

ASME BOILER AND PRESSURE VESSEL CODE
AN AMERICAN NATIONAL STANDARD

SECTION III

Rules for Construction of Nuclear Power Plant Components

DIVISION 1 – SUBSECTION NG Core Support Structures

1986 EDITION

JULY 1, 1986



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, 1986
(Includes all Addenda dated December 1985 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.

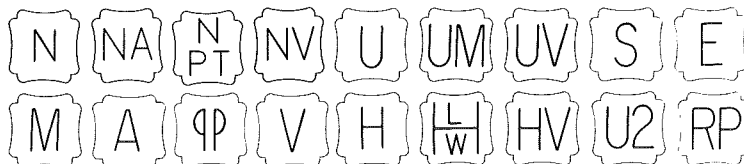
Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

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 © 1986 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

1986 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 Fiberglass-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 1989 Code. The 1986 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 1989 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 1986 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 1989 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 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.

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 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 Specification 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.

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 Ameri-

can 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, 1985

MAIN COMMITTEE

W. R. Mikesell, <i>Chairman</i>	J. R. Farr
E. J. Hemzy, <i>Vice Chairman</i>	B. D. Hackney
G. M. Eisenberg, <i>Secretary</i>	W. C. Ham
B. W. Bace	H. L. Hime
M. D. Bernstein	M. H. Jawad
R. K. Blossch	G. G. Karcher
R. D. Bonner	E. C. Kistner, Jr.
R. J. Bosnak	J. LeCoff
M. N. Bressler	J. R. MacKay
V. W. Butler	D. J. McDonald
D. A. Canonico	F. N. Moschini
R. J. Cepluch	C. C. Neely
L. J. Chockie	T. E. Northup
H. F. Dobel	R. F. Reedy
W. D. Doty	W. R. Smith, Sr.

HONORS AND AWARDS COMMITTEE

H. F. Dobel, <i>Chairman</i>	W. L. Garvin
W. R. Smith, Sr., <i>Vice Chairman</i>	M. Gold
G. M. Eisenberg, <i>Secretary</i>	R. C. Hudson
L. J. Chockie	E. C. Kistner, Jr.
J. R. Farr	F. N. Moschini
G. E. Fratcher	E. G. Nisbett
	R. K. Sager, Jr.

EXECUTIVE COMMITTEE (MAIN COMMITTEE)

E. J. Hemzy, <i>Chairman</i>	L. J. Chockie
W. R. Mikesell, <i>Vice Chairman</i>	E. C. Kistner, Jr.
G. M. Eisenberg, <i>Secretary</i>	F. N. Moschini
R. J. Bosnak	R. F. Reedy
R. J. Cepluch	

HONORARY MEMBERS (MAIN COMMITTEE)

J. D. Andrew, Jr.	E. L. Kemmler
P. M. Brister	E. M. Kloeblen
H. M. Canavan	J. E. Lattan
J. S. Clarke	C. E. Rawlins
W. E. Cooper	D. B. Wesstrom
R. M. Gibson	F. S. G. Williams
R. C. Griffin	L. P. Zick
W. L. Harding	

MARINE CONFERENCE GROUP

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

CONFERENCE COMMITTEE

R. K. Blossch — Utah (<i>Chairman</i>)	W. E. Long, Jr. — Virginia
C. H. Walters — Oregon (<i>Vice Chairman</i>)	B. M. Lovelady — Memphis and Shelby County, Tennessee
D. J. McDonald — National Board (<i>Secretary</i>)	C. C. Mann — New Orleans
H. P. Baron — Minnesota	S. M. Matthews — Texas
J. E. Brennan — Ohio	I. W. Mault — Manitoba
W. E. Brown — Kansas	H. T. McEwen — Mississippi
N. B. Burkheimer — Maryland	A. W. Meiring — Indiana
R. D. Cather — Alaska	J. P. Mickels — Nebraska
B. E. Cimino — Colorado	H. C. Mills — Kentucky
B. W. Cole — British Columbia	R. D. O'Connor — Connecticut
A. Colvin, Jr. — Washington, D.C.	H. Parker, Jr. — Nevada
Z. C. Cordero — Michigan	R. D. Reetz — North Dakota
J. T. Crosby — Arkansas	R. Rodriguez Perez — Puerto Rico
J. G. Cvar — Delaware	D. E. Ross — New Brunswick
A. W. Diamond — Newfoundland and Labrador	R. Sauve — Quebec
F. G. Dolen — New Jersey	S. Schugar — Detroit
J. J. Duffy — Wisconsin	C. A. Sjolund — Los Angeles
E. Everett — Georgia	J. L. Smith — Alberta
R. F. Frodl — Washington	M. L. Snow, Jr. — Tennessee
D. R. Gallup — Illinois	R. P. Sullivan — Maine
J. W. Greenawalt, Jr. — Oklahoma	C. W. Thompson — Louisiana
V. Harding — Hawaii	R. W. Vindich — Pennsylvania
R. D. Herman — Saskatchewan	W. A. M. West — Prince Edward Island
E. M. Hicks — New York	R. B. West — Iowa
W. J. Holmes — Chicago	G. W. Wheaton — Rhode Island
G. M. Kuetemeyer — Milwaukee	M. J. Wheel — Vermont
W. W. Larsen — Iowa	B. L. Whitley — North Carolina
J. T. Little — Arizona	H. J. Wright — Ontario
	R. A. Yeo — Nova Scotia

SUBCOMMITTEE ON POWER BOILERS (SC I)

E. C. Kistner, Jr., <i>Chairman</i>	W. L. Lowry, Jr.
J. R. MacKay, <i>Vice Chairman</i>	R. F. Manning
M. E. Sheehan, <i>Secretary</i>	D. J. McDonald
M. D. Bernstein	R. G. Presnak
D. A. Canonico	R. Sanchez P.
A. R. Faulkner	R. D. Schueller, Jr.
D. N. French	F. W. Weidner
F. R. Gerety	B. L. Whitley
O. F. Hedden	R. L. Williams
W. T. Higginbotham	L. W. Yoder
R. Leone	J. L. Aguilar, Alternate

Subgroup on Care of Power Boilers (SC I)

W. T. Higginbotham, <i>Chairman</i>	D. J. McDonald
C. J. Berg	J. W. McNeas
H. F. Dobel	A. Plauchu
D. O. Downey	G. J. Raftis
R. R. Hess	R. Sanchez P.
C. R. Hoefs	B. L. Whitley
E. A. Holden	J. R. Zahorsky
E. C. Kistner, Jr.	

Subgroup on Piping (SC I)

R. L. Williams, <i>Chairman</i>	W. L. Lowry, Jr.
F. R. Gerety, <i>Secretary</i>	T. C. McGough
M. D. Bernstein	R. G. Presnak
A. J. Breugelmanns	L. J. Sas
A. R. Faulkner	K. J. Szigety
T. E. Hansen	L. W. Yoder
R. R. Hess	

Subgroup on Fire Tube Boilers (SC I)

R. F. Manning, <i>Chairman</i>	R. G. Reid
M. A. Farrugia	L. Sanchez G.
G. L. Kasparian	B. L. Whitley
R. Leone	

Subgroup on Design (SC I)

R. D. Schueller, Jr., <i>Chairman</i>	R. Leone
M. D. Bernstein	R. F. Manning
W. R. Hankins	

Subgroup on Materials (SC I)

A. R. Faulkner, <i>Chairman</i>	C. D. Frew
S. G. Bankar	J. S. Hunter
D. A. Canonico	

Subgroup on General Requirements (SC I)

M. D. Bernstein, <i>Chairman</i>	D. J. McDonald
F. R. Gerety, <i>Secretary</i>	T. C. McGough
T. E. Hansen	R. Sanchez P.
O. F. Hedden	W. E. Somers
R. R. Hess	F. W. Weidner
R. Leone	R. L. Williams
W. L. Lowry, Jr.	L. W. Yoder

Subgroup on Fabrication and Examination (SC I)

O. F. Hedden, <i>Chairman</i>	J. Hainsworth
S. G. Bankar	W. T. Higginbotham
D. N. French	R. D. Schueller, Jr.
J. W. Gibson	

SUBCOMMITTEE ON MATERIALS SPECIFICATIONS (SC II)

V. W. Butler, <i>Chairman</i>	R. A. Moen
W. C. Banks, <i>Vice Chairman</i>	E. G. Nisbett
J. P. Millman, <i>Secretary</i>	C. J. Parmentier
R. M. Brown	D. L. Shira
A. Cohen	R. W. Swayne
M. Gold	W. R. Sylvester
G. C. Hsu	J. W. Tackett
E. T. Ishizaka	E. O. Woolridge
E. I. Landerman	A. W. Zeuthen
A. S. Melilli	

Subgroup on Steel Plates (SC II)

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

Subgroup on Steel Tubular Products (SC II)

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

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

E. G. Nisbett, <i>Chairman</i>	J. S. Orlando
W. C. Banks	C. J. Parmentier
R. F. Cappelini	W. L. Powell
B. M. Dingman	H. C. Templeton
E. I. Landerman	E. O. Woolridge
A. S. Melilli	

Subgroup on Nonferrous Alloys (SC II)

G. C. Hsu, *Chairman*
J. W. Tackett, *Secretary*
A. Cohen
A. P. Seidler
R. T. Webster
M. J. Weiss

SUBCOMMITTEE ON NUCLEAR POWER (SC III)

R. F. Reedy, *Chairman*
E. F. Gerwin, *Vice Chairman*
K. Ennis, *Secretary*
J. R. Barbee
R. J. Bosnak
E. B. Branch
M. N. Bressler
F. W. Catudal
L. J. Chockie
J. B. Christofferson
R. L. Dick
H. F. Dobel
W. D. Doty
F. R. Drahos
E. J. Hemzy
F. P. Hill, Jr.
R. E. Jagger
W. G. Knecht
D. F. Landers
J. Lang
W. N. McLean
C. A. Moore
F. N. Moschini
T. E. Northup
W. R. Smith, Sr.
M. L. Snow, Jr.
S. W. Tagart, Jr.

Special Working Group on Containment Systems for Nuclear Spent Fuel and High Level Waste Transport Packagings (SC III)

K. Goldmann, *Chairman*
R. Sanacore, *Secretary*
W. H. Brinkman
D. A. Canonico
R. J. Claverie
D. M. Dawson
J. A. Gatley
R. T. Haelsig
C. R. Johnson
R. H. Jones
J. J. McLellan
F. N. Moschini
R. E. Nickell
W. H. Rogers, Jr.
C. H. Walters
W. E. Wowak

Subgroup on General Requirements (SC III & 3C)

F. W. Brady, *Co-Chairman*
H. F. Dobel, *Co-Chairman*
J. R. Barbee
R. B. Bremmer
F. W. Catudal
E. F. Gerwin
W. S. Gibbons, Jr.
R. E. Jagger
R. D. Kulchak
M. J. Meyer
J. L. Milhoan
F. N. Moschini
R. E. Muise
M. L. Snow, Jr.
G. M. Tolson

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

W. S. Gibbons, Jr., *Co-Chairman*
R. D. Kulchak, *Co-Chairman*
R. C. Arthurs
J. N. Babcock, Jr.
J. R. Barbee
J. V. Bosco
R. B. Bremmer
B. W. Burak
J. G. Harkness
J. D. Lenardson
M. Malloy
M. J. Meyer
R. E. Muise
G. C. Pratt
A. Smith, Jr.
S. A. Sparacino
J. F. Strunk
M. F. Sullivan
G. M. Tolson

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

J. E. Ayotte
E. P. Burke
J. E. Crowe
A. C. Eberhardt
M. G. Freeman
T. E. Hansen
R. C. Howard
D. R. Kulla
B. C. Larcher
A. S. Laurenson
W. S. Little
J. R. Luke
J. K. Martin
J. D. McLoughlin
B. D. Rall
R. T. Rose
W. K. Sowder
R. E. Weber

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

R. E. Muise, *Chairman*
C. W. Allison
R. C. Arthurs
J. N. Babcock, Jr.
C. F. Buckley
B. W. Burak
J. Polcyn
R. Siever
W. K. Sowder
M. F. Sullivan

Subgroup on Materials (SC III)

W. G. Knecht, *Chairman*
W. H. Borter
B. G. Carlton
F. R. Drahos
F. P. Fetterolf
W. D. Goins
D. R. Haines
R. M. Hamschka
E. T. Ishizaka
E. I. Landerman
J. F. Longenecker
N. J. Mares
R. D. McKellar
W. N. McLean
R. A. Moen
X. E. Moore
D. A. Olsson
C. J. Parmentier
W. J. Sperko
A. Taboada

Subgroup on Design (SC III)

C. A. Moore, *Chairman*
E. B. Branch
M. N. Bressler
W. G. Brussalis, Jr.
W. F. English, Jr.
F. P. Hill, Jr.
D. F. Landers
E. M. Livingston
W. N. McLean
E. C. Rodabaugh
B. L. Silverblatt
G. C. Slagis
J. D. Stevenson
J. H. Wawrzyniak
K. R. Wichman

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

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

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

G. J. Bohm, <i>Chairman</i>	F. Jan
P. L. Anderson	D. P. Munson
C. W. Bruny	P. R. Olson
G. Bushnell	W. Pink
W. F. English, Jr.	P. P. Raju
M. Hartzman	W. A. Von Riesenmann

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

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

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

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

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

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

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

W. N. McLean, <i>Chairman</i>	L. J. Malandra
P. H. Awtrey	J. J. McGavin
I. L. Beltz	B. J. Milleville
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	B. C. Zannini
B. H. Leonard, Jr.	

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

M. N. Bressler, <i>Chairman</i>	T. C. LaCroix
J. M. Benenati	R. J. Masterson
G. M. Bove	A. E. Meligi
J. T. Boyd	E. D. Mysinger
B. J. Cheek	H. Noreen, Jr.
R. D. Ciatto	C. L. Ray, Jr.
R. P. Deubler	H. K. Shaw
H. T. H. Hui	E. O. Swain
T. Karppinen	M. P. Zyne
Z. A. Kravets	

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

B. L. Silverblatt, <i>Chairman</i>	F. T. Grubelich
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 Fabrication and Examination (SC III)

F. N. Moschini, <i>Chairman</i>	E. F. Gerwin
H. A. Sepp, Jr., <i>Secretary</i>	J. E. Harris
C. W. Allison	R. W. Jackson
D. C. Bertossa	R. M. Jesse
B. G. Carlton	W. G. Knecht
J. B. Christofferson	J. Lang
F. R. Drahos	R. E. Schuessler
G. B. Georgiev	R. E. Tschirch

Subgroup on Pressure Relief (SC III)

F. W. Catudal, <i>Chairman</i>	S. F. Harrison, Jr.
R. A. Cedel	K. Ijzerman
F. C. Cherny	D. M. Pattarini
R. J. Doelling	J. B. Vance
W. D. Greenlaw	

Subgroup on Elevated Temperature Construction (SC III)

A. W. Dalcher, <i>Chairman</i>	R. I. Jetter
J. L. McLean, <i>Secretary</i>	F. B. Litton
C. C. Bigelow	R. M. Mello
W. D. Goins	R. A. Moen
R. E. Jagger	J. M. Tanzosh
M. T. Jakub	

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

J. P. Allen III, <i>Chairman</i>	D. Marano
T. E. Northup, <i>Vice Chairman</i>	D. P. Moore
S. D. Weinman, <i>Secretary</i>	M. J. Morris
J. F. Artuso	R. G. Oesterle
R. M. Attar	F. S. Ople, Jr.
R. A. Bradshaw, Jr.	P. Reinhardt
F. W. Brady	F. Rinaldi
T. M. Brown	E. R. Rybarski
B. A. Erler	B. B. Scott
G. L. Fisher	J. D. Stevenson
A. E. Goldman	B. K. Thornley, Jr.
D. J. Haavik	R. N. White
T. E. Johnson	M. Bender, Observer
F. W. Joyce	C. P. Siess, Observer
R. D. Kulchak	

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

R. A. Bradshaw, Jr., <i>Chairman</i>	D. J. Haavik
J. P. Allen III	F. W. Joyce
R. M. Attar	D. Marano
S. Bhuyan	D. P. Moore
G. L. Fisher	

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

D. J. Haavik, <i>Chairman</i>	C. L. Grover
J. P. Allen III	J. Gutierrez
J. F. Best	D. Marano
S. Bhuyan	G. R. Murphy
R. A. Bradshaw, Jr.	E. R. Rybarski

Working Group on Reinforcing and Prestressing Systems (SG-M, C & E) (SC-3C)

D. P. Moore, <i>Chairman</i>	P. Reinhardt
J. E. Barry	S. K. Sen
H. Nierlich	B. K. Thornley, Jr.

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

G. L. Fisher, <i>Chairman</i>	L. C. Noriega
R. M. Attar	

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>	J. A. Raulinaitis
T. M. Brown	F. Rinaldi
L. I. Cheng	R. E. Shewmaker
J. A. Curtin	K. O. Stalter
J. F. Fulton	J. D. Stevenson
T. E. Johnson	A. Walsler
R. A. Mattson	R. N. White
R. G. Oesterle	M. J. Holley, Jr., Observer
F. S. Ople, Jr.	

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

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

Subgroup on Core Support Structures (SC-3C)

A. E. Goldman, <i>Chairman</i>	P. A. Stancampiano
W. Gorcholt	G. T. Yahr
W. A. Nystrom	

SUBCOMMITTEE ON HEATING BOILERS (SC IV)

T. H. Milton, <i>Chairman</i>	W. D. Hayen
M. J. Hogan, <i>Secretary</i>	G. L. Kasparian
J. E. Ayotte	J. F. Miente
F. P. Barton	R. I. Mullican
P. G. Daugirda	E. A. Nordstrom
R. B. Duggan	R. H. Weigel
G. E. Fratcher	J. I. Woodworth
D. R. Gallup	

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

J. I. Woodworth, <i>Chairman</i>	W. D. Hayen
F. P. Barton	E. M. Hicks
W. H. Dormer, Jr.	T. H. Milton
J. Giambone	R. H. Weigel

Subgroup on Water Heaters (SC IV)

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

Subgroup on Cast Iron Boilers (SC IV)

D. R. Gallup, <i>Chairman</i>	R. H. Weigel
W. L. Garvin	J. I. Woodworth

SUBCOMMITTEE ON NONDESTRUCTIVE EXAMINATION (SC V)

J. R. MacKay, <i>Chairman</i>	E. T. Hughes
R. C. Hudson, <i>Vice Chairman</i>	R. M. Jesse
P. D. Stumpf, <i>Secretary</i>	F. B. Kovacs
A. S. Birks	S. Markowitz
J. B. Christofferson	T. G. McCarty
B. H. Clark, Jr.	W. C. McCaughey
L. T. Detlor	E. D. Potter
W. H. Dormer, Jr.	L. Rabago
F. T. Duba	J. C. Spanner, Sr.
H. C. Graber	R. P. Sullivan
G. W. Hembree	J. P. Sunukjian
P. J. Herbert	E. J. Wnek

Subgroup on General Requirements (SC V)

G. W. Hembree, <i>Chairman</i>	W. H. Dormer, Jr.
W. G. Blankenship	F. T. Duba
J. O. Brown	R. P. Sullivan
B. H. Clark, Jr.	J. P. Sunukjian

Subgroup on Radiography (SC V)

E. J. Wnek, <i>Chairman</i>	F. B. Kovacs
W. L. Bierwirth	S. Markowitz
L. T. Detlor	T. G. McCarty
B. E. Foster	C. N. Sherlock
B. C. Jersild	R. D. Wallace
C. Johnson	B. K. Warren
K. L. Kluge	

Subgroup on Ultrasonics (SC V)

P. J. Herbert, <i>Chairman</i>	R. W. McClung
W. C. Koepke, <i>Secretary</i>	W. C. McGaughey
L. J. Chockie	E. D. Potter
N. O. Cross	F. J. Sattler
V. S. Goel	J. C. Spanner, Sr.
E. T. Hughes	F. R. A. Turner
J. F. Manning	

Subgroup on Surface NDE (MT, PT, & ET) (SC V)

H. C. Graber, <i>Chairman</i>	R. M. Jesse
A. S. Birks	L. C. Ludwig
J. B. Christofferson	J. T. Schmidt
J. I. Dantzer	

Special Working Group on Acoustic Emission (SC V)

D. A. White, <i>Chairman</i>	J. M. Nieters
B. H. Clark, Jr.	E. D. Potter
N. O. Cross	J. C. Spanner, Sr.
P. H. Hutton	T. L. Swanson
J. F. Manning	

SUBCOMMITTEE ON PRESSURE VESSELS (SC VIII)

R. J. Cepluch, <i>Chairman</i>	M. H. Jawad
J. R. Farr, <i>Vice Chairman</i>	G. G. Karcher
A. J. Roby, <i>Secretary</i>	J. LeCoff
A. P. Ahrendt	E. E. Morgenegg
R. D. Bonner	C. C. Neely
J. O. Brown	R. F. O'Neill
V. W. Butler	H. C. Oakley
J. J. Duffy	F. O. Parnkopf
R. E. Feigel	A. Selz
H. B. France	D. A. Staskelunas
G. E. Fratcher	J. J. Szigety
W. L. Garvin	J. W. Tackett
B. D. Hackney	K. K. Tam
H. L. Hime	C. M. Vogrin

Special Working Group on Heat Transfer Equipment (SC VIII)

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

Special Working Group on High Pressure Vessels (SC VIII)

R. F. O'Neill, <i>Chairman</i>	D. P. Kendall
M. E. Sheehan, <i>Secretary</i>	G. J. Mraz
D. J. Burns	E. G. Nisbett
B. W. Cole	H. C. Rauschenplat
C. M. Elwonger	J. R. Sims, Jr.
R. G. Fasiczka	E. R. Sliwinski
R. E. Feigel	D. H. Swift
D. M. Fryer	F. W. Tatar
R. E. Jagger	D. A. Wells

Special Working Group on Stress Multipliers (SC VIII)

C. C. Neely, <i>Chairman</i>	W. L. Garvin
M. J. Hogan, <i>Secretary</i>	C. R. Good
A. P. Ahrendt	R. F. O'Neill
R. E. Feigel	A. R. Ryshavy

Subgroup on General Requirements (SC VIII)

C. C. Neely, <i>Chairman</i>	A. J. Palmer
R. E. Tillberg, <i>Secretary</i>	A. M. Smolen
A. P. Ahrendt	A. J. Spencer
D. D. Carpenter	D. A. Staskelunas
J. J. Duffy	E. A. Steen
W. L. Garvin	W. J. Stuber
B. E. Hrubala	W. E. Vogler
H. C. Oakley	

Subgroup on Materials (SC VIII)

J. W. Tackett, Jr., <i>Chairman</i>	J. Hainsworth
H. L. Hime, <i>Secretary</i>	J. D. McLoughlin
W. C. Banks	E. G. Nisbett
V. W. Butler	K. K. Tam
W. D. Doty	D. A. Wells
J. J. Gaughan	

Subgroup on Design (SC VIII)

M. H. Jawad, <i>Chairman</i>	R. W. Mikitka
R. E. Knoblock, <i>Secretary</i>	R. F. O'Neill
M. R. Bauman	A. Selz
J. R. Farr	J. W. Stokes
R. E. Gleason	K. K. Tam
J. A. Hayward	R. M. Vogel
J. L. Jacobowitz	C. M. Vogrin
G. G. Karcher	

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

A. Selz, *Chairman*
H. B. Peters
K. V. Shipes
A. M. Smolen
E. L. Thomas, Jr.
J. L. Urner

Subgroup on Fabrication and Inspection (SC VIII)

J. J. Szigety, *Chairman*
R. F. O'Neill, *Secretary*
G. Bibel
R. W. Boyce
J. O. Brown
S. C. Cyr
R. E. Feigel
H. B. France
M. J. Houle
J. Lang
F. O. Parnkopf
R. E. Schuessler
R. F. Wagner

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

F. O. Parnkopf, *Chairman*
A. M. Smolen, *Secretary*
S. M. Caldwell
B. W. Cole
G. E. Fratcher
J. L. Jacobowitz
R. E. Pechacek
H. C. Rauschenplat

SUBCOMMITTEE ON WELDING (SC IX)

B. D. Hackney, *Chairman*
R. K. Sager, Jr., *Vice Chairman*
P. D. Stumpf, *Secretary*
B. L. Alia
M. L. Carpenter
H. R. W. Cobb
H. R. Conaway
W. D. Doty
J. J. Duffy
P. D. Flenner
H. L. Helmbrecht
H. L. Hime
M. J. Houle
R. A. LaPointe
R. E. Lorentz, Jr.
A. H. Miller
D. K. Peetz
S. D. Reynolds, Jr.
W. K. Scattergood
G. K. Sosnin
W. J. Sperko
G. W. Spohn III
D. J. Stull
K. C. Taber
R. R. Young

Subgroup on Materials (SC IX)

R. E. Lorentz, Jr., *Chairman*
M. L. Carpenter
H. R. Conaway
R. M. Jesse
A. H. Miller
R. K. Sager, Jr.
W. J. Sperko
J. W. Tackett
R. R. Young
H. E. Zielke

Subgroup on General Requirements (SC IX)

D. K. Peetz, *Chairman*
M. V. Davis
J. J. Duffy
M. L. Goedecke
R. M. Jesse
R. P. Meineke
B. R. Newmark
A. J. Spencer
K. C. Taber
C. E. Wainwright
H. E. Zielke

Subgroup on Procedure Qualification (SC IX)

M. J. Houle, *Chairman*
B. L. Alia
H. R. W. Cobb
H. L. Helmbrecht
A. H. Miller
S. D. Reynolds, Jr.
W. J. Sperko
E. G. Thompson

Subgroup on Performance Qualification (SC IX)

M. J. Houle, *Chairman*
B. W. Cole
P. D. Flenner
R. A. LaPointe
P. P. Norris
W. K. Scattergood
G. K. Sosnin
G. W. Spohn III
D. L. Tevis

Subgroup on Brazing (SC IX)

M. L. Carpenter, *Chairman*
R. A. LaPointe
A. H. Miller

SUBCOMMITTEE ON REINFORCED PLASTIC PRESSURE VESSELS (SC X)

D. M. Bertelsman, *Chairman*
M. J. Hogan, *Secretary*
D. H. Barton
R. K. Blossch
L. C. Daniels
T. J. Fowler
S. V. Hoa
L. E. Hunt
J. A. Kidd
R. Mohan
J. A. Rolston

SUBCOMMITTEE ON NUCLEAR INSERVICE INSPECTION (SC XI)

S. H. Bush, *Chairman*
W. C. Ham, *Vice Chairman*
K. I. Baron, *Secretary*
C. W. Allison
W. F. Anderson
W. H. Bamford
H. P. Baron
R. L. Beverly
A. J. Birkle
R. E. Bullock
L. J. Chockie
D. D. Davis
E. A. DeBarba
F. T. Duba
H. L. Gotschall
F. E. Gregor
L. B. Gross
J. P. Houstrup
L. R. Katz
J. J. Lance
T. J. Mawson
R. E. Muise
T. G. Parker
G. J. Pitzl
R. L. Powers
P. C. Riccardella
R. F. Sammataro
M. E. Schuster, Jr.
R. W. Swayne
J. C. Tobin
F. A. Warner
J. F. Enrietto, *Alternate*
S. D. Weinman, *Staff Representative*

Special Working Group on Plant Life Extension (SC XI)

L. R. Katz, <i>Chairman</i>	D. L. Harrison
L. B. Gross, <i>Secretary</i>	D. R. Hostetler
T. L. Bailey	J. P. Houstrup
A. J. Birkle	P. W. Ianni
A. J. Boegel	M. E. Lapidus
L. D. Bustard	J. T. McCumber
D. D. Davis	E. A. Merrick
F. T. Duba	B. M. Morris
F. E. Gregor	D. A. Piccione

Special Working Group on Editing and Review (SC XI)

R. L. Beverly, <i>Chairman</i>	M. E. Schuster, Jr.
A. L. Bradshaw	J. E. Staffiera
R. J. Claverie	R. W. Swayne
L. B. Gross	F. A. Warner
V. H. Hight	

Subgroup on Water-Cooled Systems (SC XI)

A. J. Birkle, <i>Chairman</i>	L. R. Katz
R. L. Powers, <i>Secretary</i>	S. Lefkowitz
C. W. Allison	R. E. Legate
W. F. Anderson	J. B. Martin
A. C. Ashton	C. V. Moore
H. P. Baron	L. Sage
R. J. Claverie	M. T. Strenk
D. D. Davis	R. J. Tamminga
G. A. Delp	F. Tehranchi
G. Gotch	J. H. Uhl
L. B. Gross	F. A. Warner
F. A. Hawksley	G. Wasilenko
T. C. Hinkle	

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

D. D. Davis, <i>Chairman</i>	G. P. Knippel
G. L. Belew	C. N. Krishnaswamy
J. T. Boyd	G. C. Millman
R. F. Brandt	R. L. Powers
G. A. Delp	M. P. Zyne
L. N. Hartz	

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

R. J. Tamminga, <i>Chairman</i>	L. B. Gross
R. J. Claverie, <i>Secretary</i>	R. H. Hansen
W. F. Anderson	C. E. Hartz
R. G. Edl	D. L. Tevis
R. E. Gimple	C. H. Walters
G. Gotch	

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

F. A. Hawksley, <i>Chairman</i>	G. Gotch
L. Sage, <i>Secretary</i>	C. E. Hartz
C. F. Buckley	J. C. Major
F. C. Cherny	

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

L. Sage, <i>Chairman</i>	J. B. Martin
T. C. Hinkle, <i>Secretary</i>	R. E. Scott
A. C. Ashton	M. T. Strenk
C. R. Brader	F. Tehranchi
E. J. Brown	J. H. Uhl
F. N. Famulari	R. J. Von Osinski
T. F. Lentz	W. F. Anderson, <i>Alternate</i>

Subgroup on Gas-Cooled Systems (SC XI)

F. A. Warner, <i>Chairman</i>	F. E. Lesko
R. H. Hansen, <i>Secretary</i>	F. B. Litton
H. L. Gotschall	R. W. Peters

Subgroup on Liquid-Metal Cooled Systems (SC XI)

H. C. Jung, <i>Secretary</i>	L. J. Nemeth
W. L. Chase	G. Seed
R. Hundal	J. C. Tobin
J. Matte III	T. J. Walker

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

W. L. Chase, <i>Chairman</i>	L. J. Nemeth
J. Matte III	G. Seed

Subgroup on Containment (SC XI)

R. F. Sammaturo, <i>Chairman</i>	H. T. Hill
J. E. Staffiera, <i>Secretary</i>	T. P. Keaveney
W. J. Briggs	D. R. Pitcairn
R. E. Bullock	A. J. Spencer
F. E. Gregor	J. F. Strunk
K. S. Herring	P. W. Ward

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

H. T. Hill, <i>Chairman</i>	H. L. Gotschall
J. F. Fulton, <i>Secretary</i>	S. Guha-Majumdar
H. G. Ashar	C. N. Krishnaswamy
R. E. Bullock	A. M. Salley
C. A. Byrd	P. W. Ward

Subgroup on Evaluation Standards (SC XI)

W. H. Bamford, <i>Chairman</i>	T. J. Griesbach
J. P. Houstrup, <i>Secretary</i>	S. Ranganath
C. B. Buchalet	P. C. Riccardella
C. Y. Cheng	W. A. Vandersluys
R. L. Cloud	S. Yukawa
E. A. DeBarba	

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

T. J. Griesbach, <i>Chairman</i>	J. G. Merkle
W. L. Allan	A. G. Panagos
W. H. Bamford	J. S. Panesar
H. Behnke	P. C. Paris
J. M. Bloom	J. H. Phillips
C. B. Buchalet	P. N. Randall
R. C. Cipolla	S. Ranganath
W. C. Cliff	W. L. Server
E. Friedman	F. A. Simonen
R. M. Gamble	H. W. Slager
S. R. Gosselin	A. V. A. Swaroop
J. A. Hayward	L. E. Titland
J. P. Houstrup	G. M. Wilkowski
K. Ijzerman	J. E. Wilson
R. E. Johnson	K. K. Yoon
M. Kupinski	S. Yukawa
S. D. Leshnoff	

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

R. C. Cipolla, <i>Chairman</i>	P. C. Paris
W. H. Bamford	P. P. Raju
J. M. Bloom	S. Ranganath
C. B. Buchalet	W. L. Server
C. Y. Cheng	F. A. Simonen
N. W. Edwards	A. V. A. Swaroop
E. Friedman	G. M. Wilkowski
T. J. Griesbach	J. E. Wilson
J. P. Houstrup	K. K. Yoon
M. Kupinski	S. Yukawa
J. G. Merkle	V. A. Zilberstein
J. S. Panesar	

Subgroup on Nondestructive Examination (SC XI)

E. A. DeBarba, <i>Chairman</i>	F. J. Dodd
J. F. Cook, <i>Secretary</i>	M. R. Hum
D. C. Adamonis	J. J. Lance
F. L. Becker	C. R. Osman
R. L. Beverly	J. C. Spanner, Jr.
C. B. Cheezem	J. C. Spanner, Sr.
C. D. Cowfer	R. W. Swayne
G. J. Dau	

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

C. D. Cowfer, <i>Chairman</i>	O. DeMiranda
N. R. Bentley, <i>Secretary</i>	F. J. Dodd
D. C. Adamonis	M. R. Hum
F. L. Becker	J. J. Lance
C. B. Cheezem	J. C. Spanner, Jr.
W. T. Clayton	T. T. Taylor
J. F. Cook	

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

V. H. Hight, <i>Secretary</i>	F. A. Hawksley
G. E. Abell	C. J. Hellier
S. D. Brown	W. C. Koepke
J. E. Cavender, Jr.	C. R. Osman
F. T. Duba	J. M. Ray
L. Frank	A. L. Smith

Subgroup on Repairs and Replacements (SC XI)

T. J. Mawson, <i>Chairman</i>	S. R. Eley
M. J. Crisler, <i>Secretary</i>	J. F. Enrietto
E. T. Baker III	W. L. Garvin
D. C. Bertossa	R. D. Kerr
J. D. Boardman	G. J. Pitzl
A. D. Bunch	M. E. Schuster, Jr.
J. Derrico	J. C. Tobin
F. T. Duba	K. D. Verble

Working Group on Repairs (SC XI)

J. Derrico, <i>Chairman</i>	R. F. Hollander
D. C. Bertossa	R. D. Kerr
J. D. Boardman	D. R. Pitcairn
R. W. Boyce	R. W. Swayne
J. F. Enrietto	S. Tobey

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

S. Tobey, <i>Chairman</i>	R. Labott
B. G. Carlton, <i>Secretary</i>	R. A. LaPointe
D. C. Bertossa	W. E. Mayott
B. R. Crowley	R. A. Moen
M. L. Goedecke	B. R. Newmark
M. J. Houle	P. P. Norris
W. R. Johnson	D. L. Tevis
H. J. Kaplan	E. H. Williams

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

M. J. Crisler, <i>Chairman</i>	R. E. Legate
E. T. Baker III	G. J. Pitzl
A. D. Bunch	M. E. Schuster, Jr.
S. R. Eley	A. J. Spencer
W. Kooy	R. E. Tschirch

SUBCOMMITTEE ON PROPERTIES OF METALS (SC-P)

D. A. Canonico, <i>Chairman</i>	E. T. Ishizaka
J. P. Millman, <i>Secretary</i>	R. H. Moeller
A. P. Ahrendt	R. A. Moen
H. T. Corten	W. J. O'Donnell
T. M. Cullen	A. J. Palmer
W. D. Doty	B. W. Roberts
A. R. Faulkner	D. I. Roberts
M. Gold	C. E. Spaeder
D. G. Harman	J. W. Tackett
S. O. Hilton	R. T. Webster

Subgroup on Strength, Ferrous Alloys (SC-P)

M. Gold, <i>Chairman</i>	E. T. Ishizaka
A. P. Ahrendt	J. F. Longenecker
V. W. Butler	R. A. Moen
D. A. Canonico	B. W. Roberts
T. M. Cullen	D. I. Roberts
R. J. Diletto	C. E. Spaeder
W. C. Hagel	G. M. Supko
S. O. Hilton	

Subgroup on Strength, Nonferrous Alloys (SC-P)

D. G. Harman, <i>Chairman</i>	R. A. Rosenberg
J. W. Barr	E. Shapiro
T. H. Bassford	J. W. Tackett
G. A. Knapp	R. T. Webster

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

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

Subgroup on Toughness (SC-P)

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

Working Group on Non-nuclear 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>	F. J. Loss
R. F. Cappelini	A. Selz
W. S. Hazelton	

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

H. T. Corten, <i>Chairman</i>	R. K. Nanstad
D. J. Ayres	S. Yukawa
J. M. Barsom	

SUBCOMMITTEE ON SAFETY VALVE REQUIREMENTS (SC-SV)

E. C. Kistner, Jr., <i>Chairman</i>	R. J. Doelling
W. L. Garvin, <i>Vice Chairman</i>	W. D. Greenlaw
J. S. Brzuszkiewicz, <i>Secretary</i>	H. I. Gregg
G. C. Batz	S. F. Harrison, Jr.
M. D. Bernstein	F. J. Howes
R. K. Blosch	T. L. Hughes
J. Cahoon, Jr.	M. A. Robinson
R. A. Cedel	A. J. Schmidt
O. J. Cox, Jr.	A. J. Spencer
E. C. Cullie	S. M. Sullivan
V. M. DeLuca	K. J. Szigety

Subgroup on General Requirements (SC-SV)

M. D. Bernstein, <i>Chairman</i>	T. L. Hughes
F. J. Howes	M. A. Robinson

Subgroup on Testing (SC-SV)

O. J. Cox, Jr., <i>Chairman</i>	S. F. Harrison, Jr.
E. C. Cullie	K. J. Szigety
V. M. DeLuca	

Subgroup on Design (SC-SV)

W. D. Greenlaw, <i>Chairman</i>	J. Cahoon, Jr.
G. C. Batz	H. I. Gregg
R. K. Blosch	A. J. Schmidt

SUBCOMMITTEE ON DESIGN (SC-D)

J. R. Farr, <i>Chairman</i>	E. E. Morgenegg
R. I. Jetter, <i>Vice Chairman</i>	W. J. O'Donnell
M. J. Hogan, <i>Secretary</i>	S. S. Palusamy, Jr.
O. F. Hedden	R. D. Schueler, Jr.
M. H. Jawad	M. P. Schwartz
C. A. Moore	

Subgroup on Openings (SC-D)

M. P. Schwartz, <i>Chairman</i>	P. P. Raju
S. C. Lou, <i>Secretary</i>	E. C. Rodabaugh
F. C. Adamek	H. H. Schneider
M. N. Bressler	R. W. Schneider
R. E. Gleason	H. K. Shaw
R. W. Mikitka	D. L. Shira
K. C. Morrison	

CONTENTS

A Detailed Contents Precedes Each Article

Foreword	v
Statements of Policy	vii
Personnel	ix
Organization of Section III	xxiii
Article NG-1000 Introduction	1
Article NG-2000 Material	5
Article NG-3000 Design	33
Article NG-4000 Fabrication and Installation	67
Article NG-5000 Examination	89
Article NG-8000 Nameplates, Stamping, and Reports	97
SI Units	99

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-3230 includes all paragraphs NB-3231 through NB-3236.

Wherever the term NX appears, it is intended to describe all the Subsections of Section III (NB, NC, ND, NE, NF, NG) where the referenced paragraph, Subarticle, or Article appears.

B. References to Other Sections

Other Sections referred to in Section III are:

Section II, Material Specifications. When a requirement for a material, or for the examination or testing of a material, is to be in accordance with a specification such as SA-105, SA-370, or SB-160, the reference is to material specifications in Section II. These references begin with the letter "S."

Section V, Nondestructive Examination. Section V references begin with the letter "T" and relate to the nondestructive examination of material or welds.

Section IX, Welding and Brazing Qualifications. Section IX references begin with the letter "Q" and relate to welding and brazing requirements.

Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components. When a reference is made to inservice inspection, the rules of Section XI shall apply.

C. Reference to Specifications and Standards Other Than Published in Code Sections

(1) Specifications for examination methods and acceptance standards to be used in connection with them are published by the American Society for Testing and Materials. At the time of publication of Section III, some such specifications were not included in Section II of this Code. A reference to ASTM E 71-64 refers to the specification so designated by and published by ASTM, 1916 Race St., Philadelphia, PA 19103.

(2) Dimensional standards covering products such as valves, flanges, and fittings are sponsored and published by the American Society of Mechanical Engineers and ap-

¹The American National Standards Institute (ANSI) was formerly known as the American Standards Association. Standards approved by the Association were designated by the prefix "ASA" followed by the number of the standard and the year of publication. More recently, the American National Standards Institute was known as the United States of America Standards Institute. Standards were designated by the prefix "USAS" followed by the number of the standard and the year of publication. While the letters of the prefix have changed with the name of the organization, the numbers of the standards have remained unchanged.

proved by the American National Standards Institute.¹ When a product is to conform to such a standard, for example ANSI B16.5, the standard is approved by the American National Standards Institute. The applicable year of issue is that suffixed to its numerical designation in Table NB-3132-1, for example ANSI B16.5-1977. Standards published by the American Society of Mechanical Engineers are available from ASME, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300.

(3) Dimensional and other types of standards covering products such as valves, flanges, and fittings are also published by the Manufacturers Standardization Society of the Valve and Fittings Industry and are known as Standard Practices. When a product is required by these rules to conform to a Standard Practice, for example MSS SP-6, the Standard Practice referred to is published by the Manufacturers Standardization Society of the Valve and Fittings Industry, 1815 North Ft. Meyer Drive, Arlington, VA 22209. The applicable year of issue of such a Standard Practice is that suffixed to its numerical designation in Table NB-3132-1, for example MSS SP-6-1963.

(4) Specifications for welding and brazing materials are published by the American Welding Society, 2501 Northwest 7th St., Miami, FL 33125. Specifications of this type are incorporated in Section II and are identified by the AWS designation with the prefix "SF," for example SFA-5.1.

(5) Standards applicable to the design and construction of tanks and flanges are published by the American Petroleum Institute and have designations such as API-620 and API-2000. When documents so designated are referred to in Section III, they are standards published by the American Petroleum Institute.

D. References to Appendices

Two types of Appendices are used in Section III and are designated Mandatory and Nonmandatory.

(1) Mandatory Appendices contain requirements which must be followed in construction; such references are designated by a Roman numeral followed by Arabic numerals. References to Table I-1.2 or II-1100, for example, relate to the Mandatory Appendices.

(2) Nonmandatory Appendices provide information or guidance for the use of Section III; such references are designated by a capital letter followed by Arabic numerals. A reference to D-1100, for example, relates to a Nonmandatory Appendix.

ARTICLE NG-1000

NG-1100	Scope.....	3
NG-1110	Aspects of Construction Covered by These Rules.....	3
NG-1120	Definition of Structures and Application of These Rules to Them.....	3
NG-1121	Core Support Structures.....	3
NG-1122	Internal Structures.....	3
NG-1130	Boundary of Core Support Structures.....	3

ARTICLE NG-1000

INTRODUCTION

NG-1100 SCOPE

NG-1110 ASPECTS OF CONSTRUCTION COVERED BY THESE RULES

Subsection NG establishes rules for materials, design, fabrication, examination, and preparation of reports required in the manufacture and installation of core support structures.^{1,2}

NG-1120 DEFINITION OF STRUCTURES AND APPLICATION OF THESE RULES TO THEM

NG-1121 Core Support Structures

Core support structures shall be constructed to the rules of this Subsection. Core support structures are those structures or parts of structures which are designed to provide direct support or restraint of the core (fuel and blanket assemblies) within the reactor pressure vessel. Structures which support or restrain the core only after the postulated failure of core support structures are considered to be internal structures (NG-1122).

¹(a) The rules of Subsection NG are not directed to sealing against coolant leakage. Further, gross hydrostatic loading may not be typical of the loads experienced by core support structures. Thus, hydrostatic testing of the structures is not required.

(b) The most severe loads on which design must be predicated usually result from abnormal, rather than normal, load conditions. Core support structures need not remain leak tight to perform their function. However, if leak tightness is required for a structure, the rules for pressure boundary construction may be appropriate.

²In Subsection NG it is recognized that the design functions are frequently handled separately from the fabrication functions of the Certificate Holder manufacturing core supports. The separation of these functions is necessary because the design of core support structures cannot be performed completely independent of the nuclear or hydraulic design of the coolant system. Furthermore, portions of a set of structures may be fabricated by a specialist and assembled at the site without any one fabricator having a

NG-1122 Internal Structures

(a) Internal structures are *all* structures within the reactor pressure vessel other than core support structures, fuel³ and blanket assemblies, control assemblies, and instrumentation.

(b) The rules of this Subsection apply to internal structures as defined in (a) above, only when so stipulated by the Certificate Holder manufacturing core supports, hereafter referred to in this Subsection as Certificate Holder.

(c) The Certificate Holder shall certify² that the construction of all internal structures is such as not to affect adversely the integrity of the core support structure.

NG-1130 BOUNDARY OF CORE SUPPORT STRUCTURES

The boundary of core support structures shall be taken as the welds or mechanical joints which connect such structures to the reactor vessel and to any internal structures. Such welds or mechanical joints shall be included in the core support structure boundary unless specifically included in the Design Specification for the reactor vessel.

controlling position for fabrication of the complete structure. Therefore, provisions are made herein for separate organizations to perform the design and fabricating functions of the Certificate Holder. This Section (NCA-3510), however, requires that one organization have overall responsibility for compliance with the requirements of this Subsection NG. The use of the term *Certificate Holder* therefore must be understood to mean the design or fabricating organization assuming the overall responsibility for compliance with this Section. The term *Certificate Holder*, as used in this Subsection, applies to the Certificate Holder manufacturing core supports who shall be responsible for certifying that all core support structures and internal structures, as defined in NG-1120, comply with the requirements of this Subsection.

³Note that some fuel and blanket positions in the core matrix may be filled with structures related to reflector or shielding functions. These structures also fall into the *fuel and blanket* category described above.