

ASME BOILER AND PRESSURE VESSEL CODE
AN AMERICAN NATIONAL STANDARD

SECTION III
Rules for Construction of
Nuclear Power Plant Components
DIVISION 1 — APPENDICES

1989 EDITION

JULY 1, 1989



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

Date of Issue — July 1, 1989
(Includes all Addenda dated December 1988 and earlier)

This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The Consensus Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment which provides an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

ASME does not "approve," "rate," or "endorse" any item, construction, proprietary device, or activity.

ASME does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable Letters Patent, nor assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

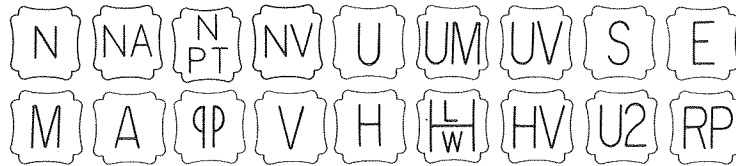
Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

ASME accepts responsibility for only those interpretations issued in accordance with governing ASME procedures and policies which preclude the issuance of interpretations by individual volunteers.

The footnotes in this document are part of this American National Standard.



ASME collective membership mark



The above ASME symbols are registered in the U.S. Patent Office.
"ASME" is the trademark of the American Society of Mechanical Engineers.

Copyright © 1989 by
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
All Rights Reserved

No part of this document may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Library of Congress Catalog Card Number: 56-3934
Printed in the United States of America

Adopted by the Council of the American Society of Mechanical Engineers, 1914.
Revised 1940, 1941, 1943, 1946, 1949, 1952, 1953, 1956, 1959, 1962, 1965, 1968, 1971, 1974, 1977, 1980, 1983, 1986, 1989

1989 ASME BOILER AND PRESSURE VESSEL CODE

SECTIONS

- I Power Boilers
- II Material Specifications
 - Part A — Ferrous Materials
 - Part B — Nonferrous Materials
 - Part C — Welding Rods, Electrodes, and Filler Metals
- III Subsection NCA — General Requirements for Division 1 and Division 2
- 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 Guidelines for the Care of Power Boilers
- VIII Pressure Vessels
 - Division 1
 - Division 2 — Alternative Rules
- IX Welding and Brazing Qualifications
- X Fiber-Reinforced Plastic Pressure Vessels
- XI Rules for Inservice Inspection of Nuclear Power Plant Components

ADDENDA

Colored-sheet Addenda, which include additions and revisions to individual Sections of the Code, are published annually and will be sent automatically to purchasers of the applicable Sections up to the publication of the 1992 Code. The 1989 Code is available only in the loose-leaf format; accordingly, the Addenda will be issued in the loose-leaf, replacement-page format.

INTERPRETATIONS

ASME issues written replies to inquiries concerning interpretation of technical aspects of the Code. The Interpretations for each individual Section will be published separately and will be included as part of the update service to that Section. They will be issued semiannually (July and December) up to the publication of the 1992 Code. Interpretations of Section III, Divisions 1 and 2, will be included with the update service to Subsection NCA. Interpretations are not part of the Code or the Addenda.

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 will appear in the appropriate 1989 Code Cases book: (1) Boilers and Pressure Vessels and (2) Nuclear Components. Supplements will be sent automatically to the purchasers of the Code Cases books up to the publication of the 1992 Code.



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 revisions of the rules, new rules as dictated by technological development, Code Cases, and requests for interpretations. Requests for interpretation must be addressed to the Secretary in writing and must give full particulars in order to receive consideration and a written interpretation (see Mandatory Appendix covering preparation of technical inquiries). 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 ASME.

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, revisions are published annually 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 ASME.

Code Editions may be used on or after the date of issue shown in the Edition. After Code revisions are approved by ASME, they may be used beginning with the date of issue shown on the Addenda.

Owners of nuclear power plants are cautioned that Code Editions, Addenda, and Cases to be used in construction shall be acceptable to the regulatory and enforcement authorities having jurisdiction at the nuclear power plant site.

Each state and municipality in the United States and each province in 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 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 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.

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. States, provinces, municipalities, or other regulatory bodies 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 materials given in Section II, Parts A and B, are identical with or similar to those of The American Society for Testing and Materials. When reference is made in an ASME Material Spec-

ification to an ASTM Specification for which a companion ASME Specification exists, the reference shall be interpreted as applying to the ASME Material Specification. The Specifications for welding materials given in Section II, Part C, are identical with or similar to those of the American Welding Society. Not all materials included in the ASME Material Specifications in Section II have been adopted for use in this Section. Usage is limited to those materials and grades listed in at least one of the Tables of Appendix I of this Section. All materials allowed by this Section and used for construction within the scope of these rules shall be furnished in accordance with the Material Specifications contained in Section II except where otherwise provided in Code Cases or in this Section of the Code. Material produced to an ASME or ASTM Material Specification is not limited as to country of origin.

When required by context in this Section, the singular shall be interpreted as the plural, and vice-versa; and the feminine, masculine, or neuter gender shall be treated as such other gender as appropriate.

Publication of the SI (Metric) Edition of the ASME Boiler and Pressure Vessel Code was discontinued with the 1986 Edition. Effective October 1, 1986, the SI Edition was withdrawn as an ASME Boiler and Pressure Vessel Code document.

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.

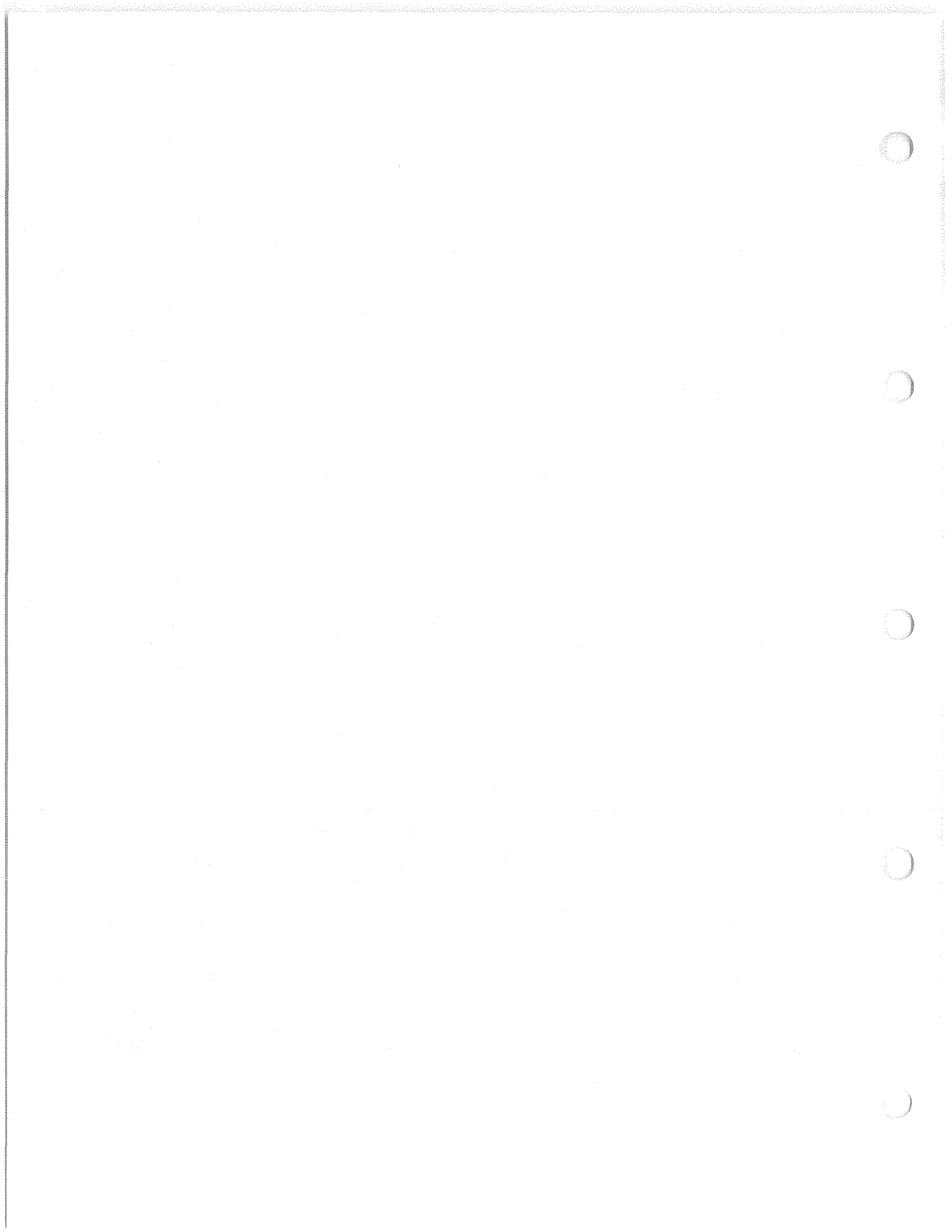
STATEMENT OF POLICY ON THE USE OF ASME MARKING TO IDENTIFY MANUFACTURED ITEMS

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.



PERSONNEL

ASME Boiler and Pressure Vessel Committee

Subcommittees, Subgroups, and Working Groups

As of December 31, 1988

MAIN COMMITTEE

W. R. Mikesell, <i>Chairman</i>	G. G. Karcher
R. J. Cepluch, <i>Vice Chairman</i>	E. C. Kistner, Jr.
G. M. Eisenberg, <i>Secretary</i>	W. G. Knecht
B. W. Bace	J. R. MacKay
M. D. Bernstein	T. J. Mawson
R. J. Bosnak	T. G. McCarty
M. N. Bressler	D. J. McDonald
D. A. Canonico	U. R. Miller
L. J. Chockie	C. C. Neely
H. F. Dobel	T. E. Northup
W. D. Doty	R. F. O'Neill
J. R. Farr	R. F. Reedy
B. D. Hackney	M. L. Snow, Jr.
W. C. Ham	J. W. Tackett
H. L. Hime	R. E. Feigel, <i>Alternate</i>
M. H. Jawad	

HONORS AND AWARDS COMMITTEE

H. F. Dobel, <i>Chairman</i>	R. C. Hudson
G. M. Eisenberg, <i>Secretary</i>	M. H. Jawad
J. R. Farr	E. C. Kistner, Jr.
C. E. Ford	E. G. Nisbett
G. E. Fratcher	R. K. Sager, Jr.
W. L. Garvin	J. W. Tackett
O. F. Hedden	

EXECUTIVE COMMITTEE (MAIN COMMITTEE)

R. J. Cepluch, <i>Chairman</i>	C. E. Ford
W. R. Mikesell, <i>Vice Chairman</i>	B. D. Hackney
G. M. Eisenberg, <i>Secretary</i>	E. C. Kistner, Jr.
R. J. Bosnak	H. A. Manning
L. J. Chockie	D. J. McDonald
J. R. Farr	R. F. Reedy

HONORARY MEMBERS (MAIN COMMITTEE)

J. D. Andrew, Jr.	E. L. Kemmler
R. D. Bonner	E. M. Kloebler
P. M. Brister	J. E. Lattan
H. M. Canavan	J. LeCoff
J. S. Clarke	F. N. Moschini
W. E. Cooper	C. E. Rawlins
G. E. Fratcher	W. R. Smith, Sr.
R. M. Gibson	W. E. Somers
R. C. Griffin	D. B. Wesstrom
W. L. Harding	F. S. G. Williams
E. J. Hemzy	L. P. Zick

MARINE CONFERENCE GROUP

J. Tiratto, <i>Chairman</i>	G. C. Johnson
C. F. Banks	E. F. Murphy
V. W. Bugg	

CONFERENCE COMMITTEE

M. L. Snow, Jr. — Tennessee (<i>Chairman</i>)	J. T. Little — Arizona
D. J. McDonald — National Board of Boiler and Pressure Vessel Inspectors (<i>Secretary</i>)	B. M. Lovelady — Memphis and Shelby County, Tennessee
D. C. Barnett, Jr. — Florida	C. C. Mann — New Orleans, Louisiana
D. E. Beaner — Pennsylvania	R. J. Mannion — New Hampshire
G. Black — Washington	S. M. Matthews — Texas
V. Bogosian — Illinois	I. W. Mault — Manitoba, Canada
E. Brandt — Los Angeles, California	H. T. McEwen — Mississippi
J. E. Brennan — Ohio	A. W. Meiring — Indiana
W. E. Brown — Kansas	E. E. Morgan — Colorado
N. B. Burkheimer — Maryland	J. W. Morvant — Louisiana
R. D. Cather — Alaska	R. F. Mullaney — Vancouver, Canada
A. Colvin, Jr. — Washington, D.C.	D. Newquist — Nebraska
R. A. Coomes — Kentucky	R. D. O'Connor — Connecticut
Z. C. Cordero — Michigan	H. Parker, Jr. — Nevada
J. G. Cvar — Delaware	J. C. Parsell — Utah
A. W. Diamond — Newfoundland, Canada	R. D. Reetz — North Dakota
M. H. Diehl, Jr. — Maryland	R. Sauve — Quebec, Canada
F. G. Dolen — New Jersey	M. Shuff — West Virginia
C. R. Erickson — California	J. L. Smith — Alberta, Canada
E. Everett — Georgia	R. P. Sullivan — Maine
J. J. Fowles — New Brunswick, Canada	N. Surtees — Saskatchewan, Canada
J. W. Greenawalt, Jr. — Oklahoma	C. W. Thompson — Arkansas
S. L. Hall — North Carolina	M. W. A. West — Prince Edward Island, Canada
V. Harding — Hawaii	R. B. West — Iowa
J. Hicks — Virginia	M. J. Wheel — Vermont
C. Hinson — Oregon	R. K. White — New York
J. D. Hoh — Missouri	T. F. Wickham — Rhode Island
W. J. Holmes — Chicago, Illinois	H. J. Wright — Ontario, Canada
R. M. Johnson — California	R. A. Yeo — Nova Scotia, Canada
A. Justin — Minnesota	
V. Kanable — Wisconsin	
G. M. Kuetemeyer — Milwaukee, Wisconsin	

SUBCOMMITTEE ON POWER BOILERS (SC I)

E. C. Kistner, Jr., <i>Chairman</i>	W. T. Higginbotham
J. R. MacKay, <i>Vice Chairman</i>	R. Leone
M. E. Sheehan, <i>Secretary</i>	W. L. Lowry, Jr.
S. G. Bankar	R. F. Manning
D. L. Berger	M. Mattina
M. D. Bernstein	R. G. Presnak
D. A. Canonico	R. D. Schueler, Jr.
A. R. Faulkner	R. L. Williams
D. N. French	R. A. Yeo
F. R. Gerety	L. W. Yoder

Subgroup on Care of Power Boilers (SC I)

W. T. Higginbotham, <i>Chairman</i>	C. R. Hoefs
C. J. Berg	E. A. Holden
H. F. Dobel	E. C. Kistner, Jr.
D. O. Downey	D. J. McDonald
W. Hall	R. A. Yeo
R. R. Hess	J. R. Zahorsky

Subgroup on Piping (SC I)

R. L. Williams, <i>Chairman</i>	R. R. Hess
F. R. Gerety, <i>Secretary</i>	W. L. Lowry, Jr.
D. L. Berger	T. C. McGough
M. D. Bernstein	R. G. Presnak
A. J. Breugelmans	L. J. Sas
A. R. Faulkner	L. W. Yoder
W. Hall	

Subgroup on Design (SC I)

R. D. Schueler, Jr., <i>Chairman</i>	R. Leone
R. F. Manning, <i>Vice Chairman</i>	K. C. Morrison
R. V. Wielgoszinski, <i>Secretary</i>	A. Nassif
M. D. Bernstein	D. R. Palmer
M. A. Farrugia	C. H. Walters
W. R. Hankins	R. A. Yeo
G. L. Kasparian	

Subgroup on Materials (SC I)

A. R. Faulkner, <i>Chairman</i>	D. N. French
S. G. Bankar	J. S. Hunter
D. A. Canonico	J. M. Tanzosh

Subgroup on General Requirements (SC I)

M. D. Bernstein, <i>Chairman</i>	J. T. Pillow
F. R. Gerety, <i>Secretary</i>	W. E. Somers
R. R. Hess	C. H. Walters
R. Leone	R. L. Williams
W. L. Lowry, Jr.	R. A. Yeo
T. C. McGough	L. W. Yoder

Subgroup on Fabrication and Examination (SC I)

R. Leone, <i>Chairman</i>	W. T. Higginbotham
D. L. Berger, <i>Secretary</i>	J. S. Kandola
S. G. Bankar	J. T. Pillow
D. N. French	R. D. Schueler, Jr.
J. Hainsworth	R. V. Wielgoszinski
W. Hall	

SUBCOMMITTEE ON MATERIALS SPECIFICATIONS (SC II)

J. P. Millman, <i>Secretary</i>	R. A. Moen
A. Cohen	E. G. Nisbett
W. D. Edsall	W. R. Sylvester
M. Gold	J. W. Tackett
G. C. Hsu	E. O. Woolridge
E. I. Landerman	A. W. Zeuthen
W. A. McRoberts	

Subgroup on Steel Plates (SC II)

A. W. Zeuthen, <i>Chairman</i>	P. R. Slimmon
W. D. Edsall	J. M. Tanzosh
J. F. Longenecker	E. O. Woolridge

Subgroup on Steel Tubular Products (SC II)

W. R. Sylvester, <i>Chairman</i>	R. P. Meineke
E. A. Jonas	E. J. Rozic, Jr.
W. C. Mack	R. H. Zong

Subgroup on Steel Castings, Forgings, and Boltings (SC II)

E. G. Nisbett, <i>Chairman</i>	E. I. Landerman
R. F. Cappellini	W. A. McRoberts
B. M. Dingman	E. O. Woolridge
T. Graham	

Subgroup on Nonferrous Alloys (SC II)

G. C. Hsu, <i>Chairman</i>	W. R. Kearney
J. W. Tackett, <i>Secretary</i>	A. P. Seidler
A. Cohen	R. T. Webster
B. B. Hood	M. J. Weiss

SUBCOMMITTEE ON NUCLEAR POWER (SC III)

R. F. Reedy, <i>Chairman</i>	W. C. Ham
E. F. Gerwin, <i>Vice Chairman</i>	W. G. Knecht
K. Ennis, <i>Secretary</i>	D. F. Landers
J. R. Barbee	J. Lang
R. W. Barnes	H. A. Manning
R. J. Bosnak	W. N. McLean
E. B. Branch	C. A. Moore
M. N. Bressler	T. E. Northup
L. J. Chockie	W. R. Smith, Sr.
J. B. Christofferson	M. F. Sullivan
R. L. Dick	R. P. Sullivan
H. F. Dobel	S. W. Tagart, Jr.
W. D. Doty	R. E. Tome
F. R. Drahos	

Subgroup on General Requirements (SC III & 3C)

H. F. Dobel, <i>Co-Chairman</i>	M. J. Meyer
J. R. Barbee	A. J. Moellenbeck
R. B. Bremmer	R. E. Muise
E. F. Gerwin	L. C. Oakes
K. R. Hooks	M. F. Sullivan
R. D. Kulchak	R. P. Sullivan
M. Malloy	G. M. Tolson

Working Group on Quality Assurance (SG-GR) (SC III & 3C)

R. D. Kulchak, <i>Co-Chairman</i>	J. D. Lenardson
R. C. Arthurs	M. J. Meyer
J. N. Babcock, Jr.	R. E. Muise
J. R. Barbee	G. C. Pratt
J. V. Bosco	R. Siever
R. B. Bremmer	S. A. Sparacino
B. W. Burak	J. F. Strunk
J. G. Harkness	M. F. Sullivan
K. R. Hooks	G. M. Tolson

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

A. J. Moellenbeck, <i>Chairman</i>	A. S. Laurenson
J. E. Ayotte	J. R. Luke
J. E. Crowe	B. D. Rall
A. C. Eberhardt	R. T. Rose
R. C. Howard	W. K. Sowder
D. R. Kulla	R. E. Weber

Working Group on Data Report Forms (SG-GR) (SC III & 3C)

R. E. Muise, <i>Chairman</i>	B. W. Burak
C. W. Allison	W. K. Sowder
R. C. Arthurs	M. F. Sullivan
J. N. Babcock, Jr.	

Subgroup on Materials, Fabrication, and Examination (SC III)

W. G. Knecht, <i>Chairman</i>	W. N. McLean
C. W. Allison	W. A. McRoberts
W. H. Borter	R. A. Moen
B. G. Carlton	K. E. Moore
F. R. Drahos	D. A. Olsson
G. B. Georgiev	C. J. Pieper
E. F. Gerwin	R. E. Schuessler
R. M. Hanschka	H. A. Sepp, Jr.
J. E. Harris	N. M. Simpson
R. W. Jackson	W. J. Sperko
R. M. Jessee	A. Taboada
E. I. Landerman	R. E. Tschirch
J. Lang	E. H. Williams
J. F. Longenecker	

Subgroup on Design (SC III)

C. A. Moore, <i>Chairman</i>	D. F. Landers
R. W. Barnes, <i>Secretary</i>	W. N. McLean
E. B. Branch	R. W. Mikitka
M. N. Bressler	E. C. Rodabaugh
W. G. Brussalis, Jr.	B. L. Silverblatt
G. D. Cooper	G. C. Slagis
N. W. Edwards	J. D. Stevenson
W. F. English, Jr.	J. H. Wawrzeniak
F. P. Hill, Jr.	K. R. Wichman

Special Working Group on Dynamic Analysis (SG-D) (SC III)

R. Wray, <i>Chairman</i>	A. E. Meligi
M. K. Au-Yang	B. J. Mitchel
R. D. Blevins	T. M. Mulcahy
G. J. Bohm	S. W. Tagart, Jr.
P.-Y. Chen	J. N. Underwood
A. H. Hadjian	J. Wallach

Special Working Group on Faulted Conditions (SG-D) (SC III)

G. J. Bohm, <i>Chairman</i>	D. P. Munson
P. L. Anderson	P. R. Olson
C. W. Bruny	R. F. Perry
G. Bushnell	W. Pink
M. Hartzman	J. Wallach

Working Group on Vessels (SG-D) (SC III)

G. D. Cooper, <i>Chairman</i>	R. W. Mikitka
C. W. Bruny	C. A. Moore
N. W. Edwards	P. P. Raju
J. F. Finn, Jr.	H. S. Thornton
F. P. Hill, Jr.	R. E. Tome
A. Merend	A. Walsenko

Working Group on Piping (SG-D) (SC III)

G. C. Slagis, <i>Chairman</i>	D. F. Landers
S. Gils	S. E. Moore
A. B. Glickstein	E. D. Mysinger
D. J. Guzy	E. C. Rodabaugh
R. W. Haupt	M. S. Sills
R. S. Hill III	E. O. Swain
R. B. Jenkins	L. E. Wright
M. Z. Khlafallah	M. P. Zyne
G. T. Kitz	

Working Group on Pumps (SG-D) (SC III)

D. B. Nickerson, <i>Chairman</i>	D. R. Hyatt
C. S. Boster	D. M. Kitch
H. L. Brammer	P. J. Nagengast
R. B. Camper	J. J. Ranft
F. P. Colon	H. Tafarrodi
D. L. Cummings	J. H. Wawrzeniak

Working Group on Valves (SG-D) (SC III)

W. N. McLean, <i>Chairman</i>	J. J. McGavin
R. R. Brodin	H. R. Sonderegger
J. M. Cowley	J. C. Tsacoyeanes
R. J. Kiessel	R. G. Visalli
W. G. Knecht	J. R. Zahorsky
R. Koester	

Working Group on Component Supports (SG-D) (SC III)

M. N. Bressler, <i>Chairman</i>	R. J. Masterson
J. M. Benenati	A. E. Meligi
R. D. Ciatto	E. D. Mysinger
J. R. Cole	A. Nguyen
R. P. Deubler	H. Noreen, Jr.
R. W. Haupt	G. M. Quinn
H. T. H. Hui	C. L. Ray, Jr.
T. Karppinen	H. K. Shaw
Z. A. Kravets	E. O. Swain
T. C. LaCroix	M. P. Zyne
A. S. Laurenson	

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

B. L. Silverblatt, <i>Chairman</i>	J. F. Mullooly
T. Vetter, Jr., <i>Secretary</i>	E. Steinkamp
W. F. English, Jr.	

Working Group on FRP Pipe (SG-D) (SC III)

L. Loziuk, <i>Chairman</i>	A. B. Glickstein
F. R. Gerety	

Subgroup on Pressure Relief (SC III)

F. C. Cherny, <i>Chairman</i>	S. F. Harrison, Jr.
R. A. Cedel	H. Honig
J. J. Chappell	K. Ijzerman
R. J. Doelling	D. Kadakia
W. D. Greenlaw	D. M. Pattarini

Subgroup on Elevated Temperature Construction (SC III)

A. W. Dalcher, <i>Chairman</i>	M. T. Jakub
J. M. Tanzosh, <i>Secretary</i>	R. M. Mello
C. C. Bigelow	V. Regis

Subgroup on Containment Systems for Spent Fuel and High Level Waste Transport Packagings (SC III)

E. F. Gerwin, <i>Chairman</i>	J. V. Massey
K. B. Sorenson, <i>Secretary</i>	R. E. Nickell
W. H. Brinkman	W. H. Rogers, Jr.
H. H. Chung	J. Santucci
K. Goldmann	W. W. Teper
R. T. Haelsig	T. C. Thompson
B. B. Hood	C. H. Walters
R. H. Jones	S. Yukawa
R. W. Lambert	

Working Group on General Requirements (SG-NUPACK) (SC III)

K. Goldmann, <i>Chairman</i>	D. L. Tevis
J. V. Massey	

Working Group on Material (SG-NUPACK) (SC III)

S. Yukawa, <i>Chairman</i>	J. G. Merkle
T. J. Griesbach	M. W. Schwartz
B. B. Hood	F. A. Simonen
J. T. Martin	K. B. Sorrenson
P. McConnell	M. P. Walsh

Working Group on Design (SG-NUPACK) (SC III)

D. G. Abbott	W. W. Teper
M. E. Balmert	T. C. Thompson
A. G. Eggers	H. H. Woo
R. E. Nickell	

Working Group on Fabrication and Examination (SG-NUPACK) (SC III)

W. H. Brinkman, *Chairman*

JOINT ACI-ASME COMMITTEE ON CONCRETE COMPONENTS FOR NUCLEAR SERVICE (SC-3C)

J. P. Allen III, <i>Chairman</i>	R. D. Kulchak
J. Karian, <i>Secretary</i>	D. Marano
J. F. Artuso	D. P. Moore
R. M. Attar	R. G. Oesterle
T. M. Brown	F. Rinaldi
B. A. Erler	B. B. Scott
D. J. Haavik	C. P. Siess
T. E. Johnson	J. D. Stevenson
F. W. Joyce	R. N. White

Subgroup on Materials, Construction, and Examination (SC-3C)

D. J. Haavik, <i>Chairman</i>	J. Gutierrez
J. P. Allen III	F. W. Joyce
J. F. Artuso	D. Marano
R. M. Attar	D. P. Moore
J. E. Barry	G. R. Murphy
J. F. Best	H. Nierlich
S. Bhuyan	L. C. Noriega
G. L. Fisher	S. K. Sen
C. L. Grover	

Working Group on Concrete Inspectors Qualifications (SG-M, C, & E) (SC-3C)

F. W. Joyce, <i>Chairman</i>	R. J. Vurpillat
J. F. Artuso	R. E. Wilson
C. E. Jaycox	

Subgroup on Design (SC-3C)

B. B. Scott, <i>Chairman</i>	F. S. Ople, Jr.
T. M. Brown	F. Rinaldi
L. I. Cheng	R. E. Shewmaker
J. F. Fulton	J. D. Stevenson
T. E. Johnson	A. Walser
R. G. Oesterle	M. J. Holley, Jr., Observer

Working Group on Testing and Protection Against Overpressure (SG-D) (SC-3C)

T. M. Brown, <i>Chairman</i>	H. T. Hill
S. Guha-Majumdar	N. J. Tuholski

Subgroup on Core Support Structures (SC-3C)

R. Vollman	G. T. Yahr
------------	------------

SUBCOMMITTEE ON HEATING BOILERS (SC IV)

T. H. Milton, <i>Chairman</i>	M. Mattina
F. P. Barton, <i>Vice Chairman</i>	K. McTague
K. I. Baron, <i>Secretary</i>	R. I. Mullican
J. E. Ayotte	E. A. Nordstrom
R. B. Duggan	S. V. Voorhees
G. E. Fratcher	C. H. Walters
J. W. Greenawalt, Jr.	R. H. Weigel
W. L. Haag	J. I. Woodworth
G. L. Kasparian	

Subgroup on Care and Operation of Heating Boilers (SC IV)

J. I. Woodworth, <i>Chairman</i>	W. D. Hayen
F. P. Barton	K. McTague
W. H. Dormer, Jr.	R. H. Weigel
J. Giambrone	

Subgroup on Water Heaters (SC IV)

G. E. Fratcher, <i>Chairman</i>	G. R. Lewis
F. P. Barton	K. McTague
W. L. Garvin	E. A. Nordstrom
J. W. Greenawalt, Jr.	C. W. Staats
W. L. Haag	K. J. Szigety
B. Klinke	E. Wenczl

Subgroup on Cast Iron Boilers (SC IV)

K. McTague, <i>Chairman</i>	R. H. Weigel
R. B. Duggan	J. I. Woodworth
W. L. Garvin	

SUBCOMMITTEE ON NONDESTRUCTIVE EXAMINATION (SC V)

J. R. MacKay, <i>Chairman</i>	G. W. Hembree
R. C. Hudson, <i>Vice Chairman</i>	P. J. Herbert
G. P. Mancini, <i>Secretary</i>	E. T. Hughes
A. S. Birks	B. C. Jersild
J. B. Christofferson	R. M. Jessee
B. H. Clark, Jr.	F. B. Kovacs
J. G. Cvar	S. Markowitz
L. T. Detlor	T. G. McCarty
B. E. Foster	W. C. McGaughey
H. C. Graber	J. P. Sunukjian
O. F. Hedden	D. A. White

Subgroup on Radiography (SC V)

T. G. McCarty, <i>Chairman</i>	B. C. Jersild
W. L. Bierwirth	C. Johnson
L. T. Detlor	F. B. Kovacs
B. E. Foster	S. Markowitz

Subgroup on Ultrasonics (SC V)

P. J. Herbert, <i>Chairman</i>	R. W. McClung
N. O. Cross	W. C. McGaughey
O. F. Hedden	R. Paillaman
W. T. Higginbotham	F. J. Sattler
E. T. Hughes	J. C. Spanner, Sr.
J. F. Manning	F. R. A. Turner

Subgroup on Acoustic Emission (SC V)

D. A. White, <i>Chairman</i>	J. F. Manning
B. H. Clark, Jr.	J. R. Mitchell
N. O. Cross	J. M. Nieters
P. M. Horrigan	J. C. Spanner, Sr.

Subgroup on General Requirements and Surface Examination (SC V)

H. C. Graber, <i>Chairman</i>	B. H. Clark, Jr.
A. S. Birks	J. G. Cvar
W. G. Blankenship	R. M. Jessee
A. S. Britton	L. C. Ludwig
J. O. Brown	R. McGuire
J. B. Christofferson	J. P. Sunukjian

SUBCOMMITTEE ON PRESSURE VESSELS (SC VIII)

J. R. Farr, <i>Chairman</i>	R. W. Mikitka
R. J. Cepluch, <i>Vice Chairman</i>	U. R. Miller
A. J. Roby, <i>Secretary</i>	E. E. Morgeneegg
A. P. Ahrendt	C. C. Neely
J. O. Brown	R. F. O'Neill
S. M. Caldwell	F. O. Parnkopf
W. J. Carter	A. Selz
S. C. Cyr	A. M. Smolen
R. E. Feigel	D. A. Staskelunas
G. E. Fratcher	E. A. Steen
W. L. Garvin	J. J. Szigety
B. D. Hackney	J. W. Tackett
H. L. Hime	K. K. Tam
M. H. Jawad	E. L. Thomas, Jr.
G. G. Karcher	J. S. Brzuszkiewicz, Staff Representative
J. LeCoff	
S. M. Matthews	

Special Working Group on Heat Transfer Equipment (SC VIII)

J. H. Kissel, <i>Chairman</i>	G. G. Karcher
U. R. Miller, <i>Vice Chairman</i>	A. Lohmeier
H. A. Schmidt, Jr., <i>Secretary</i>	A. P. Rochino
C. F. Andreone	J. E. Soehrens
D. E. Bolt	A. I. Soler
G. Borushko	W. A. Treff
S. M. Caldwell	S. Yokell
T. K. Haldas	

Special Working Group on High Pressure Vessels (SC VIII)

J. R. Sims, Jr., <i>Chairman</i>	G. J. Mraz
M. E. Sheehan, <i>Secretary</i>	E. G. Nisbett
D. J. Burns	L. Ohlsson
C. M. Elwonger	E. R. Sliwinski
R. G. Fasiczka	A. M. Smolen
R. E. Feigel	J. F. Sullivan
D. M. Fryer	F. W. Tatar
J. F. Harvey	D. A. Wells
D. P. Kendall	

Subgroup on General Requirements (SC VIII)

C. C. Neely, <i>Chairman</i>	P. M. Nightengale
R. E. Tillberg, <i>Secretary</i>	A. S. Olivares
A. P. Ahrendt	A. M. Smolen
W. J. Carter	A. J. Spencer
W. L. Garvin	D. A. Staskelunas
C. R. Good	E. A. Steen
S. M. Matthews	W. J. Stuber

Subgroup on Materials (SC VIII)

J. W. Tackett, <i>Chairman</i>	E. G. Nisbett
H. L. Hime, <i>Secretary</i>	D. W. Rahoi
W. D. Doty	K. K. Tam
J. Hainsworth	D. A. Wells
J. D. McLoughlin	

Subgroup on Design (SC VIII)

R. F. O'Neill, <i>Chairman</i>	R. W. Mikitka
R. E. Knoblock, <i>Secretary</i>	U. R. Miller
M. R. Bauman	K. Mokhtarian
J. R. Farr	A. Selz
J. A. Hayward	J. W. Stokes
J. L. Jacobowitz	K. K. Tam
M. H. Jawad	E. L. Thomas, Jr.
G. G. Karcher	

Working Group on Noncircular Vessels (SG-D) (SC VIII)

A. Selz, <i>Chairman</i>	A. M. Smolen
G. Ganeshan	B. K. Thakur
H. E. Gordon	E. L. Thomas, Jr.
P. M. Nightengale	J. L. Urner
R. K. Rothenbucher	S. V. Voorhees
K. V. Shipes	

Subgroup on Fabrication and Inspection (SC VIII)

J. O. Brown, <i>Chairman</i>	M. J. Houle
R. F. O'Neill, <i>Secretary</i>	H. Lewis, Jr.
G. Bibel	F. O. Parnkopf
R. W. Boyce	H. C. Rauschenplat
S. C. Cyr	R. E. Schuessler
R. E. Feigel	J. J. Szigety
H. B. France	R. F. Wagner

Working Group on Layered Vessels (SGFI) (SC VIII)

F. O. Parnkopf, <i>Chairman</i>	J. L. Jacobowitz
A. M. Smolen, <i>Secretary</i>	H. C. Rauschenplat
S. M. Caldwell	M. A. Tracy
G. E. Fratcher	

SUBCOMMITTEE ON WELDING (SC IX)

B. D. Hackney, <i>Chairman</i>	B. R. Newmark
R. K. Sager, <i>Vice Chairman</i>	P. P. Norris
P. D. Stumpf, <i>Secretary</i>	S. D. Reynolds, Jr.
B. L. Alia	B. S. Russell
M. L. Carpenter	W. K. Scattergood
H. R. W. Cobb	J. L. Smith
H. R. Conaway	W. J. Sperko
W. D. Doty	G. W. Spohn III
J. G. Feldstein	D. J. Stull
P. D. Flenner	K. C. Taber
M. J. Houle	D. L. Tevis
R. A. LaPointe	R. R. Young
R. E. Lorentz, Jr.	J. B. Christofferson, <i>Alternate</i>
R. P. Meineke	W. J. Wagner, <i>Alternate</i>
A. H. Miller	

Subgroup on Materials (SC IX)

R. E. Lorentz, Jr., <i>Chairman</i>	R. K. Sager
M. L. Carpenter	C. E. Spaeder
H. R. Conaway	W. J. Sperko
M. V. Davis	K. C. Taber
P. D. Flenner	J. W. Tackett
R. M. Jessee	R. R. Young
A. H. Miller	

Subgroup on General Requirements (SC IX)

B. R. Newmark, <i>Chairman</i>	J. L. Smith
M. V. Davis	A. J. Spencer
R. M. Jessee	K. C. Taber
R. P. Meineke	C. E. Wainwright
A. S. Olivares	

Subgroup on Procedure Qualification (SC IX)

M. J. Houle, <i>Chairman</i>	A. H. Miller
B. L. Alia	S. D. Reynolds, Jr.
R. K. Brown, Jr.	D. E. Smith
H. R. W. Cobb	W. J. Sperko
J. G. Feldstein	

Subgroup on Performance Qualification (SC IX)

M. J. Houle, <i>Chairman</i>	P. P. Norris
D. A. Bowers, Jr.	W. K. Scattergood
J. B. Christofferson	G. W. Spohn III
P. D. Flenner	D. L. Tevis
R. A. LaPointe	W. J. Wagner

Subgroup on Brazing (SC IX)

M. L. Carpenter, <i>Chairman</i>	A. H. Miller
R. A. LaPointe	J. Serre

SUBCOMMITTEE ON REINFORCED PLASTIC PRESSURE VESSELS (SC X)

D. M. Bertelsman, <i>Chairman</i>	L. E. Hunt
J. Yarmush, <i>Secretary</i>	W. J. Johns
D. H. Barton	J. A. Kidd
J. H. Bouchard	F. R. Pfloderer
L. C. Daniels	J. A. Rolston
T. J. Fowler	A. I. Snyder
S. V. Hoa	C. H. Walters

**SUBCOMMITTEE ON NUCLEAR INSERVICE INSPECTION
(SC XI)**

S. H. Bush, <i>Chairman</i>	R. C. Howard
K. I. Baron, <i>Secretary</i>	L. R. Katz
C. W. Allison	R. D. Kerr
W. F. Anderson	J. J. Lance
A. C. Ashton	J. Matte III
W. H. Bamford	T. J. Mawson
R. L. Beverly	G. C. Millman
A. J. Birkle	R. E. Muise
L. J. Chockie	T. G. Parker
D. C. Cowfer	G. J. Pitzl
M. J. Crisler	R. L. Powers
D. D. Davis	P. C. Riccardella
E. A. DeBarba	R. F. Sammataro
A. M. DiBiasio	M. L. Snow, Jr.
F. E. Gregor	R. W. Swayne
L. B. Gross	R. J. Tamminga
R. H. Hansen	J. C. Tobin
O. F. Hedden	S. D. Weinman, Staff Representative
H. T. Hill	
J. P. Houstrup	

Special Working Group on Plant Life Extension (SC XI)

L. R. Katz, <i>Chairman</i>	J. T. McCumber
L. B. Gross, <i>Secretary</i>	H. McShane
T. L. Bailey	E. A. Merrick
A. J. Birkle	D. R. Payne
L. D. Bustard	D. A. Piccione
D. D. Davis	D. Sattar
T. M. Erwin	W. B. Scott
W. L. Garvin	V. N. Shah
F. E. Gregor	E. A. Siegel
B. Gutherman	P. P. Stancavage
D. L. Harrison	A. Taboada
D. R. Hostetler	R. J. Tamminga
J. P. Houstrup	L. B. Tittle
R. C. Howard	S. A. Traiforos
M. E. Lapidés	

Special Working Group on Core Supports (SC XI)

J. C. Tobin, <i>Chairman</i>	J. J. Lance
H. Behnke	R. A. Moen
S. Chandra	J. F. Mullooly
R. M. Gribble	B. L. Silverblatt
E. T. Ishizaka	E. Steinkamp

Special Working Group on Pipe Wall Thinning (SC XI)

S. H. Bush, <i>Chairman</i>	P. C. Riccardella
V. K. Chexal	J. C. Rivers
T. N. Epps III	J. C. Spanner, Jr.
T. L. Gerber	A. Taboada
J. P. Houstrup	R. J. Tamminga
D. S. Kerr	P. C. S. Woo

Special Working Group on Pressure Testing (SC XI)

R. C. Howard, <i>Chairman</i>	C. E. Jensen
M. P. Lintz, <i>Secretary</i>	S. Ranganath
E. D. Crane	F. J. Schaaf, Jr.
R. M. Gamble	J. H. Uhl
S. R. Gosselin	R. A. Yonekawa

Special Working Group on Editing and Review (SC XI)

R. L. Beverly, <i>Chairman</i>	M. P. Lintz
A. L. Bradshaw	J. E. Staffiera
L. B. Gross	R. W. Swayne
V. H. Hight	

Subgroup on Water-Cooled Systems (SC XI)

A. J. Birkle, <i>Chairman</i>	G. C. Millman
T. F. Lentz, <i>Secretary</i>	C. V. Moore
C. W. Allison	R. L. Powers
W. F. Anderson	L. Sage
A. C. Ashton	M. L. Snow, Jr.
D. D. Davis	R. J. Tamminga
L. B. Gross	F. Tehranchi
T. C. Hinkle	D. L. Tevis
C. E. Jensen	J. H. Uhl
L. R. Katz	G. Wasilenko
R. E. Legate	

Working Group on Component Supports (SG-WCS) (SC XI)

D. D. Davis, <i>Chairman</i>	L. F. Lake
E. Beffa	G. C. Millman
G. L. Belew	R. L. Powers
G. A. Delp	R. F. Tegethoff
G. P. Knippel	M. P. Zyne
C. N. Krishnaswamy	

Working Group on General Requirements (SG-WCS) (SC XI)

R. J. Tamminga, <i>Chairman</i>	L. B. Gross
T. M. Zwick, <i>Secretary</i>	R. H. Hansen
W. F. Anderson	C. E. Hartz
R. G. Edl	R. K. Mattu
J. C. Goulart	D. L. Tevis
D. A. Graham	

Working Group on Pumps and Valves (SG-WCS) (SC XI)

C. E. Jensen, <i>Chairman</i>	W. C. Holston
M. P. Lintz, <i>Secretary</i>	R. K. Mattu
A. Cardillo	D. R. Payne
F. C. Cherny	L. Sage
C. E. Hartz	E. V. Werry

**Working Group on Inspection of Systems and Components
(SG-WCS) (SC XI)**

L. Sage, <i>Chairman</i>	A. A. Koehl
J. C. Rivers, <i>Secretary</i>	T. F. Lentz
A. C. Ashton	M. P. Lintz
E. D. Crane	W. B. Scott
D. A. Gallino	F. Tehranchi
T. C. Hinkle	J. H. Uhl
M. R. Hum	R. J. Von Osinski
C. E. Jensen	

Subgroup on Gas-Cooled Systems (SC XI)

R. H. Hansen, *Chairman*

Subgroup on Liquid-Metal Cooled Systems (SC XI)

J. Matte III, *Chairman*
C. G. McCarger, *Secretary*
W. L. Chase
S. Hattori
R. Hundal
H. C. Jung
E. Larson

L. R. Monson
L. J. Nemeth
W. J. Rowan
G. Seed
J. C. Tobin
T. J. Walker

Working Group on Liquid-Metal Reactor Covers (SG-LMCS) (SC XI)

W. L. Chase, *Chairman*
L. J. Nemeth, *Secretary*
S. Hattori
R. Hundal

E. Larson
J. Matte III
G. Seed

Subgroup on Containment (SC XI)

R. F. Sammataro, *Chairman*
J. E. Staffiera, *Secretary*
W. J. Briggs
K. K. N. Chao
N. W. Edwards
F. E. Gregor
H. T. Hill

D. R. Pitcairn
C. G. Ranganath
A. J. Spencer
J. F. Strunk
P. W. Ward
R. N. Watson
K. R. Wichman

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

H. T. Hill, *Chairman*
W. J. Briggs, *Secretary*
H. G. Ashar
T. L. Bradley
C. A. Byrd
K. K. N. Chao

J. F. Fulton
S. Guha-Majumdar
C. N. Krishnaswamy
C. G. Ranganath
A. M. Salley
P. W. Ward

Subgroup on Evaluation Standards (SC XI)

W. H. Bamford, *Chairman*
J. P. Houstrup, *Secretary*
C. Y. Cheng
R. C. Cipolla
T. J. Griesbach
K. Iida
R. E. Johnson
M. Kupinski

D. M. Norris
S. Ranganath
P. C. Riccardella
W. L. Server
W. A. Van Der Sluys
K. K. Yoon
S. Yukawa

Working Group on Operating Plant Criteria (SG-ES) (SC XI)

T. J. Griesbach, *Chairman*
R. M. Gamble, *Secretary*
A. S. Amar
W. F. Anderson
W. H. Bamford
H. Behnke
A. F. Billy
J. M. Bloom
R. C. Cipolla
W. C. Cliff
E. Friedman
R. B. Ganta
S. R. Gosselin
J. P. Houstrup
K. Ijzerman
R. E. Johnson

M. Kupinski
S. D. Leshnoff
R. M. Pace
A. G. Panagos
J. S. Panesar
J. H. Phillips
S. W. Pullins
P. N. Randall
S. Ranganath
W. L. Server
V. N. Shah
E. A. Siegel
F. A. Simonen
G. M. Wilkowski
K. K. Yoon
S. Yukawa

Working Group on Flaw Evaluation (SG-ES) (SC XI)

R. C. Cipolla, *Chairman*
J. M. Bloom, *Secretary*
A. S. Amar
W. H. Bamford
M. Basol
C. Y. Cheng
N. W. Edwards
E. Friedman
T. J. Griesbach
J. P. Houstrup
K. Iida
M. Kupinski
J. G. Merkle

D. M. Norris
J. S. Panesar
P. C. Paris
P. P. Raju
S. Ranganath
W. L. Server
F. A. Simonen
G. M. Wilkowski
J. E. Wilson
K. K. Yoon
S. Yukawa
V. A. Zilberstein

Subgroup on Nondestructive Examination (SC XI)

E. A. DeBarba, *Chairman*
J. C. Spanner, Sr., *Secretary*
D. C. Adamonis
R. L. Beverly
D. A. Brunner
C. B. Cheezem
J. F. Cook
D. C. Cowfer

G. J. Dau
F. J. Dodd
M. R. Hum
J. J. Lance
C. R. Osman
T. G. Parker
R. J. Scott
J. C. Spanner, Jr.

Working Group on Procedure Qualification and Volumetric Examination (SG-NDE) (SC XI)

D. C. Cowfer, *Chairman*
N. R. Bentley, *Secretary*
D. C. Adamonis
D. A. Brunner
C. B. Cheezem
W. T. Clayton
G. J. Dau
T. N. Epps III

O. DeMiranda
F. J. Dodd
R. Kellerhall
J. J. Lance
J. Muscara
M. J. Saporito
J. C. Spanner, Jr.
T. T. Taylor

Working Group on Personnel Qualification and Surface Visual and Eddy Current Examination (SG-NDE) (SC XI)

J. F. Cook, *Chairman*
V. H. Hight, *Secretary*
J. E. Cavender, Jr.
D. R. Dadson
N. Economos
D. O. Henry
W. C. Koepke

C. R. Osman
J. M. Ray
R. J. Scott
M. F. Sherwin
A. L. Smith
J. C. Spanner, Sr.

Special Working Group on Eddy Current Examination (SC XI)

D. O. Henry, *Chairman*
B. Curtis, *Secretary*
J. M. Benson
S. D. Brown
A. Curtis
C. J. Denton
D. R. Dodson
R. H. Ferris

M. J. Gallagher
R. H. Ingraham
J. H. Kang
R. J. Kurtz
R. E. Marlow
S. A. Redner
D. D. Weber

Subgroup on Repairs and Replacements (SC XI)

T. J. Mawson, <i>Chairman</i>	R. D. Kerr
M. J. Crisler, <i>Secretary</i>	W. Kooy
E. T. Baker III	R. S. Lewis
J. D. Boardman	R. E. Muise
B. W. Burak	D. R. Payne
J. Derrico	G. J. Pitzl
A. M. DiBiasio	R. R. Stevenson
W. L. Garvin	R. W. Swayne
R. E. Gimple	S. Tobey
O. F. Hedden	J. C. Tobin
R. C. Howard	A. J. Walcutt
E. T. Ishizaka	S. J. Walmsley
W. R. Johnson	R. A. Yonekawa
W. N. Keisler	

Working Group on Repairs (SG-RR) (SC XI)

J. Derrico, <i>Chairman</i>	W. N. Keisler
J. D. Boardman	R. D. Kerr
R. W. Boyce	D. R. Pitcairn
R. E. Cantrell	F. J. Schaaf, Jr.
R. F. Hollander	R. W. Swayne
E. T. Ishizaka	S. Tobey

Special Working Group on Repairs by Welding (SG-RR) (SC XI)

S. Tobey, <i>Chairman</i>	H. J. Kaplan
M. E. Reese, <i>Secretary</i>	R. A. LaPointe
C. Brookbank	W. E. Mayott
R. E. Cantrell	B. R. Newmark
B. R. Crowley	P. P. Norris
W. V. Gwaltney	D. L. Tevis
M. J. Houle	E. H. Williams
W. R. Johnson	

Working Group on Replacements (SG-RR) (SC XI)

A. M. Di Biasio, <i>Chairman</i>	W. Kooy
R. E. Gimple, <i>Secretary</i>	R. E. Legate
E. T. Baker III	G. J. Pitzl
C. E. Hartz	R. R. Stevenson
O. F. Hedden	A. J. Walcutt
W. C. Holston	R. A. Yonekawa
R. C. Howard	

SUBCOMMITTEE ON PROPERTIES OF METALS (SC-P)

D. A. Canonico, <i>Chairman</i>	F. Masuyama
J. P. Millman, <i>Secretary</i>	R. A. Moen
A. P. Ahrendt	R. K. Nanstad
T. M. Cullen	A. J. Palmer
W. D. Doty	D. W. Raho
A. R. Faulkner	B. W. Roberts
M. Gold	D. I. Roberts
D. G. Harman	C. E. Spaeder
S. O. Hilton	J. W. Tackett
E. T. Ishizaka	R. T. Webster

Subgroup on Strength, Ferrous Alloys (SC-P)

M. Gold, <i>Chairman</i>	S. O. Hilton
A. P. Ahrendt	J. F. Longenecker
D. A. Canonico	R. A. Moen
T. M. Cullen	D. W. Raho
R. M. Curran	B. W. Roberts
R. J. Diletto	D. I. Roberts
J. J. Heger	C. E. Spaeder

Subgroup on Strength, Nonferrous Alloys (SC-P)

R. T. Webster, <i>Chairman</i>	R. A. Rosenberg
M. H. Gilkey	E. Shapiro
B. B. Hood	L. E. Shoemaker
W. R. Kearney	J. W. Tackett

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

W. D. Doty, <i>Chairman</i>	D. I. Roberts
H. R. W. Cobb	R. K. Sager
B. W. Roberts	C. E. Spaeder

Subgroup on Toughness (SC-P)

R. K. Nanstad, <i>Chairman</i>	E. G. Nisbett
J. M. Barsom	A. Selz
R. F. Cappellini	I. Sprung
H. T. Corten	R. D. Stout
W. Hanzalek	M. F. Wheatcroft
W. S. Hazelton	S. Yukawa
E. I. Landerman	R. Zawierucha

Working Group on Nonnuclear Application (SG-T) (SC-P)

A. Selz, <i>Chairman</i>	M. F. Wheatcroft
E. G. Nisbett	R. Zawierucha
R. D. Stout	

Working Group on Nuclear Application (SG-T) (SC-P)

E. I. Landerman, <i>Chairman</i>	W. S. Hazelton
R. F. Cappellini	A. Selz

Working Group on Toughness Criteria (SG-T) (SC-P)

J. M. Barsom	S. Yukawa
R. K. Nanstad	

SUBCOMMITTEE ON SAFETY VALVE REQUIREMENTS (SC-SVR)

E. C. Kistner, Jr., <i>Chairman</i>	W. D. Greenlaw
W. L. Garvin, <i>Vice Chairman</i>	H. I. Gregg
C. J. Gomez, <i>Secretary</i>	S. F. Harrison, Jr.
G. C. Batz	W. D. Hayen
M. D. Bernstein	F. J. Howes
J. Cahoon, Jr.	M. A. Robinson
R. A. Cedel	A. J. Spencer
O. J. Cox, Jr.	L. L. Thompson
E. C. Cullie	F. W. Weidner
R. J. Doelling	

Subgroup on General Requirements (SC-SVR)

M. D. Bernstein, *Chairman* C. A. Neumann
W. D. Hayen M. A. Robinson
F. J. Howes L. L. Thompson
D. Kadakia

Subgroup on Testing (SC-SVR)

O. J. Cox, Jr., *Chairman* V. M. DeLuca
R. A. Cedel S. F. Harrison, Jr.
E. C. Cullie F. W. Weidner

Subgroup on Design (SC-SVR)

W. D. Greenlaw, *Chairman* R. J. Doelling
G. C. Batz H. I. Gregg
J. Cahoon, Jr. G. W. Neerbasch

SUBCOMMITTEE ON DESIGN (SC-D)

M. H. Jawad, *Chairman* O. F. Hedden
R. I. Jetter, *Vice Chairman* C. A. Moore
J. Yarmush, *Secretary* W. J. O'Donnell
T. K. Burr R. F. O'Neill
W. J. Carter R. D. Schueler, Jr.
J. R. Farr M. P. Schwartz

Subgroup on Openings (SC-D)

M. P. Schwartz, *Chairman* P. P. Raju
R. W. Mikitka, *Secretary* M. D. Rana
S. C. Lou E. C. Rodabaugh
R. B. Luney H. H. Schneider
K. Mokhtarian R. W. Schneider
K. C. Morrison H. K. Shaw
D. R. Palmer G. M. Tunnell, Jr.

Subgroup on External Pressure (SC-D)

W. J. Carter, *Chairman* W. J. Koves
D. J. Green H. W. Marsh
J. S. Kandola C. D. Miller

Subgroup on Design Analysis (SC-D)

T. K. Burr, *Chairman* T.-H. Liu
K. S. Ahluwalia A. Lohmeier
R. S. Barsoum T. V. Narayanan
S. Chattopadhyay S. S. Palusamy
C. Chen T. P. Pastor
A. G. Eggers M. W. Ringer, Jr.
H. M. Fishman E. R. Sliwinski
J. L. Hechmer E. L. Thomas, Jr.
A. Kalnins R. J. Thomas

Subgroup on Elevated Temperature Design (SC-D)

R. I. Jetter, *Chairman* R. K. Mattu
J. M. Corum, *Secretary* L. C. S. Nieh
C. R. Brinkman W. J. O'Donnell
R. D. Campbell D. I. Roberts
J. B. Conway C. C. Schultz, Jr.
A. W. Dalcher L. K. Severud
D. S. Griffin A. L. Snow
M. T. Jakub W. Veljovich
C. W. Lawton B. C. Wei
S. Majumdar

Subgroup on Fatigue Strength (SC-D)

W. J. O'Donnell, *Chairman* D. P. Jones
C. R. Brinkman C. W. Lawton
B. Gowda M. J. Manjoine
J. A. Hayward A. Merend
J. L. Hechmer G. C. Millman
L. A. James

**SUBCOMMITTEE ON BOILER AND PRESSURE VESSEL
ACCREDITATION (SC-BPVA)**

C. E. Ford, *Chairman* R. C. Howard
D. J. McDonald, *Vice* D. S. Korzec
Chairman T. H. Milton
M. Gutierrez, *Secretary* E. F. Murphy
G. P. Mancini, *Assistant* M. L. Snow, Jr.
Secretary J. M. Whelan
S. C. Cyr C. B. Zekas
D. M. Fischer J. R. Farr, Alternate
W. D. Greenlaw

SUBCOMMITTEE ON NUCLEAR ACCREDITATION (SC-NA)

H. A. Manning, *Chairman* R. C. Howard
M. N. Bressler, *Vice Chairman* W. G. Knecht
A. Bagner, *Secretary* J. Lang
C. W. Allison J. D. Lenardson
E. T. Baker, III G. F. McDonald, Jr.
R. B. Bremmer R. E. Muise
D. J. Carreira T. E. Quaka
R. E. Feigel M. L. Snow, Jr.
J. E. Harris

CONTENTS

A Detailed Contents Precedes Each Appendix

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

Mandatory Appendices

Appendix I	Design Stress Intensity Values, Allowable Stresses, Material Properties, and Design Fatigue Curves	3
Appendix II	Experimental Stress Analysis	253
Appendix III	Basis for Establishing Design Stress Intensity Values and Allowable Stress Values	265
Appendix IV	Approval of New Materials Under the ASME Boiler and Pressure Vessel Code for Section III Application	271
Appendix V	Certificate Holders' Data Report Forms, Instructions, and Application Forms for Certificates of Authorization for Use of Code Symbol Stamps	275
Appendix VI	Rounded Indications	311
Appendix VII	Charts and Tables for Determining Shell Thickness of Cylindrical and Spherical Components Under External Pressure	323
Appendix XI	Rules for Bolted Flange Connections for Class 2 and 3 Components and Class MC Vessels	373
Appendix XII	Design Considerations for Bolted Flange Connections	395
Appendix XIII	Design Based on Stress Analysis for Vessels Designed in Accordance With NC-3200	401
Appendix XIV	Design Based on Fatigue Analysis for Vessels Designed in Accordance With NC-3200	417
Appendix XVIII	Capacity Conversions for Pressure Relief Valves	425
Appendix XIX	Integral Flat Head With a Large Opening	433
Appendix XX	Preparation of Technical Inquiries to the Boiler and Pressure Vessel Committee	439
Appendix XXI	Adhesive Attachment of Nameplates	443
Appendix XXII	Design of Reinforcement for Cone-to-Cylinder Junction Under External Pressure	447

Nonmandatory Appendices		
Appendix A	Stress Analysis Methods	455
Appendix B	Owner's Design Specifications	513
Appendix C	Certificate Holder's Design Report	539
Appendix D	Nonmandatory Preheat Procedures	545
Appendix E	Minimum Bolt Cross-Sectional Area	549
Appendix F	Rules for Evaluation of Service Loadings With Level D Service Limits	557
Appendix G	Protection Against Nonductile Failure	569
Appendix J	Owner's Design Specifications for Core Support Structures	581
Appendix K	Recommended Maximum Deviations and Tolerances for Component Supports	585
Appendix L	Class FF Flange Design	589
Appendix M	Recommendations for Control of Welding, Postweld Heat Treatment, and Nondestructive Examination of Welds	609
Appendix N	Dynamic Analysis Methods	613
Appendix O	Rules for Design of Safety Valve Installations	649
Appendix P	Contents of Certified Material Test Reports	657
Appendix Q	Design Rules for Clamp Connections	661
Appendix R	Determination of Permissible Lowest Service Metal Temperature From T_{NDT} for Classes 2 and MC Construction	671
SI Units		675

ORGANIZATION OF SECTION III

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 nine books make up the two Divisions.

Subsection NCA — General Requirements for Division 1 and Division 2

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	Overpressure Protection
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.

A. References to Other Portions of Section III

When a reference is made to another Article, Subarticle, or paragraph, all numbers subsidiary to that reference shall be included. For example, reference to NB-3000 includes all material in Article NB-3000; reference to NB-3200 includes