PROPOSED STANDARD CODE FOR

CONCRETE REACTOR VESSELS AND CONTAINMENTS

(Proposed Section III , Division 2)

ASME Boiler and Pressure Vessel Code

ISSUED FOR TRIAL USE AND COMMENT

ACI - ASME TECHNICAL COMMITTEE ON
CONCRETE PRESSURE COMPONENTS
FOR NUCLEAR SERVICE

ACI COMMITTEE 359
ASME SUBCOMMITTEE ON NUCLEAR POWER

PUBLISHED BY

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

United Engineering Center 345 East 47th Street New York, N. Y. 10017

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PREFACE

This document has been prepared by the Joint ACI-ASME Technical Committee on Concrete Pressure Components for Nuclear Service. With approval by the sponsoring American Concrete Institute and the American Society of Mechanical Engineers, it will be published for "Trial Use and Comment" for a period of about one year. The Societies have agreed that it will be Section III, Division 2 of the ASME Boiler and Pressure Vessel Code. This proposed standard, and any subsequent changes to it, shall be subject to the standardization procedures of the two sponsoring Societies.

The basic materials for this document were provided by two committee reports, one by ACI and the other by ASME. The ACI Committee 349, "Criteria for Nuclear Containment Vessels" and the ASME Boiler and Pressure Vessel Code Committee, Section III, Division 2, "Subgroup on Concrete Components," submitted their completed Committee Reports in September 1971 to the ACI and ASME, respectively. These two documents, plus additional technical material and administrative agreements reached by the two Societies during the review of the January 17, 1972 draft, were combined to form the "Proposed Standard – Code for Concrete Reactor Vessels and Containment" dated August 1, 1972. Revisions were made to the first draft, the two Societies reviewed and approved their incorporation, resulting in the present document.

The Joint Committee, whose membership includes individuals from both ACI and ASME and many others actively involved in the field, was formed in September 1971. The three primary goals of the Committee are as follows:

1. Establish rules in the form of a code for the design construction, inspection, and testing of composite concrete and steel components for reactor vessels and containments for nuclear power reactors.

2. Interpret these rules when questions arise regarding their intent.

3. Periodically update code provisions making full use of the expedited procedure for revision of standards as necessary.

This proposed standard, following the format of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, on Metal Components, is divided into three main subsections and two groups of Appendices:

1. Subsection CA – General Requirements.
2. Subsection CB – Concrete Reactor Vessels.
3. Subsection CC – Concrete Containments.
4. Mandatory Appendices.
5. Nonmandatory Appendices.

Subsection CA (General Requirements) covers the administration, quality assurance, and Authorized Inspection requirements applicable to concrete reactor vessels and to concrete containments. The CB (Reactor Vessels) and CC (Containments) Subsections each have their own material, design, construction-fabrication, examination, and testing sections, again in an organizational format similar to Division 1. In some instances, this has meant complete repetition of requirements in such areas as materials and examination. In effect, the Subsections on reactor vessels and secondary containments are thus written to stand by themselves. This organization was felt to be useful until the detailed requirements of reactor vessels and containments become well established. The organization of the appendices, where possible, also follows that of Division 1.

References in this document to such standards as ASTM Specifications, ACI Standards, and Corps of Engineers Specifications are made only where the total document is applicable. References to portions of codes or standards have not been made. Where such wording or data were required, the material has been incorporated directly into this Code. This document is intended to stand by itself and its full references in total.

The term Code Administrative Authority as used in this document includes the following groups:

1. *Joint ACI-ASME Technical Committee,* whose responsibility it is to develop the Code content and maintain it as a viable document through timely revisions and continuing review. The Code and any changes thereto shall be subject to the standardization procedures of the sponsoring American Concrete Institute (ACI) and the American Society of Mechanical Engineers (ASME).

2. *Certification Committee,* balanced among regulatory Inspectors, Users, Fabricators, and Contractors, is responsible for determining the adequacy of the Applicant's Quality Assurance program by review of the reports of the nuclear survey team. At least two members of the Committee competent in the field of concrete shall have been recommended by ACI.

3. *Survey Team,* which reports to the Certification Committee, will consist of consultants from ACI, ASME, and the National Board of Boiler and Pressure Vessel Inspectors. The makeup of the Survey Team will be based on establishing a balance of competence in the areas requiring evaluation by the Code, including quality assurance techniques, construction methods, welded fabrication, materials control, field change control, and acceptance testing.

For those applicants where the construction is predominantly concrete, the team leader is to be an ACI consultant. Where the construction involves predominantly metal fabrication, the team leader is to be an ASME consultant. Where the predominance is sufficiently in the area of concrete as determined by the retained consultants of the ACI and ASME or the staffs of these organizations, additional ACI consultants may be provided as required by the size and scope of the application; likewise, if the predominance is sufficiently on the metallic side, additional ASME consultants may be provided.

The structure of the Code Administrative Authority was developed by the sponsoring Societies on July 11, 1972. A diagram showing the interrelationship of Code requirements with the various organizations involved is presented at the end of this preface. Questions regarding any matters related to these areas should be addressed to either ACI or ASME Headquarters.

During the Trial Use and Comment period, it is anticipated that comments and discussions will be received by the Joint Committee for review. Comments shall state clearly which area and wording of the Code is being discussed. Suggested revisions shall be worded as parallel text, showing how the proposed changed paragraphs should read, and shall be accompanied by a commentary (including references where appropriate) to support the recommendations. Discussions, commentaries, and committee actions will be printed in the publications of the two Societies during the Trial Use and Comment period. Discussions may be sent to either the ACI or ASME Headquarters marked to the attention of the Joint ACI-ASME Committee. A public hearing on the proposed Code will be held before its adoption by the Societies.

ORGANIZATION

JOINT COMMITTEE ON CONCRETE COMPONENTS FOR NUCLEAR REACTORS

		Membership	*Organization*
MAIN COMMITTEE			
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Jack Janney		ACI	Wiss, Janney, Elstner and Associates
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G. Morris			Oak Ridge National Laboratory
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A. L. Parme		ACI	Consultant
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R. S. Orr		ASME	Westinghouse Electric Corporation
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R. E. Keever		ASME	Nuclear Services Corporation
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SUBGROUP ON TESTING AND PROTECTION AGAINST OVERPRESSURE			
Jack Janney	Chairman	ACI	Wiss, Janney, Elstner and Associates
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Allen R. Whiting		ASME	Southwest Research Institute
STAFF SUPPORT			
S. Henry			ACI Staff
W. J. Woollacott			ASME Staff

GENERAL CONTENTS

SUBSECTION CA
GENERAL REQUIREMENTS

CONTENTS

ARTICLE CA-1000

ARTICLE CA-1000
GENERAL REQUIREMENTS

CA-1100 SCOPE

CA-1110 NATURE AND INTENT OF THESE RULES

The rules of this Code for Concrete Reactor Vessels and Containments constitute the requirements for design, construction,[1] and use of concrete reactor vessels and concrete containment structures for nuclear power plants. A nuclear power plant as referenced in this Code consists of one or more assemblies of vessels (ASME Section III Div. 1 or 2) and other Components that serve the purpose of extracting and controlling the thermal energy produced from fissionable nuclear fuel. These rules govern the composite metal and concrete assemblies including their material constituents, Parts, and Appurtenances that collectively constitute Concrete Reactor Vessels or Concrete Containment Structures. The intent of these rules is to attain an end product that suits the use and reliability requirements needed for the safety of nuclear power plants.

CA-1120 CONCRETE REACTOR VESSEL AND CONTAINMENT STRUCTURE REFERENCE

(a) Concrete Reactor Vessels when referenced in this Code, are composite steel and concrete assemblies which are to function as a Component of the principal pressure-containing barriers for the nuclear fuel's primary heat extraction fluid (primary coolant).

(b) Concrete Containment Structures when referenced in this Code, are composite steel and concrete assemblies that are designed as an integral part of the containment's pressure-retaining barrier which retains or controls the release of radioactive or hazardous effluents released from the nuclear power plant equipment which the containment encloses.

CA-1130 LIMITS OF THESE RULES AND COMPONENTS TO WHICH THEY ARE NOT APPLICABLE

The rules of this Code provide requirements for new construction of concrete reactor vessels and containment structures. They are applicable only to these components that are designed to provide a pressure retaining barrier. They are not applicable to other concrete structures in the nuclear power plant, for example, to concrete shield and support structures except as they directly affect the components as defined in CA-1210.

The rules provide requirements to assure the structural integrity of the component. They do not cover auxiliary systems except as stated in CA-1220.

CA-1200 JURISDICTION OF THIS CODE

The jurisdiction of this Code is limited to:

(a) Concrete Reactor Vessels constructed of prestressed concrete lined with carbon steel and associated Materials, Parts, Appurtenances, and Auxiliary Systems to the extent delineated in CA-1220(a).

(b) Concrete Containment Structures constructed of steel reinforced concrete lined with carbon steel and associated Materials, Parts, Appurtenances, and Auxiliary Systems to the extent delineated in CA-1220(b).

[1] "Construction," as used in this Code, includes all those operations required to build the vessel or structure and its Parts and Appurtenances in accordance with the design drawings and specifications which have been prepared by the Designer.

(c) Concrete Containment Structures constructed of prestressed concrete lined with carbon steel and associated Materials, Parts, Appurtenances, and Auxiliary Systems to the extent delineated in CA-1220(b).

CA-1210 JURISDICTIONAL COVERAGE

The jurisdictional coverage is for:

(a) Concrete Reactor Vessels: All pressure resisting and leakage sealing concrete and steel portions of the vessels; all Parts or Appurtenances that act integrally with the pressure resisting portions to carry the fluid pressure and other direct loads except that (1) Parts and Appurtenances under the jurisdiction of Section III of the ASME Boiler and Pressure Vessel Code shall be considered only as they function in concert with the concrete and steel portions of the vessel to carry loads, and (2) Parts and Appurtenances under the jurisdiction of Section III of the ASME Boiler and Pressure Vessel Code whose loading effects on the concrete vessel can be described by moments and forces acting on discrete portions of the concrete vessel may for design purposes be characterized by such loading conditions which for the Concrete Reactor Vessel can be shown to be functionally acceptable.

(b) Concrete Containment Structures: All pressure resisting and leak sealing concrete and steel portions of the Structures; all Parts or Appurtenances that act integrally with the pressure resisting portion to carry the fluid pressure loads except that (1) Parts and Appurtenances under the jurisdiction of Division 1 shall be considered only with respect to their functional collaboration with the concrete and steel portions of the Component in carrying loads, and (2) Parts and Appurtenances under the jurisdiction of Division 1 whose directional loadings can be described by moments and forces acting on discrete portions of the Concrete Component may for design purposes be characterized by such loading conditions which for the Concrete Containment Structure can be shown to be functionally acceptable.

CA-1220 JURISDICTIONAL REQUIREMENTS FOR AUXILIARY SYSTEMS

(a) Auxiliary Systems for Concrete Reactor Vessels that are required to assure functional adequacy of the vessels in accord with the requirements of the Design Specification including, but not limited to, concrete cooling systems, thermal insulation, corrosion protection, leakage monitors, and strain monitoring systems must be delineated fully by appropriate performance, reliability, and test requirements.

(b) Auxiliary Systems for Concrete Containment Structures that are required to assure functional adequacy of the Component in accord with the requirements of the Design Specification including but not limited to corrosion protection, leakage monitors, thermal insulation, and strain monitoring systems must be delineated fully by appropriate performance, reliability, and test requirements.

CA-1230 EFFECTIVE DATES OF CODE EDITIONS, ADDENDA, AND CASES[1]

(a) Code Editions and Addenda may be used on and after the date of issue and become mandatory six months after the date of issue for new construction.

(b) Code Case Interpretations may be used beginning with the date of approval by the Code Administrative Authority[2] for newly constructed Components.

(c) Code Case Special Rulings may be used beginning with the date of approval by the Code Administrative Authority and, being permissive, do not become mandatory.

(d) The Code Edition, including Addenda, which is mandatory on the date that the Design Specification is certified (CA-3251), shall determine the mandatory rules for construction of the component. Earlier editions shall not be used.

(e) The Contract Date for an entire nuclear power system does not govern the Code Edition, Addenda, and Cases applicable to the component.

(f) Code Editions, Addenda, and Cases which have not become mandatory on the date that the Design Specification is certified (CA-3251), may be used by mutual consent of the Owner or his agent, the Designer and the Constructor, on or after the dates permitted by CA-1230 (a), (b), and (c). It is permitted to use specific provisions within an Edition or Addenda provided that all related requirements are met.

Cautionary Note: Owners, Designers, Fabricators, and Constructors are cautioned against using Addenda or Cases that are different from former requirements without having assurance that they are acceptable to the enforcement authorities having jurisdiction at the location of the power plant's construction.

CA-1300 AUTHORIZATION AND STAMPING

Code authorization shall be given for a Code Stamp applied to all Concrete Reactor Vessels and all Concrete Containment Structures conforming to this Code. Table CA-1300-1 shows the required authorization and stamping.

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[1] Subarticle CA-1230 will become effective only after this document has been approved as a Code or Standard following the "Trial Use and Comment" period.

[2] The term Code Administrative Authority is defined in Appendix III.

TABLE CA-1300-1
CERTIFICATE OF AUTHORIZATION AND STAMPING REQUIREMENTS

	Certificate of Authorization Required by	Stamp Affixed by	Code Symbol	Data Report[1] to be Submitted to Code Administrative Authority
Concrete Containment Structure	O, C, F	C	CC	Yes
Concrete Reactor Vessel	O, C, F	C	CR	Yes
Part (Either Vessel or Structure)	C[2], F[2]	C or F[3]	NPT(2)[4]	Yes
Appurtenance (Either Vessel or Structure)	C[2], F[2]	C or F[3]	NPT(2)[4]	Yes

NOTE: O = Owner, C = Constructor, F = Fabricator.

[1]Data Report Forms are shown in Appendix V for typical Structures, Vessels, Parts, and Appurtenances. Report forms are intended to establish the service use of the Stamped Component, Part, or Appurtenance and to provide a permanent record of Stamps with the Code Administrative Authority. (Appendix V is in course of preparation for later issue.)

[2]If Owner acts as Constructor or Fabricator, he must have Certificate of Authorization.

[3]The stamp will be applied by the organization responsible for construction of the Part or Appurtenance.

[4]The (2) indicates that the Part was constructed under the rules of ASME Section III, Division 2. Parts designated NPT are constructed to Division 1 rules and may be used for Division 2 Components in accord with Subarticle CA-1330.

CA-1310 CERTIFICATES OF AUTHORIZATION

Components, Parts, and Appurtenances conforming to this Code shall be fabricated and constructed only by holders of a Certificate of Authorization establishing that the holder has the needed capabilities to comply with this Code. Certificates of Authorization will be granted by the Code Administrative Authority to Owners, Constructors, and Fabricators.

CA-1311 Qualification for Certificate of Authorization

The requirements for obtaining a Certificate of Authorization are given in Article CA-8000. Certificates will be granted for specific Components, Parts, and Appurtenances but may be extended to cover additional Components, Parts, and Appurtenances of like character if the Certificate Holder shows that he has maintained the capabilities which qualified him for initial certification. Before granting a Certificate of Authorization, the Code Administrative Authority shall obtain a report from its designated Surveyors showing that the Applicant for Certification has appropriate capabilities to satisfy the requirements which he is authorized to meet by the Certificate of Authorization.

CA-1320 REACTOR VESSEL AND CONCRETE CONTAINMENT STRUCTURE STAMPING

A Code Stamp will be affixed to the Vessel or Structure by the Authorized Constructor in accord with the requirements of Article CA-8000 and after review and approval of the Construction Report by the Owner, Designer, and concurrence by the Inspector.

CA-1330 PART AND APPURTENANCE STAMPING

Parts and Appurtenances as designated in CA-1410 and other items specifically called out as Parts (Div. 2) by the Designer shall be stamped as shown in Table CA-1300-1. Stamping of Parts signifies that the Parts have been produced in accordance with the requirements of Division 2, but does not necessarily establish that the use of the Part in the Component to be stamped (CA-1320) satisfies the Code Requirements of the Component. The designer must separately establish that the use of such parts satisfies the requirements of the Design Specification, the Construction Specification, and the Design Drawings prior to approving them for the application of the Code Stamp as required in CA-1320.

Those items designated as Parts (Div. 1) or Appurtenances (Div. 1) when used in a Division 2 Component if stamped as a Part (Div. 1) may be used without further stamping under Division 2 requirements provided (a) that the Designer identifies the parts to be stamped under Division 1 requirements in the Construction Specification, and (b) that the Designer separately establishes that the use of such parts satisfies the requirements of the Design Specification, the Construction Specification, and the Design Drawings.

When Parts or Appurtenances (Div. 1) are to be attached to Parts, Appurtenances, or Components (Div. 2) such Parts shall be stamped separately prior to attachment. The Construction Specification shall identify any additional requirements of Division 1 Parts and Appurtenances arising from their use with a Division 2 Component and the Designer shall determine that the requirements of Division 1 and Division 2 are both satisfied in the use of such Parts and Appurtenances prior to specifying the use of Parts (Div. 1) in the Construction Specification.

CA-1400 GENERAL REQUIREMENTS FOR, AND DEFINITION OF, COMPONENTS, MATERIALS, PARTS, AND APPURTENANCES

CA-1410 COMPONENTS

Concrete Reactor Vessels and Concrete Containment Structures are designated as Components by this Code. Other types of Components are designated in ASME Section III, Division 1 and, when referenced in this Code (Division 2) will be identified by the following notation (Division 1). Components governed by this Code shall be included in the Data Report N-5 as required by NA-1210 of ASME Section III, Division 1.

CA-1420 PARTS

As used in this Code, the term Part refers to an item which is fabricated, inspected, and stamped independently of the Component. The Part is attached to the Component during construction of the Component. An item will be designated as a Part by the Designer when the work required to produce the item is of a level requiring inspection in order to ensure structural or leak-tight integrity of the completed Component.

The following items are designated as Parts:

Metal Liner

Penetration Assemblies

Major Structural Fabricated Embedments

Other Items as Designated by the Designer in the Construction Specification

All Parts must be attached to or included in the Component before the Component Stamp is affixed

(CA-1320). The Construction Specification shall establish the requirements for Parts and the Designer shall account for the adequacy of Parts to satisfy all performance conditions of the Design Specification in the Design Report and the Construction Report.

CA-1430 APPURTENANCES

An Appurtenance is a Part of significance to structural integrity or leak tightness which can be attached to a component that has been completed and previously stamped. All Appurtenances shall be identified in either the Design Specification or the Construction Specification and the Designer shall account for the adequacy of the Appurtenances to satisfy all conditions of the Design Specification in the Design Report and the Construction Report.

CA-1440 ATTACHMENTS

Attachments are items having neither structural integrity nor leak tightness significance. They may be installed without stamping if shown and so designated on the Design Drawings or on Shop Drawings approved by the Designer.

CA-1450 MATERIALS

As used in this Code the term "material" refers to any constituent substance that may be used in a Component, Part, or Appurtenance. Typical materials include the following ingredients of the concrete-steel composite, which may be used in Parts, Components, or Appurtenances:

(a) Concrete Materials – Portland cement, fine aggregate, coarse aggregate, water, and admixtures.

(b) Reinforcing materials – steel reinforcement, reinforcement tie wires, spacers, splices, splice welding rod and flux.

(c) Prestressing materials – tendon assemblies, anchorages, prestressing steel wire, strand and bars, coatings, injectants, ducts, and couplings.

(d) Concrete embedments – structural elements including anchor bolts and screeds, service sleeves (instrument, piping, and electrical), concrete anchorages, measuring devices including strain gages and vibrating wire assemblies.

(e) Liner materials – steel sheet, steel plate, welding rod, weld filler, welding flux, studs and other liner attachment devices, plate and sheet stiffeners, leak test channels, coatings – including paint and other corrosion protection.

(f) Other materials as specified in the Construction Specification.

All Materials listed in (a) through (f) shall be produced and certified in accordance with requirements of Article CB-2000 and CC-2000.