING	MNB 5120		A1
NB-5130	EXAMINATION OF WELD EDGE PREPARATION SURFACES	MNB 5130		A1(S/C)

NB-5140	EXAMINATION OF WELDS AND ADJACENT BASE MATERIAL	MNB 5140		A1
NB-5210	CATEGORY A VESSEL WELDED JOINTS AND LONGITUDINAL WELDED JOINTS IN OTHER COMPONENTS	MNB 5210		A1
NB-5221	Vessel Welded Joints	MNB 5221		A1
NB-5222	Piping, Pump, and Valve Circumferential Welded Joints	MNB 5222		A1
NB-5231	General Requirements	MNB 5231		A1
NB-5241	General Requirements	MNB 5241		A1
NB-5242	Full Penetration Butt Welded Nozzles, Branch, and Piping Connections	MNB 5242		A1
NB-5243	Corner Welded Nozzles, Branch and Piping Connections	MNB 5243		A1
NB-5244	Weld Metal Buildup at Openings for Nozzles, Branch and Piping Connections	MNB 5244		A1
NB-5245	Fillet Welded and Partial Penetration Welded Joints	MNB 5245		A1
NB-5246	Oblique Full Penetration Nozzles, Branch and Piping Connections	MNB 5246		A1
NB-5261	Fillet, Partial Penetration and Socket Welded Joints	MNB 5261		A1
NB-5262	Structural Attachment Welded Joints	MNB 5262		A1
NB-5271	Welded Joints of Specially Designed	MNB 5271		A1

	Seals			
NB-5272	Weld Metal Cladding	MNB 5272		A1
NB-5273	Hard Surfacing	MNB 5273		A1
NB-5274	Tube-to-Tubesheet Welded Joints	MNB 5274		A1
NB-5275	Brazed Joints	MNB 5275		A1
NB-5276	Inertia and Continuous Drive Friction Welds	MNB 5276		A1(R/S)
NB-5277	Electron Beam Welds	MNB 5277		A1
NB-5278	Electroslag Welds	MNB 5278		A1
NB-5279	Special Exceptions	MNB 5279		A1
NB-5281	General Requirements	MNB 5281	ASME : NCA-3252(c) KEPIC : KEPIC-MNA 6111 (For reference, MNA 6111 not adopted NCA-3252(a)(6) which is related fracture mechanics data but, the others are identical to NCA-3252) ASME : NCA-4134.17 KEPIC : KEPIC-MNA 4200.17 (See the comment for NB-4622.2 of this document)	A1(R/S)
NB-5282	Examination Requirements	MNB 5282	ASME : Section XI, table IWB-2500-1 KEPIC : KEPIC-MIB, table MIB 2500-1	A1(R/S)

NB-5283	Components Exempt From Preservice Examination	MNB 5283		A1
NB-5320	RADIOGRAPHIC ACCEPTANCE STANDARDS	MNB 5320		A1
NB-5331	Fabrication	MNB 5331		A1
NB-5332	Preservice Examination	MNB 5332		A1
NB-5341	Evaluation of Indications	MNB 5341		A1
NB-5342	Acceptance Standards	MNB 5342		A1(S/C)
NB-5343	Preservice Examination	MNB 5343		A1
NB-5351	Evaluation of Indications	MNB 5351		A1
NB-5352	Acceptance Standards	MNB 5352		A1(S/C)
NB-5353	Preservice Examination	MNB 5353		A1
NB-5360	EDDY CURRENT PRESERVICE EXAMINATION OF INSTALLED NONFERROMAGNETIC STEAM GENERATOR HEAT EXCHANGER TUBING	MNB 5360	ASME : NCA-3252(c) KEPIC : KEPIC-MNA 6111	A1(R/S)
NB-5370	VISUAL ACCEPTANCE STANDARDS FOR BRAZED JOINTS	MNB 5370		A1
NB-5380	BUBBLE FORMATION TESTING	MNB 5380		A1(R/S)
NB-5410	EXAMINATION AFTER HYDROSTATIC TEST	MNB 5410		A1
NB-5510	GENERAL REQUIREMENTS	MNB 5510		A1
NB-5521	Qualification Procedure	MNB 5521	ASME : See the NB-5521 (omission)	B1 for NDE personnel

			KEPIC : (1) Personnel performing nondestructive examinations shall be qualified in accordance with KEPIC-MEN 1002. (2) For visual examination, the Jaeger Number 1 letters shall be used in lieu of the Jaeger Number 2 letters specified in paragraph 9.1(1) of KEPIC-MEN 1002. The use of equivalent type and size letters is permitted (3) For nondestructive examination methods not covered by KEPIC-MEN 1002, personnel shall be qualified to comparable levels of competency by subjection to comparable examinations on the particular method involved. (4) The emphasis shall be on the individual's ability to perform the nondestructive examination in accordance with the applicable procedure for the intended application. (KEPIC-MEN 1002 adopted ASNT SNT-TC-1A-96. See the 'KEPIC-MEN vs. ASME Sec. V.doc' file. In KEPIC-MEN 1002, *KEPIC-MEN demands the national license based on the Korean law in addition to the requirement of ASME Section V for NDE personnel.*)	qualification & certification Differences are caused by national education and qualification system in Korea.
NB-5522	Certification of Personnel	-	ASME : *(a)* The Employer retains responsibility for the adequacy of the program and is responsible for certification of Levels I, II, and III nondestructive examination personnel. *(b)* When ASNT is the outside agency administering the Level III basic and method examinations [NB-5521(a)(1)(a)], the Employer	B1 for NDE personnel qualification & certification (This is required in KEPIC-MEN.)

			may use a letter from ASNT as evidence on which to base the certification. *(c)* When an outside agency is the examining agent for Level III qualification of the Employer's personnel, the examination results shall be included with the Employer's record. KEPIC : *Not mentioned in MNB 5521, however, personnel qualification & certification are performed as per the requirements of KEPIC-MEN which adopted ASNT SNT-TC-1A-96.*	
NB-5523	Verification of Nondestructive Examination Personnel Certification	MNB 5522		A1
NB-5530	RECORDS	-	ASME : Personnel qualification records identified in paragraph 9.4 of SNT-TC-1A shall be retained by the Employer. KEPIC : "deleted" (The requirements of SNT-TC-1A are adopted in KEPIC-MEN.)	A2 (This is required in KEPIC-MEN.)
NB-6111	Scope of Pressure Testing	MNB 6111		A1
NB-6112	Pneumatic Testing	MNB 6112		A1
NB-6112.1	Pneumatic Test Limitations	MNB 6112.1		A1
NB-6112.2	Precautions to Be Employed in Pneumatic Testing	MNB 6112.2		A1
NB-6113	Witnessing of Pressure Tests	MNB 6113		A1(R/S)
NB-6114.1	System Pressure Test	MNB 6114.1		A1
NB-6114.2	Component and Appurtenance Pressure	MNB 6114.2	ASME : stamped with the NPT symbol, except as	A2(R/S)

	Test		provided in NCA-8330. KEPIC : stamped with the KEPIC symbol, except as provided in KEPIC-MNA 8330.	
NB-6114.3	Material Pressure Test	MNB 6114.3		A1
NB-6115	Machining After Pressure Test	MNB 6115		A1
NB-6121	Exposure of Joints	MNB 6121		A1
NB-6122	Addition of Temporary Supports	MNB 6122		A1
NB-6123	Restraint or Isolation of Expansion Joints	MNB 6123		A1
NB-6124	Isolation of Equipment Not Subjected to Pressure Test	MNB 6124		A1
NB-6125	Treatment of Flanged Joints Containing Blanks	MNB 6125		A1
NB-6126	Precautions Against Test Medium Expansion	MNB 6126		A1
NB-6127	Check of Test Equipment Before Applying Pressure	MNB 6127		A1
NB-6211	Venting During Fill Operation	MNB 6211		A1
NB-6212	Test Medium and Test Temperature	MNB 6212		A1
NB-6221	Minimum Hydrostatic Test Pressure	MNB 6221		A1
NB-6222	Maximum Permissible Test Pressure	MNB 6222		A1
NB-6223	Hydrostatic Test Pressure Holding Time	MNB 6223		A1
NB-6224	Examination for Leakage After Application of Pressure	MNB 6224		A1

NB-6311	General Requirements	MNB 6311		A1
NB-6312	Test Medium and Test Temperature	MNB 6312		A1
NB-6313	Procedure for Applying Pressure	MNB 6313		A1
NB-6321	Minimum Required Pneumatic Test Pressure	MNB 6321		A1
NB-6322	Maximum Permissible Test Pressure	MNB 6322		A1
NB-6323	Test Pressure Holding Time	MNB 6323		A1
NB-6324	Examination for Leakage After Application of Pressure	MNB 6324		A1
NB-6411	Types of Gages to Be Used and Their Location	MNB 6411		A1
NB-6412	Range of Indicating Pressure Gages	MNB 6412		A1
NB-6413	Calibration of Pressure Test Gages	MNB 6413		A1
NB-6610	COMPONENTS DESIGNED FOR EXTERNAL PRESSURE	MNB 6610		A1
NB-6621	Pressure Chambers Designed to Operate Independently	MNB 6621		A1
NB-6622	Common Elements Designed for a Maximum Differential Pressure	MNB 6622		A1
NB-7110	SCOPE	MNB 7110		A1
NB-7111	Definitions	MNB 7111		A1
NB-7120	INTEGRATED OVERPRESSURE PROTECTION	MNB 7120		A1

NB-7131	Construction	MNB 7131		A1
NB-7141	Pressure Relief Devices	MNB 7141	ASME : NV Certificate Holder KEPIC : Pressure Relief Valve Manufacturer	A2
NB-7142	Stop Valves	MNB 7142		A1
NB-7143	Draining of Pressure Relief Devices	MNB 7143		A1
NB-7151	Pressure Relief Valves	MNB 7151		A1
NB-7152	Non-reclosing Pressure Relief Devices	MNB 7152		A1
NB-7161	Deadweight Pressure Relief Valves	MNB 7161		A1
NB-7171	Safety Valves	MNB 7171		A1
NB-7172	Safety Relief Valves	MNB 7172		A1
NB-7173	Relief Valves	MNB 7173		A1
NB-7174	Pilot Operated Pressure Relief Valves	MNB 7174		A1
NB-7175	Power Actuated Pressure Relief Valves	MNB 7175		A1
NB-7176	Safety Valves With Auxiliary Actuating Devices	MNB 7176		A1
NB-7177	Pilot Operated Pressure Relief Valves With Auxiliary Actuating Devices	MNB 7177		A1
NB-7178	Non-reclosing Devices	MNB 7178		A1
NB-7210	RESPONSIBILITY FOR REPORT	MNB 7210		A1
NB-7220	CONTENT OF REPORT	MNB 7220		A1
NB-7230	CERTIFICATION OF REPORT	MNB 7230	ASME : the requirements of Appendix XXIII of Section III Appendices.	A1(R/S)

<table>
<tr><td></td><td></td><td></td><td>KEPIC : the requirements of KEPIC-QAR

The below is explanation of KEPIC-QAR.
<table>
<tr><th>Description</th><th>ASME</th><th>KEPIC</th></tr>
<tr><td>Applicable Standard</td><td>ASME Sec. III Div. 1 App. XXIII</td><td>KEPIC-QAR</td></tr>
<tr><td>Technical Field</td><td>Mechanical, Structural</td><td>Identical to ASME</td></tr>
<tr><td>Required National Certificate</td><td>Registered Professional Engineer</td><td>- Professional Engineer (2-yr job experiences) or
- Engineer (7-yr job experiences)</td></tr>
<tr><td>Knowledge</td><td>Code & Working Knowledge</td><td>Identical to ASME</td></tr>
<tr><td>Accreditation Body</td><td>Certificate Holder</td><td>KEA</td></tr>
</table></td><td>B1 for RPE qualification requirements.

Differences, shown as the table of left side column, are caused by national education and qualification system in Korea.</td></tr>
<tr><td>NB-7240</td><td>REVIEW OF REPORT AFTER INSTALLATION</td><td>MNB 7240</td><td>ASME : the requirements of Appendix XXIII of Section III Appendices.

KEPIC : the requirements of KEPIC-QAR</td><td>A1(R/S)</td></tr>
<tr><td>NB-7250</td><td>FILING OF REPORT</td><td>MNB 7250</td><td></td><td>A1</td></tr>
<tr><td>NB-7311</td><td>Relieving Capacity of Pressure Relief Devices</td><td>MNB 7311</td><td></td><td>A1</td></tr>
<tr><td>NB-7312</td><td>Relieving Capacity of Pressure Relief Devices Used With Pressure-Reducing Devices</td><td>MNB 7312</td><td></td><td>A1</td></tr>
<tr><td>NB-7313</td><td>Required Number and Capacity of Pressure Relief Devices</td><td>MNB 7313</td><td></td><td>A1</td></tr>
<tr><td>NB-7314</td><td>Required Number and Capacity of Pressure Relief Devices for Isolatable Components</td><td>MNB 7314</td><td></td><td>A1</td></tr>
</table>

NB-7321	Relieving Capacity of Pressure Relief Devices	MNB 7321		A1
NB-7410	SET PRESSURE LIMITATIONS FOR EXPECTED SYSTEM PRESSURE TRANSIENT CONDITIONS	MNB 7410		A1
NB-7420	SET PRESSURE LIMITATION FOR UNEXPECTED SYSTEM EXCESS PRESSURE TRANSIENT CONDITIONS	MNB 7420		A1
NB-7511.1	Spring-Loaded Valves	MNB 7511.1		A1
NB-7511.2	Balanced Valves	MNB 7511.2		A1
NB-7511.3	Antisimmer Type Valves	MNB 7511.3		A1
NB-7512.1	Antichattering and Lift Requirements	MNB 7512.1	ASME : NCA-3250 KEPIC : KEPIC-MNA 3240 and 6110	A1(S/C)
NB-7512.2	Set Pressure Tolerance	MNB 7512.2		A1(S/C, R/S)
NB-7512.3	Blowdown	MNB 7512.3		A1(R/S)
NB-7513	Safety Relief and Relief Valve Operating Requirements	MNB 7513		A1(S/C)
NB-7513.1	Set Pressure Tolerance	MNB 7513.1		A1(S/C, R/S)
NB-7513.2	Blowdown	MNB 7513.2		A1(R/S)
NB-7514	Credited Relieving Capacity	MNB 7514		A1
NB-7515	Sealing of Adjustments	MNB 7515		A1
NB-7521	General Requirements	MNB 7521		A1
NB-7522.1	Actuation	MNB 7522.1		A1

NB-7522.2	Response Time	MNB 7522.2		A1(R/S)
NB-7522.3	Main Valve Operation	MNB 7522.3		A1(S/C)
NB-7522.4	Sensing Mechanism Integrity	MNB 7522.4		A1
NB-7522.5	Set Pressure Tolerance	MNB 7522.5		A1(S/C, R/S)
NB-7522.6	Blowdown	MNB 7522.6		A1(R/S)
NB-7523	Credited Relieving Capacity	MNB 7523		A1
NB-7524	Sealing of Adjustments	MNB 7524		A1
NB-7531	General Requirements	MNB 7531		A1
NB-7532.1	Actuation	MNB 7532.1		A1(R/S)
NB-7532.2	Response Times	MNB 7532.2		A1
NB-7532.3	Main Valve Operation	MNB 7532.3		A1(S/C)
NB-7532.4	Sensors, Controls and External Energy Sources	MNB 7532.4		A1(R/S)
NB-7533	Certified Relieving Capacity	MNB 7533		A1
NB-7534.1	Expected System Pressure Transient Conditions	MNB 7534.1		A1
NB-7534.2	Unexpected System Excess Pressure Transient Conditions	MNB 7534.2		A1
NB-7535	Sealing of Adjustments	MNB 7535		A1
NB-7541	General Requirements	MNB 7541		A1
NB-7542	Construction	MNB 7542		A1

NB-7543	Auxiliary Device Sensors and Controls	MNB 7543		A1
NB-7544.1	Expected System Pressure Transient Conditions	MNB 7544.1		A1
NB-7544.2	Unexpected System Excess Pressure Transient Conditions	MNB 7544.2		A1
NB-7544.3	Credited Relieving Capacity	MNB 7544.3		A1
NB-7545	Response Time	MNB 7545		A1
NB-7551	General Requirements	MNB 7551		A1
NB-7552	Correlation	MNB 7552		A1
NB-7553	Verification of Correlation Procedure	MNB 7553		A1
NB-7554	Procedure	MNB 7554		A1
NB-7610	RUPTURE DISK DEVICES	MNB 7610		A1
NB-7611	Burst Pressure Tolerance	MNB 7611		A1(S/C)
NB-7612	Tests to Establish Stamped Burst Pressure	MNB 7612		A1
NB-7621	Provisions for Venting or Draining	MNB 7621		A1
NB-7622	System Obstructions	MNB 7622		A1
NB-7623	Rupture Disk Devices at the Outlet Side of Pressure Relief Valves	MNB 7623		A1
NB-7710	RESPONSIBILITY FOR CERTIFICATION OF PRESSURE RELIEF VALVES	MNB 7710		A1
NB-7720	RESPONSIBILITY FOR CERTIFICATION OF NONRECLOSING	MNB 7720		A1

	PRESSURE RELIEF DEVICES			
NB-7731.1	Capacity Certification	MNB 7731.1		A1
NB-7731.2	Test Media	MNB 7731.2		A1(S/C)
NB-7731.3	Test Pressure	MNB 7731.3		A1(S/C)
NB-7731.4	Blowdown	MNB 7731.4		A1
NB-7731.5	Drawings	MNB 7731.5	ASME : ASME designated organization KEPIC : KEA(or ASME) designated organization	A2
NB-7731.6	Design Changes	MNB 7731.6		A1
NB-7732.1	Flow Capacity	MNB 7732.1		A1
NB-7732.2	Demonstration of Function	MNB 7732.2	ASME : ASME designated organization KEPIC : KEA(or ASME) designated organization ASME : NV Certificate Holder KEPIC : Pressure Relief Valve Manufacturer	A2
NB-7733	Slope Method	MNB 7733	ASME : ASME designated organization KEPIC : KEA(or ASME) designated organization	A2
NB-7734	Coefficient of Discharge Method	MNB 7734		A1
NB-7734.1	Number of Valves to Be Tested	MNB 7734.1		A1
NB-7734.2	Establishment of Coefficient of Discharge	MNB 7734.2		A1(S/C)
NB-7734.3	Calculation of Certified Capacity	MNB 7734.3		A1
NB-7734.4	Demonstration of Function	MNB 7734.4		A1

NB-7735.1	Valve Capacity Within Test Facility Limits	MNB 7735.1		A1
NB-7735.2	Valve Capacity in Excess of Test Facility Limits	MNB 7735.2		A1
NB-7735.3	Valve Demonstration of Function	MNB 7735.3		A1
NB-7736	Proration of Capacity	MNB 7736		A1
NB-7737	Capacity Conversions	MNB 7737		A1
NB-7738	Laboratory Acceptance of Pressure Relieving Capacity Tests	MNB 7738	ASME : ASME designated organization KEPIC : KEA(or ASME) designated organization	A2
NB-7739	Laboratory Acceptance of Demonstration of Function Tests	MNB 7739	ASME : NV Certificate Holder KEPIC : Pressure Relief Valve Manufacturer	A2
NB-7741.1	Capacity Certification	MNB 7741.1		A1
NB-7741.2	Test Medium	MNB 7741.2		A1(S/C)
NB-7741.3	Test Pressure	MNB 7741.3		A1(S/C)
NB-7741.4	Blowdown	MNB 7741.4		A1
NB-7741.5	Drawings	MNB 7741.5	ASME : ASME designated organization KEPIC : KEA(or ASME) designated organization	A2
NB-7741.6	Design Changes	MNB 7741.6		A1
NB-7742	Valve Designs in Excess of Test Facility Limits	MNB 7742		A1
NB-7743	Slope Method	MNB 7743	ASME : ASME designated organization KEPIC : KEA(or ASME) designated organization	A2

NB-7744	Coefficient of Discharge Method	MNB 7744		A1
NB-7744.1	Number of Valves to Be Tested	MNB 7744.1		A1
NB-7744.2	Establishment of Coefficient of Discharge	MNB 7744.2	ASME : ASME designated organization KEPIC : KEA(or ASME) designated organization	A2 (A1 for S/C)
NB-7744.3	Calculation of Certified Capacity	MNB 7744.3		A1
NB-7744.4	Demonstration of Function	MNB 7744.4		A1
NB-7745	Single Valve Method	MNB 7745		A1
NB-7746	Laboratory Acceptance of Pressure Relieving Capacity Tests	MNB 7746	ASME : ASME Boiler and Pressure Vessel Committee KEPIC : KEPIC committee(or ASME Boiler and Pressure Vessel Committee)	A2
NB-7747	Proration of Capacity	MNB 7747		A1
NB-7748	Capacity Conversions	MNB 7748		A1
NB-7748	Laboratory Acceptance of Demonstration of Function Tests	MNB 7748	ASME : NV Certificate Holder KEPIC : Pressure Relief Valve Manufacturer	A2
NB-7811	Marking and Stamping	MNB 7811		A1(S/C, R/S)
NB-7812	Report Form for Pressure Relief Valves	MNB 7812	ASME : Code NV symbol KEPIC : KEPIC symbol	A2
NB-7821	Rupture Disks	MNB 7821		A1
NB-7822	Disk Holders (If Used)	MNB 7822		A1
NB-7830	CERTIFICATE OF AUTHORIZATION TO USE CODE SYMBOL STAMP	MNB 7830	ASME : Code NV symbol KEPIC : KEPIC symbol	B1 Refer to remark of NB-

				4121.
MNB 8100	GENERAL REQUIREMENTS	NB-8100		A1

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		KEPIC MNA	Differences
Article No.	Title	Article No.	
NCA-1000	**Scope of Section III**	**MNA 1000**	
NCA-1100	General	MNA 1100	
NCA-1110	Scope	MNA 1110	- KEPIC-MNA is applied to the field of ASME Sec.III Division 1 and Division 3, and the chiller and air handling unit under the category of KEPIC-MH which is identical to ASME AG-1. And, KEPIC-SNA is applied to ASME Sec.III Division 2 items.
NCA-1120	Definitions	MNA 1120	- Identical
NCA-1130	Limits of These Rules	MNA 1130	- Identical, except for addition of the requirements for Class 1E items (KEPIC-EN, which are identical to several standards of IEEE) and Division 3 items.
NCA-1140	Use of Code Editions, Addenda and Cases	MNA 1140	- Identical, except for the use of Code Edition and Addenda early than 5 years prior to Construction Permit instead of 3 years in ASME Sec.III.
(None)	(None)	MNA 1150	- Describes the relationship between KEPIC-MN and ASME Sec.III.
NCA-1150	Units of Measurement	MNA 1160	- KEPIC-MN adopted U.S. Customary units, and SI Units by soft metrication are information only.

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
NCA-1200	General Requirements for Items and Installation	MNA 1200	- Identical, except for addition of the requirements for Division 3 items.
NCA-1210	Components	MNA 1210	- Identical, except for addition of the requirements for Division 3 items, and separation of the requirements of Nonmetallic Materials to KEPIC-SNA.
NCA-1220	Materials	MNA 1220	- Identical
NCA-1230	Parts, Piping Subassemblies and Supports	MNA 1231, 1232, 1233	- Identical
NCA-1260	Appurtenances	MNA 1234	- Identical
NCA-1270	Miscellaneous Items	MNA 1240	- Identical
NCA-1280	Installation	MNA 1250	- Identical
(None)	(None)	MNA 1300	- Describes the types and definitions of organizations, such as Owner, Manufacturer (N and NPT Certificate Holder), Installer (NA Certificate Holder), Material Organization, Authorized Inspection Agency (AIA), Korea Electric Association (KEA), and Test Laboratory.

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		KEPIC MNA	Differences
Article No.	Title	Article No.	
NCA-2000		**MNA 2000**	
NCA-2100	**Classification of Components and Supports**	MNA 2100	- KEPIC adds the requirements for Division 3 items to scope, and specifies the guidance of classification to Korean Government Notice or the related KEPIC. And rules for Division 2 items are separated to KEPIC-SNA.
NCA-2110	General Requirements Scope	MNA 2110	- Identical, except for addition of the requirements for Division 3 items.
NCA-2120		MNA 2120	- Identical, except for addition of the requirements for Division 3 items.
NCA-2130	Purpose of Classifying Items of a Nuclear	MNA 2200	- Separated to KEPIC-SNA
NCA-2131	Power Plant	MNA 2210	- Identical

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
	Classifications and Rules of This Section		- Identical
NCA-2132	Code Classes and Rules of Division 1	(None)	- Identical, except for addition of the requirements for Division 3 items, and separation of the requirements for Concrete Containments to KEPIC-SNA.
NCA-2133		MNA 2220	
NCA-2134	Rules of Division 2	MNA 2230	
NCA-2140	Multiple Code Class Components	MNA 2300	- Identical
	Optional Use of Code Classes		
NCA-2160	Design Basis	MNA 2330	
	Special Requirements Applied to Code Classes		- Identical
NCA-3000		**MNA 3000**	
NCA-3100		MNA 3100	- Identical for description, but details are partially different as bellow.
NCA-3110	**Responsibilities and Duties**	MNA 3110	
NCA-3120	General	MNA 3120	- Identical
NCA-3121	Responsibilities vs. Legal Liabilities	MNA 3121	- Calibration or Testing Service Organization accredited by Korea Laboratory Accreditation Scheme (KOLAS) in accordance with ISO/IEC 17025 is not required to survey or audit.
	Accreditation		
NCA-3125	Type of Certificates	MNA 3130	
NCA-3126		MNA 3732(3)	- Identical for welding, but the requirements of Subcontracted Construction Services for Division

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
			2 are separated to KEPIC-SNA.
	Subcontracted Services		
	Subcontracted Calibration Services		- Identical, but the requirements for Division 2 are separated to KEPIC-SNA.
NCA-3130		MNA 3140	- Owner's responsibilities as a Certificate Holder are added, reflecting the practice in Korea.
	Welding and Subcontracting During Construction		- Identical
NCA-3200		MNA 3200	- Identical
NCA-3220		MNA 3210	
	Owner' Responsibilities		- Identical
(None)	Categories of the Owner' Responsibilities	MNA 3211	- Additional fracture mechanics data is not contained in contents. The others are identical.
NCA-3230	(None)	MNA 3220	- Identical
NCA-3240		MNA 3230	
NCA-3250	Owner' Certificate	MNA 3240	- Identical, but the requirements for Division 2 are separated to KEPIC-SNA.
NCA-3251	Provision of Adequate Supporting Structures	MNA 3241	- Identical, but the requirements for Division 2 are separated to KEPIC-SNA, and RPE shall be qualified in accordance with KEPIC-QAR which is referred to Appendix XXIII of ASME Sec.III.
NCA-3252	Provision of Design Specifications	MNA 6111	
NCA-3253	Provision and Correlation	MNA 3242/6113	- Identical
	Contents of Design Specification		- Identical, but the requirements for Division 2 are separated to KEPIC-SNA.
NCA-3254			

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
	Classification of Components, Parts, and Appurtenances	MNA 6112	- Identical
NCA-3255			- Identical. In addition, KEPIC describes more detail requirements.
	Boundaries of Jurisdiction	MNA 3243	
			- Identical
	Certification of the Design Specifications		- Separated to KEPIC-SNA
NCA-3256			
NCA-3260		MNA 3244	
		MNA 3250	- Separated to KEPIC-SNA.
NCA-3270	Filing of Design Specifications		
NCA-3280	Review of Design Report	MNA 6130	
		MNA 6620	- Combined N Certificate Holder and NPT Certificate Holder to Manufacturer
NCA-3290	Overpressure Protection Report		- Identical
	Owner's Data Report and Filing	MNA 3260	
NCA-3300			- Identical
	Owner's Responsibility for Records	(None)	- Identical
NCA-3400			
	Responsibilities of a Designer — Division 2	(None)	- Identical. In addition, KEPIC describes more detail requirements such as responsibilities of Certificate Holder for subcontract of stress analysis or design activities, and adds the requirements of Containment Fabrication
NCA-3500			
	Responsibilities of an N Certificate	MNA 3300	

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
NCA-3520	Holder —Division 2		Specification for Division 3.
		MNA 3310	- Identical
NCA-3530	Responsibilities of an N Certificate Holder —Division 1	(1)~(12),(14)	- Identical
NCA-3540	Categories of the N Certificate Holder' Responsibilities	MNA 3320	- Identical
NCA-3550		MNA 3330	
NCA-3551	Obtaining a Certificate	MNA 6200	- Identical, but the requirements for Division 3 are added, and RPE shall be qualified in accordance with KEPIC-QAR which is referred to Appendix XXIII of ASME Sec.III
	Compliance with This Section	MNA 6210	
	Requirements for Design Output Documents		- Identical
	General (Design Report, Load Capacity Data Sheet, Certified Design Report Summary)		- Identical
NCA-3552			
NCA-3553		MNA 6220	- Design and heat treatment are additionally included in subcontracted service examples, and the requirements for furnace brazing operation subcontracted service are not included. The others are identical.
NCA-3554		MNA 6230	
		MNA 6240	
NCA-3555	Design Output Documents for Parts		- Identical
	Design Output Documents for Appurtenances	MNA 3341	
NCA-3556	Modification of Documents and Reconciliation with Design Report		- Identical
NCA-3557	Certification of Design Report	MNA 3342	- Identical, except for KEPIC Symbol application instead of stamping
NCA-3560		MNA 3343	- The requirements of Containment Fabrication

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
NCA 3561		MNA 3350	Specification preparation for Division 3 are added.
	Submittal of Design Report for Owner Review	MNA 3351	- Combined NPT Certificate Holder and N Certificate Holder to Manufacturer
	Availability of Design Report		- Identical
NCA-3562	Responsibility for Quality Assurance		
	Scope of Responsibilities		- Identical
NCA 3563		MNA 3352/6510(1)	- Identical
NCA-3570		MNA 6510(2)	- Identical
		MNA 6250	
(None)	Documentation of Quality Assurance Program	MNA 3360	- The requirements for furnace brazing operation subcontracted service are not included. The others are identical.
NCA-3600	Filing of Quality Assurance Manual		- Identical
		MNA 3300	
NCA-3620	Data Report		- Identical
	(None)	MNA 3310 (1)~(10),(13)	- Identical, except for KEPIC Symbol application instead of stamping
NCA-3630			- Not adopted NS Certificate
NCA-3640		MNA 3320	
NCA-3650	Responsibilities of an NPT Certificate Holder	MNA 3330	- NA Certificate Holder → Installer
NCA-3660		MNA 6230	- Identical
NCA 3661	Categories of the NPT Certificate	MNA 3350	

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		KEPIC MNA	Differences
Article No.	Title	Article No.	
	Holder’s Responsibilities	MNA 3351	- Identical
	Obtaining a Certificate		- Identical
NCA-3662	Compliance with This Section		
	Design Documents for Appurtenances	MNA 3352/6510(1)	
NCA-3663	Responsibility for Quality Assurance	MNA 6510(2)	- Heat treatment is additionally included in subcontracted service examples, and the requirements for furnace brazing operation subcontracted service are not included. The others are identical.
NCA-3670	Scope of Responsibilities	MNA 6250	
NCA-3680		(None)	- Identical
NCA-3700		MNA 3400	
NCA-3720	Documentation of Quality Assurance Program	MNA 3410	- Identical
NCA-3730	Filing of Quality Assurance Manual		- Identical
		MNA 3420	
NCA-3740	Data Report	MNA 3430	
NCA-3760	Responsibilities of an NS Certificate Holder	MNA 3440	- Because the accredited Material Organization and Certificate
NCA 3761	Responsibilities of an NA Certificate Holder	MNA 3441	Holder by KEA are able to qualify and approve suppliers, KEPIC doesn’t allow approved suppliers to approve other suppliers that affect materials. Therefore, this limitation shall be performed by other requirements of KEPIC.
	Categories of the NA Certificate Holder’ Responsibilities		
NCA 3762	Obtaining a Certificate		

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
NCA 3763	Responsibility for Compliance with This Section	MNA 3442/6510(1)	- Identical, except for addition of the requirements for Division 3 items
NCA-3770	Responsibility for Quality Assurance	MNA 6510(2)	- Identical
NCA-3800	Scope of Responsibilities	MNA 6310	
		MNA 3500	- Identical
NCA-3810			
NCA-3811			- Identical, except for the substitution of the Society to KEA
	Documentation of Quality Assurance Program	(None)	- Identical
	Filing of Quality Assurance Manual		- Identical
	Data Report		- Identical
NCA-3812	Metallic Material Organization's Quality System Program	MNA 3540	- Identical
NCA-3820	Scope and Applicability	MNA 3520	- Instead of alternative requirement for testing and calibration laboratory in NCA-3855.3(c), KEPIC uses the organization accredited by Korea Laboratory Accreditation Scheme (KOLAS) in accordance with ISO/IEC 17025, which is not required to survey or audit. This requirement is described in MNA 3732(3). The others are identical.
	Limitations		
NCA-3830		MNA 3510	
NCA-3840		MNA 3530	
NCA-3841		MNA 3531	
NCA-3842		MNA 3532	- Identical
NCA-3850	Exclusions		- Identical

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		KEPIC MNA	Differences
Article No.	Title	Article No.	
NCA-3851		MNA 4300	- Identical
NCA-3852	Accreditation or Qualification of Material Organizations	MNA 4310	
NCA 3853		MNA 4320	- Identical
NCA 3855	Responsibilities of Material Organizations	MNA 4330	
		MNA 4340	- Identical
	Evaluation of the Program		
	Evaluation by the Society		
	Evaluation by Parties Other Than the Society		
			- Separated to Certificate of Material Test Report and Certificate of Compliance.
	Quality System Program Requirements		
			- Identical
NCA 3856			
	Responsibility and Organization		- Identical
NCA 3857		MNA 4350	
	Personnel		- Identical
NCA-3858		MNA 4360	
	Program Documentation		- Separated to KEPIC-SNA.
		MNA 4370	
NCA-3859	Control of Purchased Materials, Source Materials, and Services		
NCA-3860		MNA 4380	
			- Quoted the related KEPIC Identification and Article numbers for qualification of Registered Professional Engineer, Authorized Nuclear Inspector, Supervisor, Welder, Welding Operator, and Nondestructive Examination Personnel.
NCA-3861			
		MNA 4390	
NCA-3862			
NCA-3862.1	Identification, Marking, and Material Control	MNA 6400	Subcontracted Service Organization's Responsibilities and Qualification –

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
	Process Control		Nondestructive Examination, Design, Heat Treatment, etc.
(a)~(f),(h)	Control of Examinations, Tests and Nonconforming Material	MNA 6410	
(g),(h)		MNA 6420	
	Audits and Corrective Action	MNA 6430	
NCA 3862.2	Certification Requirements	(None)	- Added Division 3 scope, and separated Division 2 scope to KEPIC-SNA.
NCA-3900	Certification Requirements for Material Organizations		- Identical
	Certification of Material		
(None)	Material Certification	MNA 3600	- Refer to MNA 4110 : MNA 4300 applied
			- Separated to KEPIC-SNA
	- Certificate of Material Test Report		- Refer to MNA 4110 : MNA 4300 applied
	- Certificate of Compliance		- Added Class TC, SC, and separated CC to KEPIC-SNA
(None)	Quality System Program Statement	MNA 3700	
	Nonmetallic Material Manufacturer' and Constituent Supplier's Quality System Program		- Identical
		MNA 4000	- Identical
NCA-4000	(None)		- Identical
NCA-4100		MNA 4100	- Identical
NCA-4110		MNA 4110	- Identical
		MNA 4120	- Identical
NCA-4120	(None)		- Identical

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
NCA-4130		(None)	- Identical
NCA-4131		(None)	- Identical
NCA-4132	**Quality Assurance**	(None)	- Identical
NCA-4133	Requirements	MNA 4200	- Identical
NCA-4134	Scope and Applicability		- Identical
		MNA 4200.1	- Identical
NCA-4134.1	Definitions	MNA 4200.2	- Identical
	Establishment and Implementation	MNA 4200.3	- Identical
NCA-4134.2	Material Organizations, Division 1	MNA 4200.4	- Identical
NCA-4134.3	Material Organizations, Division 2	MNA 4200.5	- Identical, except for addition of the records for Division 3, and separation of the records for Division 2 to KEPIC-SNA.
	Material Organizations, Division 1	MNA 4200.6	
NCA-4134.4	N, NV, NPT, NS, and NA Certificate Holders for Class 1,2,3,MC,CS, and CC Construction	MNA 4200.7	- Identical
		MNA 4200.8	
NCA-4134.5	Organization	MNA 4200.9	
NCA-4134.6	Quality Assurance Program	MNA 4200.10	
	Design Control	MNA 4200.11	
NCA-4134.7	Procurement Document Control	MNA 4200.12	
	Instructions, Procedures and Drawings	MNA 4200.13	
NCA-4134.8		MNA 4200.14	
	Document Control	MNA 4200.15	
NCA-			

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
4134.9 NCA-4134.10 NCA-4134.11 NCA-4134.12 NCA-4134.13 NCA-4134.14 NCA-4134.15 NCA-4134.16 NCA-4134.17 NCA-4134.18	Control of Purchased Items and Services Identification and Control of Items Control of Processes Inspection Test Control Control of Measuring and Test Equipment Handling, Storage and Shipping Inspection and Test Status Control of Nonconforming Items Corrective Action Quality Assurance Records Audits	MNA 4200.16 MNA 4200.17 MNA 4200.18	- Identical - The Authorized Inspection Agency (AIA) shall be accredited in accordance with KEPIC-QAI referred to ASME QAI-1, and when required, shall be designated or accredited from the Korean Regulatory Authority. The others are identical. - Identical - Identical - Satisfied. Requirements of KEPIC are more detail.

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
		MNA 5000	- Identical
		MNA 5100	
		MNA 5110	- Identical, and satisfied by Overall of this Section
		MNA 5120	- Identical, and the requirements for Division 3 are added.
		MNA 5121	
			- Identical, and the requirements for Division 3 are added.
			- Identical
		MNA 5122	
			- Identical
		MNA 5123	
			- Identical, and the requirements for Division 3 are added.
	Authorized Inspection	MNA 5300	
	Introduction		- Identical
	Applicability	MNA 5130	- Identical
NCA-5000	Performance of Inspection	MNA 5400	- Identical, and the requirements for Division 2 are separated to KEPIC-SNA.
NCA-5100	Authorized Inspection Agency	MNA 5410	
			- Identical, except for addition of duties required by the Regulatory Authority
NCA-5110		MNA 5410	
NCA-5120		MNA 5420	
NCA-5121			
	Authorized Nuclear Inspector Supervisor	MNA 5430	
		MNA 5440	

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		KEPIC MNA	Differences
Article No.	Title	Article No.	
	Authorized Nuclear Inspector	MNA 5450	
NCA-5122	Duties of Authorized Nuclear Inspector Supervisors	MNA 5460	
NCA-5123	Access for Inspection Agency Personnel	MNA 5470	
NCA-5125		MNA 5480	
	Duties of Inspector		
NCA-5130	General Inspection Duties	MNA 5200	
NCA-5200	Categories of Inspector's Duties		
NCA-5210	Scope of Work, Design Specifications and Design Reports		
NCA-5220	Quality Assurance Programs		
NCA-5230	Qualification Records		
NCA-5240	Materials, Parts and Heat Treatment		
NCA-5250	Examinations and Tests		
NCA-5260	Final Tests		
NCA-5270	Data Reports and Construction Reports		
NCA-5280			
NCA-5290	Responsibilities of the Authorized Inspection Agency		
NCA-5300			- Not adopted Stamping, but KEPIC Symbol marking on the nameplate.

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
NCA-8000	**Certificates, Nameplates, Code Symbol Stamping, and Data Reports** Authorization to Perform Code	**MNA 8000** MNA 8100 MNA 8110 MNA 8120 MNA 8130 MNA 8140 MNA 8150 MNA 8151	- Division 3 items and Subcontracted Service Organizations are included in the scopes for accreditation by KEA. And Division 2 items are separated to KEPIC-SNA. General guides for Certificates are identical or very similar to those of ASME Sec.III. (Refer to Table MNA 8100) - Identical - Identical (Refer to MNA 4000) - Identical - Identical. And requirements for Division 3 items are added. - Identical - Identical - Identical. And additional documentation requirements for an applicant related to pressure relief devices are included. - Identical - Identical - Identical - Certification of Material Organization - Not adopted Stamping

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		KEPIC MNA	Differences
Article No.	Title	Article No.	
	Activities	MNA 8152	- KEPIC Symbol application instead of Stamping, if applicable, Owner's equipment number, and pressure class rating of KEPIC-MGG referred to ASME B16.34 for line valves are included in contents of nameplate.
NCA-8100	General	MNA 8153	
NCA-8110		MNA 8160	
	Scope of Certificates	MNA 8161	
NCA-8120			- Requirements of KEPIC Symbol application are described. (Refer to FIG. MNA 8212)
		MNA 8162	- Identical
		MNA 8170	- Identical
		MNA 8180	- Identical
	Inspection Agreement Required	MNA 8190	- Identical
NCA-8130	Quality Assurance Program Requirements	MNA 8200	- Identification requirements for removable items of Division 3 are described.
NCA-8140	Application for Accreditation	MNA 8210	
NCA-8150	Field Operation	MNA 8211	
NCA- 8151	Shop Assembly		- Identical, except for KEPIC Symbol application instead of Stamping
NCA-8152	Activities Prior to Obtaining a Certificate		
NCA-8153			
NCA-8160	Evaluation	MNA 8212	- Identical, except for KEPIC Symbol application instead of Stamping
NCA-8161	Evaluation for a Certificate		- Identical, except for KEPIC Symbol application instead of Stamping
		MNA 8213	
NCA-8162	Evaluation for an Owner's Certificate	MNA 8220	- Alternative requirements for attachment of Division 3 containments are described.
NCA-8170	Issuance	MNA 8230	

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		KEPIC MNA	Differences
Article No.	Title	Article No.	
NCA-8180	Renewal	MNA 8240	- Identical, except for KEPIC Symbol application instead of Stamping
(None)	(None)	MNA 8250	
NCA-8200	Nameplates and Stamping		
NCA-8210	General Requirements	MNA 8300	- Refer to Table MNA 6600
NCA-8211	Nameplates	MNA 8310	- Identical except for separation Division 2 Data Reports to KEPIC-SNA
			- Not intentional exclusion
		MNA 8320	- Identical
		MNA 8321	- Identical
NCA-8212	Stamping		
		MNA 8322	- Not adopted NS Certificate. NF-1 Data Reports are applied to welded supports.
MNA 8213	Attachment of Nameplates		
NCA-8220	Nameplates for Components	MNA 8323	
NCA-8230	Nameplates for NPT Stamped Items		
NCA-8240	Removed Nameplates	MNA 8330	
(None)	(None)		
		MNA 6600	
NCA-8300	Code Symbol Stamps	MNA 6610	
NCA-8310	General Requirements	MNA 6611	
NCA-8320	Application of the N Symbol Stamp	(None)	

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		**KEPIC MNA**	**Differences**
Article No.	**Title**	**Article No.**	
NCA-8321	Authorization and Time of Stamping	MNA 6620 MNA 6630	
NCA-8322	Application of the N Symbol Stamp at Field Site or Other Locations		- Identical
(None)	(None)	MNA 6640	- Identical, except for the case of administrative differences between KEPIC-MN and ASME Sec.III.
NCA-8330	Parts and Piping Subassemblies Furnished without Stamping		
NCA-8400	Data Reports		
NCA-8410	General Requirements		
NCA-8411	Compiling Data Report Records		
NCA-8412	Availability of Data Reports		
NCA-8420	Owner's Data Report		
NCA-8430	Data Reports, Tubular Products and Fittings Welded with Filler Metal		
NCA-8440	Certificates of Conformance for Welded Supports	**MNA 9000** MNA 9100 MNA 9200	

Subject	ASME Sec.III NCA (2007) vs. KEPIC MNA (2008)		
ASME Sec. III NCA		KEPIC MNA	Differences
Article No.	Title	Article No.	
	Glossary		
NCA-9000	Introduction		
NCA-9100	Definitions		
NCA-9200			

APPENDIX D: CSA N285 VERSUS ASME SECTION III DETAILED COMPARISON TABLE

Appendix D1: CSA N285.0 Versus ASME Section III Div. 1 – NB Comparison

Appendix D2 : CSA N285.0 Versus ASME SECTION III DIV. 1 - NCA COMPARISON

Appendix D: CSA N285.0 VS. ASME Section III Div. 1 – NB Comparison

<u>Code Editions</u>:

1. CSA Standard N285.0 – 2008 (Update 2)
2. ASME BPV Code Section III, Div. 1, NB, 2007 Edition (No Addenda)

<u>Comparison Scale Used</u>:

These are the definitions of the scale used for the code comparison throughout the report.

A1 – SAME Requirements classified as category A1 are considered to be technically identical. Requirements are classified as category A1 and considered to be the same even if there are inconsequential differences in wording, such as might result due to translation from one language to another, as long as the wording does not change the meaning or interpretation of the requirement. Likewise, differences in paragraph numbering are not considered when classifying requirements as long as the same requirement exists in both codes being compared.	B1 - DIFFERENT – NOT SPECIFIED Requirements are considered to be different - not specified, if one code or standard includes requirements that the compared code or standard does not specify. This classification may result because of differences in the scope of equipment covered by a respective code, the scope of industrial practices applied in context of the respective code, differences in regulatory requirements applicable in conjunction with application of a particular code, or simply as a result of differences in requirements addressed in one code versus those of another.
A2 – EQUIVALENT Requirements are considered to be equivalent when applying either code or standard, if compliance with the applied code or standard will also meet the requirements of the other code or standard. Equivalence is not affected by differences in level of precision of unit conversions.	B2 - TECHNICALLY DIFFERENT Requirements are considered to be technically different if either code requires something more or less than, or otherwise technically different from, the requirements imposed by the other. These differences might be due to different technical approaches applied by a code or imposition of regulatory requirements within the country from which a code originates.

These are the definitions of the scale used for the code comparison throughout the report.

Summary of Comparison:

The Table shown below shows a preliminary comparison and indicates many areas that are identical, some that are similar or equivalent and a few that are different. A detailed line-by-line comparison is performed to highlight these differences.

Subject	ASME	CSA	Comment
Introduction (Scope)	NB-1000	Preface & Clause 1	A1, End Note
Material	NB-2000	Clause 8.1.1	A1, End Note
Design	NB-3000	Clause 7.1.1	A1, End Note
Fabrication Installation	NB-4000	Clause 9.2.1	A1, End Note
Examination	NB-5000	Clause 11.1.1	A1, B2, End Note
Testing	NB-6000	Clause 11.4.4	A1, End Note
Overpressure Protection	NB-7000	Clause 7.7.1.1	A1, End Note

NB-1000: INTRODUCTION		**Compared to CSA N285.0 Preface and Clause 1: Scope**	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-1100	**SCOPE**		
NB-1110	Aspects of Construction Covered by these Rules	Identical	A1
NB-1120	Temperature Limits	Identical	A1
NB-1130	Boundaries of Jurisdiction Applicable to this Subsection		
NB-1131	Boundary of Components	Identical	A1
NB-1132	Boundary Between Components and Attachments		
NB-1140	Electrical and Mechanical Penetration Assemblies	Identical (ID-E)[4] • Annex I has some requirements for penetration	A1

4. See end notes at the end of this appendix.

NB-2000: MATERIALS		Compared to CSA N285.0 Clause 8.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-2100	**GENERAL REQUIREMENTS FOR MATERIAL**		
NB-2110	Scope of principal terms employed	Identical (ID-E) • Materials not covered by the rules of ASME, specific to CANDU nuclear power plants, the rules provided by the CSA N285.6 governs.	A1
NB-2120	Pressure-retaining material		
NB-2121	Permitted Material Specifications	Identical	A1
NB-2122	Special Requirements Conflicting With Permitted Material Specifications		
NB-2124	Size Ranges		
NB-2125	Fabricated Hubbed Flanges		
NB-2126	Finned Tubes		
NB-2127	Seal Membrane Material		
NB-2128	Bolting Material		
NB-2130	Certification of material	Identical	A1
NB-2140	Welding material	Identical	A1
NB-2150	Material identification	Identical	A1
NB-2160	Deterioration of material in-service	Identical	A1
NB-2170	Heat treatment to enhance impact properties	Identical	A1
NB-2180	Procedures for heat treatment of material	Identical	A1
NB-2190	Nonpressure-retaining Material	Identical	A1
NB-2200	**MATERIAL TEST COUPONS AND SPECIMENS FOR FERRITIC STEEL MATERIAL**		
NB-2210	Heat treatment Requirements		
NB-2211	Test Coupon Heat Treatment for Ferritic Material	Identical	A1
NB-2212	Test Coupon Heat Treatment for Quenched and Tempered Material		

NB-2000: MATERIALS		Compared to CSA N285.0 Clause 8.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-2220	Procedure For Obtaining Test Coupons And Specimens For Quenched And Tempered Material		
NB-2221	General Requirements	Identical	A1
NB-2222	Plates		
NB-2223	Forgings		
NB-2224	Bar and Bolting Material		
NB-2225	Tubular Products and Fittings		
NB-2226	Tensile Test Specimen Location		
NB-2300	**FRACTURE TOUGHNESS REQUIREMENTS FOR MATERIAL**		
NB-2310	Material to be impact tested		
NB-2311	Material for Which Impact Testing Is Required	Identical	A1
NB-2320	Impact test procedures		
NB-2321	Type of Tests	Identical	A1
NB-2322	Test Specimens		
NB-2330	Test requirements and acceptance standards		
NB-2331	Material for Vessels	Identical	A1
NB-2332	Material for Piping, Pumps and Valves, Excluding Bolting Material		
NB-2333	Bolting Material		
NB-2340	Number of impact tests required		
NB-2341	Plates	Identical	A1
NB-2342	Forgings and Castings		
NB-2343	Bars		
NB-2344	Tubular Products and Fittings		
NB-2345	Bolting Material		
NB-2346	Test Definitions		

NB-2000: MATERIALS		**Compared to CSA N285.0 Clause 8.1.1**	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-2350	Retests	Identical	A1
NB-2360	Calibration of instruments and equipment	Identical	A1
NB-2400	**WELDING MATERIAL**		
NB-2410	General requirements	Identical	A1
NB-2420	Required tests	Identical	A1
NB-2430	Weld metal tests		
NB-2431	Mechanical Properties Test	Identical	A1
NB-2432	Chemical Analysis Test		
NB-2343	Delta Ferrite Determination		
NB-2440	Storage and handling of welding material	Identical	A1
NB-2500	**EXAMINATION AND REPAIR OF PRESSURE-RETAINING MATERIAL**		
NB-2510	Examination of pressure-retaining Material	Identical	A1
NB-2520	Examination after quenching and tempering	Identical	A1
NB-2530	Examination and repair of Plate		
NB-2531	Required Examinations	Identical	A1
NB-2532	Examination Procedures		
NB-2537	Time of Examination		
NB-2538	Elimination of Surface Defects		
NB-2539	Repair by Welding		
NB-2540	Examination and repair of forgings and bars		
NB-2541	Required Examinations	Identical	A1
NB-2542	Ultrasonic Examination		
NB-2545	Magnetic Particle Examination		
NB-2546	Liquid Penetrant Examination		
NB-2547	Time of Examination		

NB-2000: MATERIALS		Compared to CSA N285.0 Clause 8.1.1	
Clause #	Clause Title	Comment	Scale
NB-2548	Examination of Surface Defects		
NB-2549	Repair by Welding		
NB-2550	Examination and repair of Seamless and welded (without filler metal) Tubular products and Fittings		
NB-2551	Required Examination	Identical	A1
NB-2552	Ultrasonic Examination		
NB-2553	Radiographic Examination		
NB-2554	Eddy Current Examination		
NB-2555	Magnetic Particle Examination		
NB-2556	Liquid Penetrant Examination		
NB-2557	Time of Examination		
NB-2558	Elimination of Surface Defects		
NB-2559	Repair by Welding		
NB-2560	Examination and repair of Tubular products and Fittings welded with filler Metal		
NB-2561	Required Examination	Identical	A1
NB-2562	Ultrasonic Examination		
NB-2563	Radiographic Examination		
NB-2564	Eddy Current Examination		
NB-2565	Magnetic Particle Examination		
NB-2566	Liquid Penetrant Examination		
NB-2567	Time of Examination		
NB-2568	Elimination of Surface Defects		
NB-2569	Repair by Welding		
NB-2570	Examination and repair of Statically and Centrifugally cast products	Identical	A1
NB-2580	Examination of bolts, studs and nuts		
NB-2581	Required Examination	Identical	A1

NB-2000: MATERIALS		Compared to CSA N285.0 Clause 8.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-2582	Visual Examination		
NB-2583	Magnetic Particle Examination		
NB-2584	Liquid Penetrant Examination		
NB-2585	Ultrasonic Examination for Sizes Greater Than 2 in		
NB-2586	Ultrasonic Examination for Sizes Over 4 in		
NB-2587	Time of Examination		
NB-2588	Elimination of Surface Defects		
NB-2589	Repair by Welding		
NB-2600	MATERIAL ORGANIZATIONS' QUALITY SYSTEM PROGRAMS		
NB-2610	Documentation and maintenance of quality system programs	Identical	A1
NB-2700	DIMENSIONAL STANDARDS	Identical	A1

NB-3000: DESIGN		Compared to CSA N285.0 Clause 7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-3100	**GENERAL DESIGN**		
NB-3110	Loading Criteria		
NB-3111	Loading Conditions	Identical	A1
NB-3112	Design Loadings		
NB-3113	Service Conditions		
NB-3120	Special Considerations		
NB-3121	Corrosion	Identical	A1
NB-3122	Cladding		
NB-3123	Welding		
NB-3124	Environmental Effects		
NB-3125	Configuration		

NB-3000: DESIGN		Compared to CSA N285.0 Clause 7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-3130	General Design Rules		
NB-3131	Scope	Identical	A1
NB-3132	Dimensional Standards for Standard Products		
NB-3133	Components Under External Pressure		
NB-3134	Leak Tightness		
NB-3135	Attachments		
NB-3136	Appurtenances		
NB-3137	Reinforcement for Openings		
NB-3200	DESIGN BY ANALYSIS		
NB-3210	Design Criteria		
NB-3211	Requirements for Acceptability	Identical	A1
NB-3212	Basis for Determining Stresses		
NB-3213	Terms Relating to Stress Analysis		
NB-3214	Stress Analysis		
NB-3215	Derivation of Stress Intensities		
NB-3217	Classification of Stresses		
NB-3220	Stress Limits for Other than Bolts		
NB-3221	Design Loadings	Identical	A1
NB-3222	Level A Service Limits		
NB-3223	Level B Service Limits		
NB-3224	Level C Service Limits		
NB-3225	Level D Service Limits		
NB-3226	Testing Limits		
NB-3227	Special Stress Limits		
NB-3228	Application of Plastic Analysis		
NB-3229	Design Stress Values		

NB-3000: DESIGN		Compared to CSA N285.0 Clause 7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-3230	Stress Limits for Bolts		
NB-3231	Design Conditions	Identical	A1
NB-3232	Level A Service Limits		
NB-3233	Level B Service Limits		
NB-3234	Level C Service Limits		
NB-3235	Level D Service Limits		
NB-3236	Design Stress Intensity Values		
NB-3300	VESSEL DESIGN		
NB-3310	General Requirements		
NB-3311	Acceptability	Identical	A1
NB-3320	Design Considerations		
NB-3321	Design and Service Loadings	Identical	A1
NB-3322	Special Considerations		
NB-3323	General Design Rules		
NB-3324	Tentative Pressure Thickness		
NB-3330	Openings and Reinforcement		
NB-3331	General Requirements for Openings	Identical	A1
NB-3332	Reinforcement Requirements for Openings in Shells and Formed Heads		
NB-3333	Reinforcement Requirements for Openings in Flat Heads		
NB-3334	Limits of Reinforcement		
NB-3335	Metal Available for Reinforcement		
NB-3336	Strength of Reinforcing Material		
NB-3337	Attachment of Nozzles and Other Connections		
NB-3338	Fatigue Evaluations of Stressed in Openings		
NB-3339	Alternative Rules for Nozzle Design		

NB-3000: DESIGN		Compared to CSA N285.0 Clause 7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-3340	Analysis of Vessels	Identical	A1
NB-3350	Design of Welded Construction		
NB-3351	Welded Joint Category	Identical	A1
NB-3352	Permissible Types of Welded Joints		
NB-3354	Structural Attachment Welds		
NB-3355	Welding Grooves		
NB-3357	Thermal Treatment		
NB-3360	Special Vessel Requirements		
NB-3361	Category A or B Joint Between Sections of Unequal Thickness	Identical	A1
NB-3362	Bolted Flange Connections		
NB-3363	Access Openings		
NB-3364	Attachments		
NB-3365	Supports		
NB-3400	PUMP DESIGN		
NB-3410	General Requirements for Centrifugal Pumps		
NB-3411	Scope	Identical	A1
NB-3412	Acceptability		
NB-3414	Design and Service Conditions		
NB-3415	Loads from Connected Piping		
NB-3417	Earthquake Loadings		
NB-3418	Corrosion		
NB-3419	Cladding		

NB-3000: DESIGN		Compared to CSA N285.0 Clause 7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-3420	Definitions		
NB-3421	Radially Split Casing	Identical	A1
NB-3422	Axially Split Casing		
NB-3423	Single and Double Volute Casings		
NB-3424	Seal Housing		
NB-3425	Typical Examples of Pump Types		
NB-3430	Design Requirements for Centrifugal Pumps		
NB-3431	Design of Welding	Identical	A1
NB-3432	Cutwater Tip Stresses		
NB-3433	Reinforcement of Pump Casing Inlets and Outlets		
NB-3434	Bolting		
NB-3435	Piping		
NB-3436	Attachments		
NB-3437	Pump Covers		
NB-3438	Supports		
NB-3440	Design of Specific Pump Types		
NB-3441	Standard Pump Types	Identical	A1
NB-3442	Special Pump Types – Type J Pumps		
NB-3500	**VALVE DESIGN**		
NB-3510	Acceptability		
NB-3511	General Requirements	Identical	A1
NB-3512	Acceptability of Large Valves		
NB-3513	Acceptability of Small Valves		
NB-3515	Acceptability of Metal Bellows and Metal Diaphragm Stem Sealed Valves		

NB-3000: DESIGN		Compared to CSA N285.0 Clause 7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-3520	Design Considerations		
NB-3521	Design and Service Loadings	Identical	A1
NB-3524	Earthquake		
NB-3525	Level A and B Service Limits		
NB-3526	Level C Service Limits		
NB-3527	Level D Service Limits		
NB-3530	General Rules		
NB-3531	Pressure-Temperature Ratings and Hydrostatic Tests	Identical	A1
NB-3532	Design Stress		
NB-3533	Marking		
NB-3534	Nomenclature		
NB-3540	Design of Pressure-Retaining Parts		
NB-3541	General Requirements for Body Wall Thickness	Identical	A1
NB-3542	Minimum Wall Thickness of Listed Pressure Rated Valves		
NB-3543	Minimum Wall Thickness of Valves of Nonlisted Pressure Rating		
NB-3544	Body Shape Rules		
NB-3545	Body Primary and Secondary Stress Limits		
NB-3546	Design Requirements for Valve Parts Other than Bodies		
NB-3550	Cyclic Loading Requirements		
NB-3551	Verification of Adequacy for Cyclic Conditions	Identical	A1
NB-3552	Excluded Cycles		
NB-3553	Fatigue Usage		
NB-3554	Cyclic Stress Calculations		

NB-3000: DESIGN		Compared to CSA N285.0 Clause 7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-3560	Design Reports		
NB-3561	General Requirements	Identical	A1
NB-3562	Design Report for Valves Larger than NPS 4 (DN 100)		
NB-3563	Design Report Requirements for NPS 4 and Smaller (≤ DN100)		
NB-3590	Pressure Relief Valve Design		
NB-3591	Acceptability	Identical	A1
NB-3592	Design Considerations		
NB-3593	Special Design Rules		
NB-3594	Design of Pressure Relief Valve Parts		
NB-3595	Design Report		
NB-3600	**PIPING DESIGN**		
NB-3610	General Requirements		
NB-3611	Acceptability	Identical	A1
NB-3612	Pressure-Temperature Ratings		
NB-3613	Allowances		
NB-3620	Design Considerations		
NB-3621	Design and Service Loadings	Identical	A1
NB-3622	Dynamic Effects		
NB-3623	Weight Effects		
NB-3624	Thermal Expansion and Contraction Loads		
NB-3625	Stress Analysis		
NB-3630	Piping Design and Analysis Criteria	Identical	A1

NB-3000: DESIGN		**Compared to CSA N285.0 Clause 7.1.1**	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-3640	Pressure Design		
NB-3641	Straight Pipe	Identical	A1
NB-3642	Curved Segments of Pipe		
NB-3643	Intersections		
NB-3644	Miters		
NB-3646	Closures		
NB-3647	Pressure Design of Flanged Joints and Blanks		
NB-3648	Reducers		
NB-3649	Pressure Design of Other Piping Products		
NB-3650	Analysis of Piping Products		
NB-3651	General Requirements	Identical	A1
NB-3652	Consideration of Design Conditions		
NB-3653	Considerations of Level A Service Limits		
NB-3654	Considerations of Level B Service Limits		
NB-3655	Considerations of Level C Service Limits		
NB-3656	Considerations of Level D Service Limits		
NB-3657	Test Loadings		
NB-3658	Analysis of Flanged Joints		
NB-3660	Design of Welds		
NB-3661	Welded joints	Identical	A1
NB-3670	Special Piping Requirements		
NB-3671	Selection and Limitation of Non-welded Piping Joints	Identical	A1
NB-3672	Expansion and Flexibility		
NB-3674	Design of Pipe Supporting Elements		
NB-3677	Pressure Relief Piping		

NB-3000: DESIGN		Compared to CSA N285.0 Clause 7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-3680	Stress Indices and Flexibility Factors		
NB-3681	Scope	Identical	A1
NB-3682	Definitions of Stress Indices and Flexibility Factors		
NB-3683	Stress Indices for Use With NB-3650		
NB-3684	Stress Indices for Detailed Analysis		
NB-3685	Curved Pipe or Welding Elbows		
NB-3686	Flexibility Factors		
NB-3690	Dimensional Requirements for Piping Products		
NB-3691	Standard Piping Products	Identical	A1
NB-3692	Nonstandard Piping Products		

NB-4000: FABRICATION AND INSTALLATION		Compared to CSA N285.0 Clause 9.2.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-4100	GENERAL REQUIREMENTS		
NB-4110	Introduction	Identical	A1
NB-4120	Certification of materials and fabrication by Certificate holder		
NB-4121	Means of Certification	Identical	A1
NB-4122	Material Identification		
NB-4123	Examinations		
NB-4125	Testing of Welding and Brazing Material		
NB-4130	Repair of material	Identical	A1

NB-4000: FABRICATION AND INSTALLATION		Compared to CSA N285.0 Clause 9.2.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-4200	**FORMING, FITTING, AND ALIGNING**		
NB-4210	Cutting, forming and bending		
NB-4211	Cutting	Identical	A1
NB-4212	Forming and Bending Processes		
NB-4213	Qualification of Forming Processes for Impact Property Requirements		
NB-4214	Minimum Thickness of Fabricated Material		
NB-4220	Forming tolerances		
NB-4221	Tolerances for Vessel Shells	Identical	A1
NB-4222	Tolerances for Formed Vessel Heads		
NB-4223	Tolerances for Formed or Bent Piping		
NB-4230	Fitting and aligning		
NB-4231	Fitting and Aligning Methods	Identical	A1
NB-4232	Alignment Requirements When Components are Welded From Two Sides		
NB-4233	Alignment Requirements When Inside Surfaces Are Inaccessible		
NB-4240	Requirements for weld joints in components		
NB-4241	Category A Weld Joints in Vessels and Longitudinal Weld Joints in Other Components	Identical	A1
NB-4242	Category B Weld Joints in Vessels and Circumferential Weld Joints in Other Components		
NB-4243	Category C Weld Joints in Vessels and Similar Weld Joints in Other Components		
NB-4244	Category D Weld Joints in Vessels and Similar Weld Joints in Other Components		
NB-4245	Complete Joint Penetration Welds		
NB-4246	Piping Branch Connections		

NB-4000: FABRICATION AND INSTALLATION		Compared to CSA N285.0 Clause 9.2.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-4250	Welding end transitions — maximum envelope	Identical	A1
NB-4300	**WELDING QUALIFICATIONS**		
NB-4310	General Requirements		
NB-4311	Types of Processes Permitted	Identical	A1
NB-4320	Welding Qualifications, Records and Identifying Stamps		
NB-4321	Required Qualifications	Identical	A1
NB-4322	Maintenance and Certification of Records		
NB-4323	Welding Prior to Qualifications		
NB-4324	Transferring Qualifications		
NB-4330	General Requirements for Welding Procedure Qualification Tests		
NB-4331	Conformance to Section IX Requirements	Identical	A1
NB-4333	Heat Treatment of Qualification Welds for Ferritic Materials		
NB-4334	Preparation of Test Coupons and Specimens		
NB-4335	Impact Test Requirements		
NB-4336	Qualification Requirements for Built-up Weld Deposits		
NB-4337	Welding of Instrument Tubing		
NB-4350	Special Qualification Requirements for Tube-to-Tubesheet Welds	Identical	A1
NB-4360	Qualification Requirements for Welding Specially Designed Welded		
NB-4361	General Requirements	Identical	A1
NB-4362	Essential Variables for Automatic Machine and Semiautomatic Welding		
NB-4363	Essential Variables for Manual Welding		
NB-4366	Test Assembly		
NB-4367	Examination of Test Assembly		
NB-4368	Performance Qualification Test		

NB-4000: FABRICATION AND INSTALLATION		Compared to CSA N285.0 Clause 9.2.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-4400	**RULES GOVERNING MAKING, EXAMINING, AND REPAIRING WELDS**		
NB-4410	Precautions to Be Taken Before Welding		
NB-4411	Identification, Storage, and Handling of Welding Material	Identical	A1
NB-4412	Cleanliness and Protection of Welding Surfaces	Identical	A1
NB-4420	Rules for Making Welded Joints		
NB-4421	Backing Rings	Identical	A1
NB-4422	Peening		
NB-4423	Miscellaneous Welding Requirements		
NB-4424	Surface of Welds		
NB-4425	Welding Items of Different Diameters		
NB-4426	Reinforcement of Welds		
NB-4427	Shape and Size of Fillet Welds		
NB-4428	Seal Welds of Threaded Joints		
NB-4429	Welding of Clad Parts		
NB-4430	Welding of Attachments		
NB-4431	Materials for Attachments	Identical	A1
NB-4432	Welding of Structural Attachments		
NB-4433	Structural Attachments		
NB-4434	Welding of Internal Structural Supports to Clad Components		
NB-4435	Welding of Nonstructural Attachments and Their Removal		
NB-4436	Installation of Attachments to Piping Systems After Testing		
NB-4440	Welding of Appurtenances	Identical	A1

NB-4000: FABRICATION AND INSTALLATION		Compared to CSA N285.0 Clause 9.2.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-4450	Repair of Weld Metal Defects		
NB-4451	General Requirements	Identical	A1
NB-4452	Elimination of Surface Defects		
NB-4453	Requirements for Making Repairs of Welds		
NB-4500	BRAZING		
NB-4510	Rules for Brazing		
NB-4511	Where Brazing May be Used	Identical	A1
NB-4512	Brazing Material		
NB-4520	Brazing Qualification Requirements		
NB-4521	Brazing Procedure and Performance Qualification	Identical (ID-E) The welding and brazing procedures are required to be registered by the authorized inspection agency as required by CSA N285 Clause 6.1.11.1	A1
NB-4522	Valve Seat Rings		
NB-4523	Reheated Joints		
NB-4524	Maximum Temperature Limits		
NB-4530	Fitting and Aligning of Parts to be Brazed	Identical	A1
NB-4540	Examination of Brazed Joints	Identical	A1
NB-4600	**HEAT TREATMENT**		
NB-4610	Welding Preheat Requirements		
NB-4611	When Preheat is Necessary	Identical	A1
NB-4612	Preheating Methods		
NB-4613	Interpass Temperature		
NB-4620	Postweld Heat Treatment		
NB-4621	Heating and Cooling Methods	Identical	A1
NB-4622	PWHT Time and Temperature Requirements		
NB-4623	PWHT Heating and Cooling Rate Requirements		
NB-4624	Methods of Postweld Heat Treatment		

NB-4000: FABRICATION AND INSTALLATION		Compared to CSA N285.0 Clause 9.2.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-4630	Heat Treatment of Welds Other Than the Final Postweld Heat Treatment	Identical	A1
NB-4650	Heat Treatment After Bending or Forming for Pipes, Pumps and Valves		
NB-4651	Conditions Requiring Heat Treatment After Bending or Forming	Identical	A1
NB-4652	Exemptions From Heat Treatment After Bending Forming		
NB-4660	Heat Treatment of Electroslag Welds	Identical	A1
NB-4700	**MECHANICAL JOINTS**		
NB-4710	Bolting and Threading		
NB-4711	Thread Engagement	Identical	A1
NB-4712	Thread Lubricants		
NB-4713	Removal of Thread Lubricants		
NB-4720	Bolting Flanged Joints	Identical	A1
NB-4730	Electrical and Mechanical Penetration Assemblies	Identical	A1

NB-5000: EXAMINATION		Compared to CSA N285.0 Clause 11.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-5100	**GENERAL REQUIREMENTS FOR EXAMINATION**		
NB-5110	Methods, Nondestructive Examination Procedures and Cleaning		
NB-5111	Methods	Identical	A1
NB-5112	Nondestructive Examination Procedures		
NB-5113	Post-Examination Cleaning		
NB-5120	Time of Examination of Welds and Weld Metal Cladding	Identical	A1
NB-5130	Examination of Weld Edge Preparation Surfaces	Identical	A1

NB-5000: EXAMINATION		Compared to CSA N285.0 Clause 11.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-5140	Examination of Welds and Adjacent Base Material	Identical	A1
NB-5200	**REQUIRED EXAMINATION OF WELDS FOR FABRICATION AND PRE-SERVICE BASELINE**		
NB-5210	Category A Vessel Welded Joints and Longitudinal Welded Joints in Other Components	Identical	A1
NB-5220	Category B Vessel Welded Joints and Circumferential Welded Joints in Piping, Pumps and Valves		
NB-5221	Vessel Welded Joints	Identical	A1
NB-5222	Piping, Pump and Valve Circumferential Welded Joints		
NB-5230	Category C Vessel Welded Joints and Similar Welded Joints in Other Components		
NB-5231	General Requirements	Identical	A1
NB-5240	Category D Vessel Welded Joints and Branch and Piping Connections in Other Components		
NB-5241	General Requirements	Identical	A1
NB-5242	Full Penetration Butt Welded Nozzles, Branch and Piping Connections		
NB-5243	Corner Welded Nozzles, Branch and Piping Connections		
NB-5244	Weld Metal Building at Openings for Nozzles, Branch and Piping Connections		
NB-5245	Fillet Welded and Partial Penetration Welded Joints		
NB-5246	Oblique Full Penetration Nozzles, Branch and Piping Connections		
NB-5260	Fillet, Partial Penetration, Socket and Attachment Welded Joints		
NB-5261	Fillet, Partial Penetration and Socket Welded Joints	Identical	A1
NB-5262	Structural Attachment Welded Joints		

NB-5000: EXAMINATION		Compared to CSA N285.0 Clause 11.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-5270	Special Welded Joints		
NB-5271	Welded Joints of Specially Designed Seals	Identical	A1
NB-5272	Weld Metal Cladding		
NB-5273	Hard Surfacing		
NB-5274	Tube-to-Tubesheet Welded Joints		
NB-5275	Brazed Joints		
NB-5276	Inertia and Continuous Drive Friction Welds		
NB-5277	Electron Beam Welds		
NB-5278	Electroslag Welds		
NB-5279	Special Exceptions		
NB-5280	Pre-service Examination		
NB-5281	General Requirements	Identical	A1
NB-5282	Examination Requirements		
NB-5283	Components Exempt From Preservice Examination		
NB-5300	**ACCEPTANCE STANDARDS**		
NB-5320	Radiographic Acceptance Standards	Identical	A1
NB-5330	Ultrasonic Acceptance Standards		
NB-5331	Fabrication	Identical	A1
NB-5332	Preservice Examination		
NB-5340	Magnetic Particle Acceptance Standards		
NB-5341	Evaluation of Indications	Identical	A1
NB-5342	Acceptance Standards		
NB-5343	Preservice Examination		

NB-5000: EXAMINATION		Compared to CSA N285.0 Clause 11.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-5350	Liquid Penetrant Acceptance Standards		
NB-5351	Evaluation of Indications	Identical	A1
NB-5352	Acceptance Standards		
NB-5353	Preservice Examination		
NB-5360	Eddy Current Preservice Examination of Installed Non-ferromagnetic Steam Generator Heat Exchanger Tubing	Identical	A1
NB-5370	Visual Acceptance Standards for Brazed Joints	Identical	A1
NB-5380	Bubble Formation Testing	Identical	A1
NB-5400	**FINAL EXAMINATION OF VESSELS**		
NB-5410	Examination After HydroStatic Test	Identical	A1
NB-5500	**QUALIFICATIONS AND CERTIFICATION OF NONDESTRUCTIVE EXAMINATION PERSONNEL**		
NB-5510	General Requirements	Identical	A1
NB-5520	Personnel Qualification, Certification and Verification		
NB-5521	Qualification Procedure	Different CSA Clause 11.3: The licensee shall have documentation to demonstrate that persons performing nondestructive examinations on pressure-retaining components were, at the time of the examinations, qualified in accordance with the following standards: In Canada: (i) radiography, ultrasonic, magnetic particle, liquid penetrant, and eddy current methods – CAN/CGSB-48.9712/ISO 9712; and (ii) other methods — standards acceptable to the licensee and the authorized inspection agency. Outside Canada: all methods — standards acceptable to the licensee and the authorized inspection agency. Note: Stamped items are acceptable in Canada and in this case the use of SNT-TC-1A for qualification of NDE personnel is acceptable provided the AIA and the Licensee accepted its use.	B2
NB-5522	Certification of Personnel		
NB-5523	Verification of Nondestructive Examination Personnel Certification		
NB-5530	Records	Identical	A1

NB-6000: TESTING		Compared to CSA N285.0 Clause 11.4.4	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-6100	**GENERAL REQUIREMENTS**		
NB-6110	Pressure Testing of Components, Appurtenances and Systems		
NB-6111	Scope of Pressure Testing	Identical	A1
NB-6112	Pneumatic Testing		
NB-6113	Witnessing of Pressure Tests		
NB-6114	Time of Pressure Testing		
NB-6115	Machining After Pressure Test		
NB-6120	Preparation for Testing		
NB-6211	Exposure of Joints	Identical	A1
NB-6212	Addition of Temporary Supports		
NB-6213	Restraint or Isolation of Expansion Joints		
NB-6214	Isolation of Equipment Not Subjected to Pressure Test		
NB-6215	Treatment of Flanged Joints Containing Blanks		
NB-6216	Precautions Against Test Medium Expansion		
NB-6217	Check of Test Equipment Before Applying Pressure		
NB-6200	**HYDROSTATIC TESTS**		
NB-6210	Hydrostatic Test Procedure		
		Identical	A1
NB-6220	Hydrostatic Test Pressure Requirements		
NB-6221	Maximum Required Pneumatic Test Pressure	Identical	A1
NB-6222	Maximum Permissible Test Pressure		
NB-6223	Hydrostatic Test Pressure Holding Time		
NB-6224	Examination for Leakage After Application of Pressure		

NB-6000: TESTING		Compared to CSA N285.0 Clause 11.4.4	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-6300	**PNEUMATIC TESTS**		
NB-6310	Pneumatic Testing Procedures		
NB-6311		Identical	A1
NB-6312	Test Medium and Test Temperature		
NB-6313	Procedure for Applying Pressure		
NB-6320	Pneumatic Test Pressure Requirements		
NB-6321	Maximum Required Pneumatic Test Pressure	Identical	A1
NB-6322	Maximum Permissible Test Pressure		
NB-6223	Test Pressure Holding Time		
NB-6324	Examination for Leakage After Application of Pressure		
NB-6400	**PRESSURE TEST GAGES**		
NB-6411	Types of Gages to be Used and Their Location		
NB-6412	Range of Indicating Pressure Gages	Identical	A1
NB-6413	Calibration of Pressure Test Gages		
NB-6600	**SPECIAL TEST PRESSURE SITUATIONS**		
NB-6610	Components Designed for External Pressure		
NB-6620	Pressure Testing of Combination Units		
NB-6621	Pressure Chambers Designed to Operate Independently	Identical	A1
NB-6622	Common Elements Designed for a Maximum Differential Pressure		

NB-7000: OVERPRESSURE PROTECTION		Compared to CSA N285.0 Clause 7.7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-7100	**GENERAL REQUIREMENTS**		
NB-7110	Scope	Identical	A1
NB-7120	Integrated Overpressure Protection	Identical	A1
NB-7130	Verification of the Operation of Reclosing Pressure Relief Devices		
NB-7131	Construction	Identical	A1
NB-7140	Installation		
NB-7141	Pressure Relief Devices	Identical	A1
NB-7142	Stop Valves		
NB-7143	Draining of Pressure Relief Devices		
NB-7150	Acceptable Pressure Relief Devices		
NB-7151	Pressure Relief Valves	Identical	A1
NB-7152	Nonreclosing Pressure Relief Devices		
NB-7160	Unacceptable Pressure Relief Devices		
NB-7161	Deadweight Pressure Relief Valves	Identical	A1
NB-7170	Permitted Use of Pressure Relief Devices		
NB-7171	Safety Valves	Identical	A1
NB-7172	Safety Relief Valves		
NB-7173	Relief Valves		
NB-7174	Pilot Operated Pressure Relief Valves		
NB-7175	Power Actuated Pressure Relief Valves		
NB-7176	Safety Valves with Auxiliary Actuating Devices		
NB-7177	Pilot Operated Pressure Relief Valves with Auxiliary Actuating Devices		
NB-7200	**OVERPRESSURE PROTECTION REPORT**		
NB-7210	Responsibility for Report	Identical	A1

NB-7000: OVERPRESSURE PROTECTION		**Compared to CSA N285.0 Clause 7.7.1.1**	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-7220	Content of Report	Identical CSA N285 has a Table of Contents which contains similar content as ASME Sec. III	A1
NB-7230	Certification of Report	Identical	A1
NB-7240	Review of Report After Installation	Identical	A1
NB-7250	Filing of Report	Identical	A1
NB-7300	**RELIEVING CAPACITY**		
NB-7310	Expected System Pressure Transient Conditions	Identical	A1
NB-7320	Unexpected System Excess Pressure Transient Conditions	Identical	A1
NB-7400	**SET PRESSURES OF PRESSURE RELIEF DEVICES**		
NB-7410	Set Pressure Limitations for Expected System Pressure Transient Conditions	Identical	A1
NB-7420	Set Pressure Limitation for Unexpected System Excess Pressure Transient Conditions	Identical	A1
NB-7500	**OPERATING AND DESIGN REQUIREMENTS FOR PRESSURE RELIEF VALVES**		
NB-7510	Safety, Safety Relief and Relief Valves		
NB-7511	General Requirements	Identical	A1
NB-7512	Safety Valve Operating Requirements		
NB-7513	Safety Relief and Relief Valve Operating Requirements		
NB-7514	Credited Relieving Capacity		
NB-7511	Sealing of Adjustments		

NB-7000: OVERPRESSURE PROTECTION		Compared to CSA N285.0 Clause 7.7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-7520	Pilot Operated Pressure Relief Valves		
NB-7521	General Requirements	Identical	A1
NB-7522	Operating Requirements		
NB-7523	Credited Relieving Capacity		
NB-7524	Sealing of Adjustments		
NB-7530	Power Actuated Pressure Relief Valves		
NB-7531	General Requirements	Identical	A1
NB-7532	Operating Requirements		
NB-7533	Certified Relieving Capacity		
NB-7534	Credited Relieving Capacity		
NB-7535	Sealing of Adjustments		
NB-7540	Safety Valves and Pilot Operated Pressure Relief Valves With Auxiliary Actuating Devices	Identical	A1
NB-7550	Alternative Test Media		
NB-7551	General Requirements	Identical	A1
NB-7552	Correlation		
NB-7553	Verification of Correlation Procedure		
NB-7554	Procedure		
NB-7600	NON-RECLOSING PRESSURE RELIEF DEVICES		
NB-7610	Rupture Disk Devices	Identical	A1
NB-7620	Installation		
NB-7621	Provisions for Venting or Draining	Identical	A1
NB-7622	System Obstructions		
NB-7623	Rupture Disk Devices at the Outlet Side of Pressure Relief Valves		

NB-7000: OVERPRESSURE PROTECTION		Compared to CSA N285.0 Clause 7.7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-7700	**CERTIFICATION**		
NB-7710	Responsibility for Certification of Pressure Relief Valves	Identical	A1
NB-7720	Responsibility for Certification of Non-reclosing Pressure Relief Devices	Identical	A1
NB-7730	Capacity Certification Pressure Relief Valves — Compressible Fluids		
NB-7731	General Requirements	Identical	A1
NB-7732	Flow Model Test Method		
NB-7733	Slope Method		
NB-7734	Coefficient of Discharge Method		
NB-7735	Single Valve Method		
NB-7736	Proration of Capacity		
NB-7737	Capacity Conversions		
NB-7738	Laboratory Acceptance of Pressure Relieving Capacity Tests		
NB-7739	Laboratory Acceptance of Demonstration of Function Tests		
NB-7740	Capacity Certification of Pressure Relief Valves — Incompressible Fluids		
NB-7741	General Requirements	Identical	A1
NB-7742	Valve Designs in Excess of Test Facility Limits		
NB-7743	Slope Method		
NB-7744	Coefficient of Discharge Method		
NB-7745	Single Valve Method		
NB-7746	Laboratory Acceptance of Pressure Relieving Capacity Tests		
NB-7747	Proration of Capacity		

NB-7000: OVERPRESSURE PROTECTION		Compared to CSA N285.0 Clause 7.7.1.1	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-7748	Capacity Conversions		
NB-7749	Laboratory Acceptance of Demonstration of Function Tests		
NB-7800	**MARKING, STAMPING AND DATA REPORTS**		
NB-7810	Pressure Relief Valves		
NB-7811	Marking and Stamping	Identical	A1
NB-7812	Report Form for Pressure Relief Valves		
NB-7820	Rupture Disk Devices		
NB-7821	Rupture Disks	Identical	A1
NB-7822	Disk Holders		
NB-7830	Certificate of Authorization to Use Code Symbol Stamp	Identical	A1

NB-8000: NAMEPLATE, STAMPING AND REPORTS		Compared to CSA N285.0 Clause 12.4	
Clause #	**Clause Title**	**Comment**	**Scale**
NB-8100	**GENERAL REQUIREMENTS**	Identical (ID-E) • Except Code symbol stamping is not required.	A1

END NOTE(S):

<u>Identical (ID-E)</u>

1. The Division 2 deviations and other minor deviations, such as: no stamping, will be identified by "Identical (ID-E)" which is meant to indicate the requirement is identical with an exception as below.

EXPLANATION OF DIFFERENCES:

ASME BPV Code Section III, Subsection NB, Division 1 was compared against CSA Standard N285.0-08 (Update # 2). The summary of these differences are noted below:

1. CSA Standard N285.0, Annex I has requirements for penetration
2. CANDU Nuclear Power Plants specific Materials which are not covered by the rules of ASME, rules are provided by the CSA N285.6.
3. The welding and brazing procedures are required to be registered with the authorized inspection agency as required by CSA N285 Clause 6.1.11.1
4. CSA Clause 11.3: The licensee shall have documentation to demonstrate that persons performing nondestructive examinations on pressure-retaining components were, at the time of the examinations, qualified in accordance with the following standards:

   In Canada: (i) radiography, ultrasonic, magnetic particle, liquid penetrant, and eddy current methods – CAN/CGSB-48.9712/ISO 9712; and (ii) other methods — standards acceptable to the licensee and the authorized inspection agency.

   Outside Canada: all methods — standards acceptable to the licensee and the authorized inspection agency.

   Note: Stamped items are acceptable in Canada and in this case the use of SNT-TC-1A for qualification of NDE personnel is acceptable provided the AIA and the Licensee accepted its use.
5. CSA N285 has a Table of Contents which contains similar content as ASME BPV Code Section III
6. CSA N285 does not require Code symbol stamping

CODE EDITIONS:

1. CSA Standard N285.0 – 2008 (Update 2)
2. ASME BPV Code Section III, Div. 1, NCA, 2007 Edition (No Addenda)

COMPARISON SCALE USED:

These are the definitions of the scale used for the code comparison throughout the report.

A1 – SAME Requirements classified as category A1 are considered to be technically identical. Requirements are classified as category A1 and considered to be the same even if there are inconsequential differences in wording, such as might result due to translation from one language to another, as long as the wording does not change the meaning or interpretation of the requirement. Likewise, differences in paragraph numbering are not considered when classifying requirements as long as the same requirement exists in both codes being compared.	**B1 - DIFFERENT – NOT SPECIFIED** Requirements are considered to be different - not specified, if one code or standard includes requirements that the compared code or standard does not specify. This classification may result because of differences in the scope of equipment covered by a respective code, the scope of industrial practices applied in context of the respective code, differences in regulatory requirements applicable in conjunction with application of a particular code, or simply as a result of differences in requirements addressed in one code versus those of another.
A2 – EQUIVALENT Requirements are considered to be equivalent when applying either code or standard, if compliance with the applied code or standard will also meet the requirements of the other code or standard. Equivalence is not affected by differences in level of precision of unit conversions.	**B2 - TECHNICALLY DIFFERENT** Requirements are considered to be technically different if either code requires something more or less than, or otherwise technically different from, the requirements imposed by the other. These differences might be due to different technical approaches applied by a code or imposition of regulatory requirements within the country from which a code originates.

These are the definitions of the scale used for the code comparison throughout the report.

SUMMARY OF COMPARISON:

The Table shown below shows a preliminary comparison and indicates many areas that are identical, some that are similar or equivalent and a few that are different. A detailed line-by-line comparison is performed to highlight these differences.

Subject	ASME	CSA	Comment
Scope of Section III	NCA-1000	Preface & Clause 1	A1, A2, End Note
Classification	NCA-2000	Clause 5, Fig. 1, Annex A	A1, A2, End Note
Responsibilities & Duties	NCA-3000	Clause 3 & 10, Annex E	A1, A2, B2, End Note
Quality Assurance	NCA-4000	Clause 10, Annex E	A1, End Note
Authorized Inspection	NCA-5000	Clause 3	A2

Certificates, Nameplates, Data Reports	NCA-8000	Clause 12.3	A1, A2, B2, End Note
Glossary & Definitions	NCA-9000	Clause 3	A1, End Note

NCA-1000: SCOPE OF SECTION III		Compared to CSA N285.0 Preface and Clause 1: Scope	
Clause #	**Clause Title**	**Comment**	**Scale**
NCA-1100	**GENERAL**		
NCA-1110	Scope	Identical (ID-E)[5] • CSA N285 has identical requirements, except stamping is not required and the concrete requirements of Division 2 are covered by CSA N287 Series.	A1
NCA-1120	Definitions	Identical (ID-E) • CSA N285 has identical requirements, but different CANDU requirements results in some new or modified definitions.	A1
NCA-1130	Limits of These Rules	Identical (ID-E) • Except the requirements of NCA-1130 (d) are covered by CSA N287 Series.	A1
NCA-1140	Use of Code Editions, Addenda and Cases	Equivalent • Except the requirements of NCA-1140 (a) are addressed by CSA N285, Clause 4.	A2
NCA-1150	Units of Measurement	Identical	A1
NCA-1200	**GENERAL REQUIREMENTS FOR ITEMS AND INSTALLATION**		
NCA-1210	Components	Identical (ID-E) • Except Code symbol stamping is not required.	A1
NCA-1220	Materials	Identical (ID-E) • Except Code symbol stamping is not required and concrete requirements of Division 2 are covered by CSA N287 Series.	A1
NCA-1230	Parts, Piping Subassemblies and Supports	Identical (ID-E) • Except Code symbol stamping is not required.	A1
NCA-1260	Appurtenances	Identical (ID-E) • Except Code symbol stamping is not required.	A1
NCA-1270	Miscellaneous Items	Identical (ID-E)	A1

[5] See end notes at the end of this appendix

		• Except Code symbol stamping is not required.	
NCA-1280	Installation	Identical (ID-E) • Except Code symbol stamping is not required.	A1

NCA-2000: CLASSIFICATION OF COMPONENTS AND SUPPORTS Compared to CSA N285.0 Clause 5, Figure 1 and Annex A

Clause #	Clause Title	Comment	Scale
NCA-2100	**GENERAL REQUIREMENTS**		
NCA-2110	Scope	Equivalent • CSA N285 provides requirements for the classification of process and safety systems and their supports. This is beyond the scope of ASME BPVC Section III because CSA N285 provides rules for components once they have been classified to their appropriate system criteria. Annex A of CSA N285 provides requirements for CANDU nuclear power plant. • The requirements of Division 2 are covered by CSA N287 Series.	A2
NCA-2120	Purpose of Classifying Items of a Nuclear Power Plant	Identical (ID-E) • Except there are no requirements provided for Class MC, CS and CC.	A1
NCA-2130	Classifications and Rules of This Section	Identical (ID-E) • Except there are no requirements provided for Class MC, CS (NCA-2131) and CC (NCA-2132)	A1
NCA-2140	Design Basis		
NCA-2141	Consideration of Plant and System Operating and Test Conditions	Identical (ID-E) • Except the requirements of NCA-2144 (d) are covered by CSA N287 Series.	A1
NCA-2142	Establishment of Design, Service and Test Loadings and Limits		
NCA-2143	Acceptance Criteria		
NCA-2144	Concrete Containments		
NCA-2160	Special Requirements Applied to Code Classes	Identical	A1

NCA-3000: RESPONSIBILITIES AND DUTIES		Compared to CSA N285.0 Clause 3: Licensee Definition and Clause 10: QA	
Clause #	**Clause Title**	**Comment**	**Scale**
NCA-3100	**GENERAL**		
NCA-3110	Responsibilities vs. Legal Liabilities	Identical	A1
NCA-3120	Accreditation		
NCA-3121	Types of Certificates	Equivalent • CSA N285 Certificate of Authorization is different than ASME Certificates but meet the same intent, except Code symbol stamping is not required.	A2
NCA-3125	Subcontracted Services		
NCA-3126	Subcontracted Calibration Services		
NCA-3130	Welding and Subcontracting During Construction	Identical (ID-E) • Except the concrete requirements of NCA-3132 are covered by CSA N287 Series.	A1
NCA-3200	**OWNER'S RESPONSIBILITIES**		
NCA-3220	Categories of the Owner's Responsibilities	Technically Different • Regulatory process for licensing requirements is specified by the Canadian Nuclear Safety Commission (CNSC), and is not covered by CSA N285. Compliance with CNSC requirements is mandatory.	B2
NCA-3230	Owner's Certificate	Technically Different • Regulatory process for licensing requirements is specified by the Canadian Nuclear Safety Commission (CNSC), and is not covered by CSA N285. Compliance with CNSC requirements is mandatory.	B2
NCA-3240	Provision of Adequate Supporting Structures	Identical	A1
NCA-3250	Provision of Design Specifications		
NCA-3251	Provision and Correlation	Identical	A1
NCA-3252	Contents of Design Specifications		
NCA-3253	Classification of Components, Parts and Appurtenances		
NCA-3254	Boundaries of Jurisdictions		
NCA-3255	Certification of the Design Specifications		
NCA-3256	Filing of Design Specifications		

NCA-3260	Review of Design Report	Identical	A1
NCA-3270	Overpressure Protection Report		
NCA-3271	Responsibility and Content	Identical	A1
NCA-3272	Certification of Report		
NCA-3273	Filing of Report		
NCA-3280	Owner's Data Report and Filing	Identical (ID-E) • Similar process is observed in CSA N285.0 with minor variations in the form templates	A1
NCA-3290	Owner's Responsibility for Records	Identical	A1
NCA-3300	**RESPONSIBILITIES OF A DESIGNER – DIVISION 2**	Not Applicable for this comparison • The scope of CSA N285 does not cover the requirements of Division 2; CSA N287 provides rules for concrete buildings and containment.	-
NCA-3400	**RESPONSIBILITIES OF AN N CERTIFICATE HOLDER – DIVISION 2**	Not Applicable for this comparison • The scope of CSA N285 does not cover the requirements of Division 2; CSA N287 provides rules for concrete buildings and containment.	-
NCA-3500	**RESPONSIBILITIES OF AN N CERTIFICATE HOLDER**		
NCA-3520	Categories of the N Certificate Holder's Responsibilities	Equivalent • All of the requirements of this Para are adopted by CSA N285, except the requirement of NCA-3520 (a) for Code symbol stamping is not required. • NCA-3520 (o): Certificate issued by ASME is different from the certificate issued by CSA N285 but meets the same intent.	A2
NCA-3530	Obtaining a Certificate	Identical (ID-E) • All of the requirements of this Para are adopted by CSA N285, except Code symbol stamping is not required.	A1
NCA-3540	Compliance With This Section	Identical	A1
NCA-3550	Requirements for Design Output Documents		
NCA-3551	General	Identical	A1
NCA-3552	Design Output Documents for Parts		
NCA-3553	Design Output Documents for Appurtenances		
NCA-3554	Modification of Documents and Reconciliation With Design Report		

NCA-3555	Certification of Design Report		
NCA-3556	Submittal of Design Report for Owner Review		
NCA-3557	Availability of Design Report		
NCA-3560	Responsibility for Quality Assurance		
NCA-3561	Scope of Responsibilities	Identical	A1
NCA-3562	Documentation of Quality Assurance		
NCA-3563	Filing of Quality Assurance Manual		
NCA-3570	Data Report	Equivalent • CSA N285 Clause 12.3 and 12.4 require certificate holders to submit data reports and provides samples in Figures 8 – 15.	A2
NCA-3600	**RESPONSIBILITIES OF AN NPT CERTIFICATE HOLDER**		
NCA-3620	Categories of the NPT Certificate Holder's Responsibilities	Equivalent • CSA N285 Certificate of Authorization is different. Exceptions are requirement of NCA-3620 (a) for Code symbol stamping is not required and the requirements of NCA-3260 (l) for the rules of Division 2 are not covered.	A2
NCA-3630	Obtaining a Certificate	Identical (ID-E) • All of the requirements of this Para are adopted by CSA N285, except Code symbol stamping is not required.	A1
NCA-3640	Compliance With This Section	Identical	A1
NCA-3650	Design Documents for Appurtenances	Identical	A1
NCA-3660	Responsibility for Quality Assurance		
NCA-3661	Scope of Responsibilities	Identical	A1
NCA-3662	Documentation of Quality Assurance		
NCA-3663	Filing of Quality Assurance Manual		
NCA-3670	Data Report	Equivalent • CSA N285 Clause 12.3 and 12.4 require certificate holders to submit data reports and provides samples in Figures 8 – 15.	A2
NCA-3680	Responsibilities of an NS Certificate Holder		
NCA-3681	Categories of the NS Certificate Holder's Responsibilities	Equivalent • CSA N285 Certificate of Authorization is different.	A2
NCA-3682	Obtaining a Certificate		

NCA-3683	Compliance with this Section		
NCA-3684	Scope of Responsibilities		
NCA-3685	Documentation of Quality Assurance		
NCA-3686	Filing of the Quality Assurance Program		
NCA-3687	NS-1 Certificate of Conformance		
NCA-3689	Certificate of Compliance		
NCA-3700	**RESPONSIBILITIES OF AN NA CERTIFICATE HOLDER**		
NCA-3720	Categories of the NA Certificate Holder's Responsibilities	Equivalent • CSA N285 Certificate of Authorization is different than ASME Certificates but meet the same intent	A2
NCA-3730	Obtaining a Certificate	Identical (ID-E) • Except Code symbol stamping is not required.	A1
NCA-3740	Responsibility for Compliance With This Section	Identical	A1
NCA-3760	Responsibility for Quality Assurance	Identical	A1
NCA-3770	Data Report	Equivalent • CSA N285 Clause 12.3 and 12.4 require certificate holders to submit data reports and provides samples in Figures 8 – 15.	A2
NCA-3800	**METALLIC MATERIAL ORGANIZATION'S QUALITY SYSTEM PROGRAM**		
NCA-3810	Scope and Applicability	Identical	A1
NCA-3820	Accreditation or Qualification of Material Organizations	Identical	A1
NCA-3830	Responsibilities of Material Organizations	Identical	A1
NCA-3840	Evaluation of the Program	Identical	A1
NCA-3850	Quality System Program Requirements		
NCA-3851	Responsibility and Organization	Identical	A1
NCA-3852	Personnel		

NCA-3853	Program Documentation		
NCA-3855	Control of Purchased Materials, Source Materials and Services		
NCA-3856	Identification, Marking and Material Control		
NCA-3857	Process Control		
NCA-3858	Control of Examinations, Tests and Nonconforming Material		
NCA-3859	Audits and Correction Action		
NCA-3860	Certification Requirements		
NCA-3861	Certification Requirements for Material Organization	Identical	A1
NCA-3862	Certification of Material		
NCA-3900	**NONMETALLIC MATERIAL MANUFACTURER'S AND CONSTITUENT SUPPLIER'S QUALITY SYSTEM PROGRAM**		
NCA-3920	Quality System Certificate (Nonmetallic Materials)	Identical	A1
NCA-3950	Quality Program Requirements	Identical (ID-E) • Except the requirements of NCA-3950 (b) and (c) are coved by CSA N87 Series.	A1
NCA-3960	Responsibility	Equivalent • Concrete requirements of Division 2 are covered by CSA N287 Series.	A2

NCA-4000: QUALITY ASSURANCE		Compared to CSA N285.0 Clause 3: Licensee Definition and Clause 10: QA	
Clause #	**Clause Title**	**Comment**	**Scale**
NCA-4100	**REQUIREMENTS**		
NCA-4110	Scope and Applicability	Identical	A1
NCA-4120	Definitions	Identical (ID-E) • CSA N285 has identical requirements, but different CANDU requirements	A1

		results in some new or modified definitions.	
NCA-4130	Establishment and Implementation		
NCA-4131	Material Organizations, Division 1	Identical (ID-E)	A1
NCA-4132	Material Organizations, Division 2 (not applicable)	• Not applicable	-
NCA-4133	Material Organizations, Division 1	Identical (ID-E)	A1
NCA-4134	N, NV, NPT, NS, and NA Certificate Holders for Class 1, 2, 3, MC, CS and CC Construction	Identical (ID-E) • CSA N285 Certificates of Authorization is different but serves the same intent	A1

NCA-5000: AUTHORIZED INSPECTION		Compared to CSA N285.0 Clause 3: Authorized Inspection Agency Definition & Duties discussed in Clause 2.4: Data report for fabrication activities and report for repair, replacement, or modification	
Clause #	**Clause Title**	Comment	**Scale**
NCA-5100	**INTRODUCTION**		
NCA-5110	Applicability	Equivalent • CSA N285 does not address authorized inspection requirements in significant detail. However, the Canadian Nuclear Safety Commission (CNSC) prescribes mandatory requirements based on NCA-5000 and the Qualification requirements for the Authorized Inspectors are in accordance with QAI-1.	A2
NCA-5120	Performance of Inspection		
NCA-5121	Authorized Inspection Agency (AIA)	Equivalent (Same as NCA-5110)	A2
NCA-5122	Authorized Nuclear Inspection Supervisor		
NCA-5123	Authorized Nuclear Inspection		
NCA-5125	Duties of Authorized Nuclear Inspection Supervisor		
NCA-	Access for Inspection Agency Personnel		

5130			
NCA-5131	Access to the CH Facilities	Equivalent (Same as NCA-5110)	A2
NCA-5132	Access to the Owner's Facilities		
NCA-5200	**DUTIES OF INSPECTOR**		
NCA-5210	General Inspection Duties	Equivalent (Same as NCA-5110)	A2
NCA-5220	Categories of Inspector's Duties	Equivalent (Same as NCA-5110)	A2
NCA-5230	Scope of Work, Design Specifications and Design Reports	Equivalent (Same as NCA-5110)	A2
NCA-5240	Quality Assurance Programs	Equivalent (Same as NCA-5110)	A2
NCA-5250	Qualification Records	Equivalent (Same as NCA-5110)	A2
NCA-5260	Materials, Parts and Heat Treatment	Equivalent (Same as NCA-5110)	A2
NCA-5270	Examinations and Tests	Equivalent (Same as NCA-5110)	A2
NCA-5280	Final Tests	Equivalent (Same as NCA-5110)	A2
NCA-5290	Data Reports and Construction Reports	Equivalent (Same as NCA-5110)	A2
NCA-5300	**RESPONSIBILITIES OF THE AIA**	Equivalent (SAME AS NCA-5110)	A2

NCA-8000: CERTIFICATES, NAMEPLATES, CODE SYMBOL STAMPING AND DATA REPORTS		Compared to CSA N285.0 Clause 12.3	
Clause #	**Clause Title**	**Comment**	**Scale**
NCA-8100	**AUTHORIZATION TO PERFORM CODE ACTIVITIES**		
NCA-8110	General	Identical (ID-E) • Except Code symbol stamping is not required.	A1
NCA-8120	Scope of Certificates	Identical (ID-E) • CSA N285 Certificate of Authorization is different than ASME Certificates but meet the same intent and Code symbol stamping is not required.	A1
NCA-8130	Inspection Agreement Required	Identical	A1
NCA-8140	Quality Assurance Program Requirements	Identical	A1
NCA-8150	Application for Accreditation	Identical (ID-E) • CSA N285 Certificate of Authorization is different than ASME Certificates but meet the same intent.	A1
NCA-8160	Evaluation		
NCA-8161	Evaluation of a Certificate	Identical (ID-E) • CSA N285 Certificate of Authorization is different than ASME Certificates but meet the same intent and Code symbol stamping is not required.	A1
NCA-8162	Evaluation of Owner's Certificate	Technically Different • CSA N285 has no owner's certificate; CNSC imposes mandatory requirements on the Licensee (owner)	B2

NCA-8170	Issuance	Technically Different • CSA N285 has no owner's certificate; CNSC imposes mandatory requirements on the Licensee (owner)	B2
NCA-8180	Renewal	Technically Different • CSA N285 has no owner's certificate; CNSC imposes mandatory requirements on the Licensee (owner)	B2
NCA-8200	**NAMEPLATES AND STAMPING**		
NCA-8210	General Requirements	Identical (ID-E) • Additional rules are provided in CSA N285. Code symbol stamping is not required and concrete requirements are not covered.	A1
NCA-8220	Nameplates for Components	Identical	A1
NCA-8230	Nameplates for NPT Stamped Items	Identical (ID-E) • Additional rules are provided in CSA N285	A1
NCA-8240	Removed Nameplates	Identical	A1
NCA-8300	**CODE SYMBOL STAMPS**		
NCA-8310	General Requirements	Technically Different • Code symbol stamping is not required by CSA N285.	B2
NCA-8320	Application of the N Symbol Stamp	Technically Different • Code symbol stamping is not required by CSA N285.	B2
NCA-8330	Parts and Piping Subassemblies Furnished Without Stamping	Equivalent • Identification, nameplates and data reports are required but Code symbol stamping is not required by CSA N285.	A2
NCA-8400	**DATA REPORTS**		

NCA-8410	General Requirements	Equivalent • CSA N285 Clause 12.3 and 12.4 require certificate holders to submit data reports and provides samples in Figures 8 – 15.	A2
NCA-8420	Owner's Data Report	Equivalent • CSA N285 Clause 12.3 and 12.4 require certificate holders to submit data reports and provides samples in Figures 8 – 15.	A2
NCA-8430	Data Reports, Tubular Products and Fittings Welded With Filler Metal	Equivalent • CSA N285 Clause 12.3 and 12.4 require certificate holders to submit data reports and provides samples in Figures 8 – 15.	A2
NCA-8440	Certificates of Conformance for Welded Supports	Equivalent • CSA N285 Clause 12.3 and 12.4 require certificate holders to submit data reports and provides samples in Figures 8 – 15.	A2

NCA-9000: DEFINITIONS		Compared to CSA N285.0 Clause 3	
Clause #	**Clause Title**	**Comment**	**Scale**
NCA-9100	**INTRODUCTION**		
NCA-9200	**DEFINITIONS**	Identical (ID-E) • CSA N285 has identical requirements, but different CANDU requirements results in some new or modified definitions.	A1

END NOTE(S):

Identical (ID-E):

1 The Division 2 deviations and other minor deviations, such as: no stamping, will be identified by "*Identical (ID-E)*" which is meant to indicate the requirement is identical with an exception as below.

EXPLANATION OF DIFFERENCES:

ASME BPV Code Section III, Subsection NCA, Division 1 was compared against CSA Standard N285.0-08 (Update # 2), the observed differences are summarized below:

1. CSA N285 does not require Code symbol stamping
2. Concrete requirements of Division 2 are covered by CSA N287 Series
3. CSA N285 provides requirements for the classification of process and safety systems and their supports. This is beyond the scope of ASME BPVC Section III because CSA N285 provides rules for components once they have been classified to their appropriate system criteria. Annex A of CSA N285 provides requirements for CANDU nuclear power plant
4. CSA N285 does not provide requirements for Class MC, CS and CC
5. CSA N285 Certificate of Authorization is different than ASME Certificates but meet the same intent
6. Regulatory process for licensing requirements is specified by the Canadian Nuclear Safety Commission (CNSC), and is not covered by CSA N285. Compliance with CNSC requirements is mandatory
7. Similar process is observed for the Owner's review of the Data Report in CSA N285.0 with minor variations in the form templates
8. CSA N285 Clause 12.3 and 12.4 require certificate holders to submit data reports and provides samples in Figures 8 – 15
9. CSA N285 does not address authorized inspection requirements in significant detail. However, the Canadian Nuclear Safety Commission (CNSC) prescribes mandatory requirements based on NCA-5000 and the Qualification requirements for the Authorized Inspectors are in accordance with QAI-1
10. CSA N285 has no owner's certificate; CNSC imposes mandatory requirements on the Licensee (owner)

ISBN 978-0-7918-3419-0
9 780791 834190
A2241Q