ASME BOILER AND PRESSURE VESSEL CODE
AN AMERICAN NATIONAL STANDARD

ANSI/ASME BPV-III-1-ND

SECTION III

Rules for Construction of Nuclear Power Plant Components

DIVISION 1 — SUBSECTION ND

Class 3 Components

1977 EDITION

JULY 1, 1977



ASME BOILER AND PRESSURE VESSEL COMMITTEE
SUBCOMMITTEE ON NUCLEAR POWER

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
United Engineering Center 345 East 47th Street New York, N.Y. 10017

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1977 ASME
BOILER AND PRESSURE VESSEL CODE

An American National Standard

Sections*

I	Power Boilers
II	Material Specifications
	Part A — Ferrous Materials
	Part B — Nonferrous Materials
	Part C — Welding Rods, Electrodes and Filler Metals
III	Division 1 and Division 2 — Nuclear Power Plant Components: General Requirements
III	Division 1
	Subsection NB — Class 1 Components
	Subsection NC — Class 2 Components
	Subsection ND — Class 3 Components
	Subsection NE — Class MC Components
	Subsection NF — Component Supports
	Subsection NG — Core Support Structures
	Appendices
III	Division 2 — Code for Concrete Reactor Vessels and Containments
IV	Heating Boilers
V	Nondestructive Examination
VI	Recommended Rules for Care and Operation of Heating Boilers
VII	Recommended Rules for Care of Power Boilers
VIII	Pressure Vessels
	Division 1
	Division 2 — Alternative Rules
IX	Welding and Brazing Qualifications
X	Fiberglass-Reinforced Plastic Pressure Vessels
XI	Rules for Inservice Inspection of Nuclear Power Plant Components — Division 1

*Available in bound and loose-leaf versions. Either version may be used for ASME Certification.

Code Cases

The Boiler and Pressure Vessel Committee meets regularly to consider proposed additions and revisions to the Code, and to formulate Cases to clarify the intent of existing requirements or provide, when the need is urgent, rules for materials or constructions not covered by existing Code rules. Those Cases which have been adopted appear in one or both of the 1977 Code Cases books—(1) Boilers and Pressure Vessels and (2) Nuclear Components. Supplements will be sent automatically to the purchasers of one or both of the Code Cases books up to the publication of the 1980 Edition.

Addenda

Colored-sheet Addenda, which include additions and revisions to individual Sections of the Code, are published twice a year and will be sent automatically to purchasers of the applicable Sections up to the publication of the 1980 Code. Purchasers of the bound versions of the Sections will receive bound Addenda. Purchasers of the loose-leaf versions of the Sections will receive replacement pages.

Addenda Color Legend

Pink	Summer 1977	Blue	Winter 1978
Green	Winter 1977	Salmon	Summer 1979
Yellow	Summer 1978	Gray	Winter 1979

FOREWORD

The American Society of Mechanical Engineers set up a committee in 1911 for the purpose of formulating standard rules for the construction of steam boilers and other pressure vessels. This committee is now called the Boiler and Pressure Vessel Committee.

The Committee's function is to establish rules of safety governing the design, fabrication, and inspection during construction of boilers and pressure vessels, and to interpret these rules when questions arise regarding their intent. In formulating the rules, the Committee considers the needs of users, manufacturers, and inspectors of pressure vessels. The objective of the rules is to afford reasonably certain protection of life and property and to provide a margin for deterioration in service so as to give a reasonably long safe period of usefulness. Advancements in design and material and the evidence of experience have been recognized.

The Boiler and Pressure Vessel Committee deals with the care and inspection of boilers and pressure vessels in service only to the extent of providing suggested rules of good practice as an aid to owners and their inspectors.

The rules established by the Committee are not to be interpreted as approving, recommending, or endorsing any proprietary or specific design or as limiting in any way the manufacturer's freedom to choose any method of design or any form of construction that conforms to the Code rules.

The Boiler and Pressure Vessel Committee meets regularly to consider requests for interpretations and revisions of the rules, and to develop new rules as dictated by technological development. Inquiries must be addressed to the Secretary in writing and must give full particulars in order to receive consideration and a written interpretation. Proposed revisions to the Code resulting from inquiries will be presented to the Main Committee for appropriate action. The action of the Main Committee becomes effective only after confirmation by letter ballot of the Committee and approval by the Council of the Society.

Proposed revisions to the Code approved by the Committee are submitted to the American National Standards Institute and published in *Mechanical Engineering* to invite comments from all interested persons. After the allotted time for public review and final approval by ASME Council, revisions are published semiannually in Addenda to the Code.

Code Cases may be used in the construction of components to be stamped with the ASME Code symbol beginning with the date of their approval by the ASME Council.

After Code revisions are approved by Council they may be used beginning with the date of issuance shown on the Addenda. Revisions become mandatory as minimum requirements six months after such date of issuance, except for boilers or pressure vessels contracted for prior to the end of the six-month period.

Manufacturers and users of components are cautioned against making use of revisions and Cases that are less restrictive than former requirements without having assurance that they have been accepted by the proper authorities in the jurisdiction where the component is to be installed.

Each state and municipality in the United States and each province in the Dominion of Canada that adopts or accepts one or more Sections of the Boiler and Pressure Vessel Code is invited to appoint a representative to act on the Conference Committee to the Boiler and Pressure Vessel Committee. Since the members of the Conference Committee are in active contact with the administration and enforcement of the rules, the requirements for inspection in this Code correspond with those in effect in their respective jurisdictions. The required qualifications for an Authorized Inspector or an Authorized Nuclear Inspector under these rules may be obtained from the administrative authority of any state, municipality, or province which has adopted these rules.

The Boiler and Pressure Vessel Committee in the formulation of its rules and in the establishment of maximum design and operating pressures considers materials, construction, method of fabrication, inspection, and safety devices. Permission may be granted to regulatory bodies and organizations publishing safety standards to use a complete Section of the Code by reference. If usage of a Section, such as Section IX, involves exceptions, omissions, or changes in provisions, the intent of the Code might not be attained.

Where a state or other regulatory body, in the printing of any Section of the Boiler and Pressure Vessel Code, makes additions or omissions, it is recommended that such changes be clearly indicated.

The National Board of Boiler and Pressure Vessel Inspectors is composed of chief inspectors of states and

municipalities in the United States and of provinces in the Dominion of Canada that have adopted the Boiler and Pressure Vessel Code. This Board, since its organization in 1919, has functioned to uniformly administer and enforce the rules of the Boiler and Pressure Vessel Code. The cooperation of that organization with the Boiler and Pressure Vessel Committee has been extremely helpful. Its function is clearly recognized and, as a result, inquiries received which bear on the administration or application of the rules are referred directly to the National Board. Such handling of this type of inquiry not only simplifies the work of the Boiler and Pressure Vessel Committee, but action on the problem for the inquirer is thereby expedited. Where an inquiry is neither clearly an interpretation of the rules nor a problem of application or administration, it may be considered both by the Boiler and Pressure Vessel Committee and the National Board.

It should be pointed out that the state or municipality where the Boiler and Pressure Vessel Code has been made effective has definite jurisdiction over any particular installation. Inquiries dealing with problems of local character should be directed to the proper authority of such state or municipality. Such authority may, if there is any question or doubt as to the proper interpretation, refer the question to the Boiler and Pressure Vessel Committee.

The Specifications for base materials given in Section II, Parts A and B, are identical with or similar to those of The American Society for Testing and Materials. The Specifications for welding materials given in Section II, Part C, are identical with or similar to those of the American Welding Society. Use of the materials described in these Specifications is covered by the rules in one or more Sections of the Boiler and Pressure Vessel Code. All materials allowed by these various Sections and used for construction within the scope of their rules shall be furnished in accordance with ASME Materials Specifications contained in Section II except where otherwise provided in Code Cases or in the applicable Section of the Code. Materials covered by these Specifications are acceptable for use in items covered by the Code Sections only to the degree indicated in the applicable Section. Materials for Code use should preferably be ordered, produced, and documented on this basis; however, material produced under an ASTM Specification may be used in lieu of the corresponding ASME Specification, provided that the requirements of the ASTM Specification are identical (excluding editorial differences) or more stringent than the ASME Specification for the Grade, Class, or Type produced and provided that the material is confirmed as complying with the ASTM Specification. Material produced to an ASTM specification with requirements different from the requirements of the corresponding ASME Specification may also be used in accordance with the above, provided the material manufacturer or vessel manufacturer certifies with evidence acceptable to the Authorized Inspector or Authorized Nuclear Inspector that the corresponding ASME Specification requirements have been met. Material produced to an ASME or ASTM Material Specification is not limited as to country of origin.

STATEMENT OF POLICY ON THE USE OF CODE SYMBOLS AND CODE AUTHORIZATION IN ADVERTISING

ASME has established procedures to authorize qualified organizations to perform various activities in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. It is the aim of the Society to provide recognition of organizations so authorized. An organization holding authorization to perform various activities in accordance with the requirements of the Code may state this capability in its advertising literature.

Organizations that are authorized to use Code Symbols for marking items or constructions which have been constructed and inspected in compliance with the ASME Boiler and Pressure Vessel Code are issued Certificates of Authorization. It is the aim of the Society to maintain the standing of the Code Symbols for the benefit of the users, the enforcement jurisdictions, and the holders of the symbols who comply with all requirements.

Based on these objectives, the following policy has been established on the usage in advertising of facsimiles of the symbols, Certificates of Authorization, and reference to Code construction. The American Society of Mechanical Engineers does not "approve," "certify," "rate," or "endorse" any item, construction, or activity and there shall be no statements or implications which might so indicate. An organization holding a Code Symbol and/or a Certificate of Authorization may state in advertising literature that items, constructions, or activities "are built (produced or performed) or activities conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code," or "meet the requirements of the ASME Boiler and Pressure Vessel Code."

The ASME Symbol shall be used only for stamping and nameplates as specifically provided in the Code. However, facsimiles may be used for the purpose of fostering the use of such construction. Such usage may be by an association or a society, or by a holder of a Code Symbol who may also use the facsimile in advertising to show that clearly specified items will carry the symbol. General usage is permitted only when all of a manufacturer's items are constructed under the Rules.

STATEMENT OF POLICY ON THE USE OF ASME MARKING TO IDENTIFY MANUFACTURED ITEMS

The ASME Boiler and Pressure Vessel Code provides rules for the construction of boilers, pressure vessels, and nuclear components. This includes requirements for materials, design, fabrication, examination, inspection, and stamping. Items constructed in accordance with all of the applicable rules of the Code are identified with the official Code Symbol Stamp described in the governing Section of the Code.

Markings such as "ASME," "ASME Standard," or any other marking including "ASME" or the various Code Symbols shall not be used on any item which is not constructed in accordance with all of the applicable requirements of the Code.

Items shall not be described on ASME Data Report Forms nor on similar forms referring to ASME which tend to imply that all Code requirements have been met when in fact they have not been. Data Report Forms covering items not fully complying with ASME requirements should not refer to ASME or they should clearly identify all exceptions to the ASME requirements.

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M. Schupack
L. C. Shao
C. Siess (w/o vote)
A. I. Snyder
J. D. Stevenson
M. F. Stuchfield
B. K. Thornley, Jr.
H. W. Wahl
J. L. Walker
Z. Zudans

Subgroup on General Requirements (SC III & 3C)

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J. M. McLaughlin, *Co-Chairman*
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J. N. Baysden
R. J. Bosnak
F. W. Brady
F. W. Catudal
E. F. Gerwin
W. S. Gibbons, Jr.
R. E. Keever
F. N. Moschini
J. C. Quinn
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Working Group on Quality Assurance (SG-GR) (SC III & 3C)

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R. E. Keever, *Co-Chairman*
W. C. Buskey, *Secretary*
C. W. Allison
A. Breed
T. M. Brown
J. Bosco
R. B. Bremmer
J. B. Conyers
R. Davis
R. H. Jacobs
R. E. Jagger
F. W. Joyce
R. D. Kulchak
J. R. Lenardson
H. A. Manning
M. J. Meyer
J. Milhoan
W. J. Miller
W. M. Morrison
C. C. Simpson
G. M. Tolson

Working Group on Duties and Responsibilities (SG-GR) (SC III & 3C)

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W. Schultheis, *Co-Chairman*
R. E. Conry
C. Glidewell
B. D. Hackney
N. I. Hyman
L. F. Lapan
A. S. Laurenson
W. L. Lowry
A. J. Moellenbeck
M. J. Morris
B. D. Rall
L. C. Shao
D. W. Sher
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L. R. Vancott
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J. F. Artuso
D. K. Croneberger
J. F. Hildebrand
R. F. Reedy
P. Reinhardt
R. A. Rohrbacher
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Working Group on Concrete (SG-M, C & E) (SC-3C)

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R. A. Bradshaw
A. W. Isberner
F. W. Joyce
G. Karonis
R. O. Lane
G. R. Murphy
H. G. Protze, Jr.
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D. E. Wainwright
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Working Group on Reinforcing and Prestressing Systems (SG-M, C, & E) (SC-3C)

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D. S. Mehta
P. Reinhardt
R. G. Smith
R. J. Stuart
M. G. Suarez
B. K. Thornley, Jr.

Working Group on Liners (SG-M, C, & E) (SC-3C)

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G. L. Fisher
U. I. Gosts
F. J. Hildebrand
J. D. Madden
M. F. Stuchfield

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D. A. Godfrey
G. A. Harstead
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R. E. Koppe
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M. Schupack
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Working Group on Concrete Reactor Vessels (SG-D) (SC-3C)

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F. P. Schauer
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Working Group on Concrete Containments (SG-D) (SC-3C)

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C. H. Hofmayer
P. K. Hsueh
T. E. Johnson
J. A. Raulinaitis
R. A. Rettig
B. B. Scott
R. E. Shewmaker
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R. W. Brady
T. M. Brown
D. A. Godfrey
H. Hu
R. E. Lipinski
D. S. Mehta
F. Moreadith
R. S. Orr
G. S. Shaw

Working Group on Core Support Structures (SG-D) (SC-3C)

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A. A. Cline
F. V. Fair
A. E. Goldman
P. A. Stancampiano
C. P. Tan
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R. M. Gibson
P. J. Herbert
W. C. Herman
E. T. Hughes
T. Kirk
T. F. Luga
W. C. McGaughey
J. R. MacKay
D. A. Olsson
J. G. Rawlings
F. J. Sattler
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E. Potter
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T. Kirk
A. Plauchu
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F. H. Watson

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J. H. Faupel
G. E. Fratcher
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K. A. Gardner
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H. C. Rauschenplat
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W. L. Garvin
B. R. Jamieson
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H. B. France
J. Lang
J. R. Maison
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H. W. McColly
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H. Broadbent
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R. L. Harris
H. L. Helmbrecht
M. J. Houle
R. E. Lorentz
D. J. McDonald
J. Mikulak
A. H. Miller
J. P. Myers (Alternate for McDonald)
A. J. R. Rees
R. K. Sager
H. S. Sayre
W. K. Scattergood
N. G. Schreiner
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J. W. Carter
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J. Hassert
W. D. Humphrey
A. B. Isham
R. A. Johnson
E. M. Kloeblen (w/o vote)
E. D. Lowthian
H. S. Mauk
J. R. Vinson

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D. R. Bartosch (Alternate for Allison)
A. J. Birkle
S. H. Bush
F. J. Dodd (Alternate for Ham)
O. W. Dodd, Jr.
F. T. Duba
L. B. Gross
G. J. Hallinan
W. C. Ham
P. J. Herbert
W. P. Johnson
L. R. Katz
T. D. Keenan (Alternate for Johnson)
M. S. Markowicz
R. R. Maccary
J. M. Makepeace
B. J. Milleville (Alternate for Osborne)
W. C. Osborne
F. A. Warner
S. A. Zych

Special Working Group on Retention of Records (SC XI)

O. W. Dodd, *Chairman*
F. T. Duba
W. C. Ham
P. J. Krumpos
F. A. Warner
S. A. Zych

Subgroup on Testing of Pumps and Valves (SC XI)

W. C. Osborne, *Chairman*
J. C. Major, *Secretary*
G. A. Arlotto
L. J. Booth
L. M. Hausler
G. Kayser, Jr.
W. G. Knecht
R. Koester
R. A. Krauss
E. R. Kurtz
L. J. Kuzenski
G. H. Martin
B. J. Milleville
K. H. Schafer
B. R. Shelton

Subgroup on Water Cooled Systems (SC XI)

W. O. Parker, *Chairman*
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A. E. Curtis
D. D. Davis
L. B. Gross
W. C. Ham
O. F. Hedden
R. C. Holt
J. R. Knoke
R. R. Maccary
J. M. Makepeace
R. W. Smith

Special Working Group on Regulatory Guides (SG-WCS) (SC XI)

A. J. Birkle, *Chairman*
W. M. Clarke
L. B. Gross
E. J. Parent

Working Group on Evaluation (SG-WCS) (SC XI)

S. H. Bush, *Chairman*
W. H. Bamford
C. Y. Cheng
W. C. Ham
J. T. Houstrup
J. M. Makepeace
J. G. Merkle
H. S. Palme
P. C. Riccardella
S. Yukawa

Working Group on Nondestructive Examination (SG-WCS) (SC XI)

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C. D. Cowfer
F. J. Dodd
F. T. Duba
J. R. Frederick
D. F. Fox
K. J. Hannah
P. J. Herbert
M. R. Hum
W. C. McGaughey
W. O. Parker
F. J. Sattler

Working Group on Standards (SG-WCS) (SC XI)

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J. S. Caplan
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Working Group on Steam Generator Inspection (SG-WCS) (SC XI)

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L. Frank
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R. H. Jacobs
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R. W. Smith
J. D. Woodward

Working Group on Spare and Replacement Parts (SG-WCS) (SC XI)

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J. E. Gallivan
W. L. Garvin
J. Gischlon
G. W. Hallman
J. B. Henderson
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Working Group on Component Supports (SG-WCS) (SC XI)

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J. R. Hebert
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Working Group on Containment (SG-WCS) (SC XI)

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H. T. Hill
R. F. Reedy

Subgroup on Gas Cooled Systems (SC XI)

F. A. Warner, *Chairman*
W. M. Clarke, *Secretary* w/o vote
J. A. Breynaert
R. E. Bullock
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C. R. Gates
A. S. Greer
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J. T. Robb

Special Working Group on Inspection of High Temperature Materials (SG-GCS) (SC XI)

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L. Frank
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Special Working Group on Testing of Valves (SG-GCS) (SC XI)

L. M. Hausler, *Chairman*
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R. W. Peters
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Special Working Group on Reactor Internals (SG-GCS) (SC XI)

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Special Working Group on Testing of Pumps and Compressors (SG-GCS) (SC XI)

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Working Group for Inspection and Tests (SG-GCS) (SC XI)

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Working Group on Concrete Pressure Components (SG-GCS) (SC XI)

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Subgroup on Liquid Metal Cooled Systems (SC XI)

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Special Working Group on Pumps (SG-LMCS) (SC XI)

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W. F. Hickey
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Special Working Group on Valves (SG-LMCS) (SC XI)

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W. F. Hickey
R. Koester
R. Louison
G. H. Martin

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R. F. Gill
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C. E. Rawlins
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W. E. Trumpler
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E. Shapiro
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R. T. Webster
D. H. Wilson

Subgroup on Strength of Weldments (SC-P) & (SC IX) (Joint Subgroup)

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Subgroup on Fatigue Strength (SC-P)

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L. A. James
C. E. Jaske
D. P. Jones
M. Katcher
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M. J. Manjoine
G. C. Millman
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Subgroup on Toughness (SC-P)

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E. Landerman
F. J. Loss
C. E. Rawlins
R. D. Stout
R. D. Webb
R. G. Williams
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Working Group on Nuclear Application (SG-T) (SC-P)

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O. E. Buxton (Alternate for Garvin)
G. F. Carlson
F. W. Catudal
J. L. Corcoran
D. R. Gallup
W. D. Greenlaw (Alternate for Corcoran)
W. L. Harding
F. J. Howes
J. W. Kime
J. H. Parent (Alternate for Kime)
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J. F. Harvey
J. W. Kime
P. E. Loveday
E. W. Shilling
W. J. Stuber

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H. McColly
D. R. Gallup
P. M. Brister
J. H. Parent
W. J. Anderson
E. A. Becker
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C. H. Harmsen
S. F. Harrison
J. F. Harvey
E. L. Kemmler
J. E. Lattan
G. W. Reinmuth (w/o vote)

Alternates:
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D. R. Gallup
K. T. Kostal
F. N. Moschini
R. S. Orr
A. Breed
J. D. Lenardson
J. G. Gillissie
H. F. Dobel
J. A. Jagger
T. F. Luga
U. Potapovs

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E. C. Rodabaugh
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S. C. Lou
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H. H. Schneider
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D. L. Shira
E. D. Ssinegurski
E. O. Waters

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M. H. Jawad
C. J. Kelly
E. M. Livingston
E. E. Morgenegg
N. C. Small
V. Svalbonas

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E. M. Lawrence, *Secretary*
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J. H. Faupel
E. R. Sliwinski
S. W. Tagart
Z. Zudans

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R. D. Campbell
J. B. Conway
J. M. Corum
A. W. Dalcher
M. Gold
C. W. Lawton
C. F. Nash
W. J. O'Donnell
F. A. Sebring
L. K. Severud
G. V. Smith
A. L. Snow
B. C. Wei

Working Group on Creep Fatigue (SG-ETD) (SC-D)

R. D. Campbell, *Chairman*
C. R. Brinkman, *Secretary*
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D. R. Diercks
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CONTENTS

A Detailed Contents Precedes Each Article

Foreword v
Statements of Policy vii
Personnel ix
Organization of Section *III* xxi

Article ND-1000 Introduction 1
Article ND-2000 Material 5
Article ND-3000 Design 29
Article ND-4000 Fabrication and Installation 177
Article ND-5000 Examination 233
Article ND-6000 Testing 245
Article ND-7000 Protection Against Overpressure 261
Article ND-8000 Nameplates, Stamping, and Reports 273
SI Units 275

ORGANIZATION OF SECTION III, NUCLEAR POWER PLANT COMPONENTS

1. GENERAL

Section III consists of Division 1 and Division 2. Both Divisions are broken down into Subsections which are designated by capital letters preceded by the letter "N" for Division 1 and by the letter "C" for Division 2. The following eight books make up the two Divisions:

Division 1 and Division 2—General Requirements

Division 1
- Subsection NB—Class 1 Components
- Subsection NC—Class 2 Components
- Subsection ND—Class 3 Components
- Subsection NE—Class MC Components
- Subsection NF—Component Supports
- Subsection NG—Core Support Structures
- Appendices

Division 2—Code for Concrete Reactor Vessels and Containments

The Division 2 book includes Subsection CB—Concrete Reactor Vessels, Subsection CC—Concrete Containments, and Division 2 Appendices.

2. SUBSECTIONS

Subsections are divided into Articles, Subarticles, paragraphs, and, where necessary, subparagraphs and subsubparagraphs.

3. ARTICLES

Articles are designated by the applicable letters indicated above for the Subsections followed by Arabic numbers, such as NB-1000 or CB-2000. Where possible, Articles dealing with the same topics are given the same number in each Subsection in accordance with the following general scheme:

Article Number	Title
1000	Introduction or Scope
2000	Material
3000	Design
4000	Fabrication and Installation
5000	Examination
6000	Testing
7000	Protection Against Overpressure
8000	Nameplates, Stamping, and Reports

The numbering of Articles and the material contained in the Articles may not, however, be consecutive. Due to the fact that the complete outline may cover phases not applicable to a particular Subsection or Article, the rules have been prepared with some gaps in the numbering.

4. SUBARTICLES

Subarticles are numbered in units of 100, such as NB-1100 or CB-1200.

5. SUBSUBARTICLES

Subsubarticles are numbered in units of 10, such as NB-2130, and generally have no text. When a number such as NB-1110 is followed by text, it is considered a paragraph.

6. PARAGRAPHS

Paragraphs are numbered in units of 1, such as NB-2131 or CB-2132.

7. SUBPARAGRAPHS

Subparagraphs, when they are *major* subdivisions of a paragraph, are designated by adding a decimal followed by one or more digits to the paragraph number, such as NB-1111.1 or CB-1111.2. When they are *minor* subdivisions of a paragraph, subparagraphs may be designated by lowercase letters in parentheses, such as NB-1111(a) or CB-1111(b).

8. SUBSUBPARAGRAPHS

Subsubparagraphs are designated by adding lowercase letters in parentheses to the *major* subparagraph numbers, such as NB-1111.1(a) or CB-1111.1(b). When further subdivisions of *minor* subparagraphs are necessary, subsubparagraphs are designated by adding Arabic numerals in parentheses to the subparagraph designation, such as NB-1111(a)(1) or CB-1111(a)(2).

9. REFERENCES

References used within Section III generally fall into one of the following four categories: