



# REGULATORY GUIDE

OFFICE OF STANDARDS DEVELOPMENT

## REGULATORY GUIDE 1.136

## MATERIAL FOR CONCRETE CONTAINMENTS

(Article CC-2000 of the "Code for Concrete Reactor Vessels and Containments")

## A. INTRODUCTION

General Design Criterion 1, "Quality Standards and Records," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires, in part, that structures, systems, and components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 requires, in part, that measures be established to assure materials control and control of special processes such as welding, and that proper testing be performed.

The American Society of Mechanical Engineers and the American Concrete Institute have jointly published the "Code for Concrete Reactor Vessels and Containments," which is referred to in this guide as the Code. The NRC staff will be setting forth its position on the acceptability of the Code for licensing purposes in a series of regulatory guides. The Code was formally issued for the first time in 1975 and has been undergoing a number of technical and editorial revisions that are to be expected of any newly issued code. Consideration will be given to endorsing the

Code in the Federal Regulations only after experience has been accumulated with its use.

This guide, the first of the series, provides information regarding the NRC staff's position on the acceptability for NRC licensing actions of Article CC-2000, "Material," of the "Code for Concrete Reactor Vessels and Containments."

## B. DISCUSSION

Article CC-2000 of the Code specifies certain requirements for materials associated with the construction of concrete containments for nuclear power plants. These material requirements cover concrete and its constituents, reinforcing bars, prestressing systems, steel liners, and welding material and their manufacturers' quality assurance programs. Revisions and deletions to Article CC-2000 were subsequently published in the Winter 1975 and 1976 Addenda<sup>1</sup> to the Code.

The principal purpose of this guide is to provide information regarding the NRC staff's position on the acceptability for NRC licensing actions of Article CC-2000 of the "Code for Concrete Reactor Vessels and Containments." No attempt has been made to coordinate all literature (standards, codes, guidelines, regulations, etc.) that may be relevant to the subject of this guide. In those areas where the provisions of the referenced Code are insufficient for licensing purposes, the staff has provided supplementary guidelines it considers to be acceptable. These guidelines are contained in the regulatory position. Brief reasons for recommending them are given below.

<sup>1</sup> The "Code for Concrete Reactor Vessels and Containments" is also known either as the ASME Boiler and Pressure Vessel Code, Section III, Division 2, 1975 edition or as ACI Standard 359-74. Copies of the Code and addenda thereto may be obtained from the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, N.Y. 10017 or the American Concrete Institute, Box 19150, Detroit, Mich. 48219.

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Comments and suggestions for improvements in these guides are encouraged at all times, and guides will be revised, as appropriate, to accommodate comments and to reflect new information or experience. However, comments on this guide, if received within about two months after its issuance, will be particularly useful in evaluating the need for an early revision.

Comments should be sent to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch.

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### 1. CC-2232.1(a)<sup>2</sup>

Paragraph CC-2232.1(a) gives no guidance as to how conformance with the concrete strength requirements is to be demonstrated. This is clarified in Regulatory Position C.1.

### 2. CC-2232.2(a)

The Code lacks tolerance limits for the maximum permitted slump and air content. The limits in Regulatory Position C.2 are taken from the Proposed Revisions to Building Code Requirements for Reinforced Concrete (ACI 318-71).<sup>3</sup>

### 3. CC-2243.3(a)

It has not been established that the Code limit of 300 ppm chlorides is low enough to prevent significant deterioration of prestressing elements. Moreover, it has been reported<sup>4</sup> that the ability of chloride ions to cause corrosion increases with decreasing alkalinity of the calcium hydroxide solutions. The staff believes that the limits of chloride content in grout constituents as stated in Regulatory Position C.3 are better related to actual material properties than the limit given in the Code. These recommended limits are taken from Regulatory Guide 1.107, "Qualifications for Cement Grouting for Prestressing Tendons in Containment Structures."

### 4. CC-2463.1

Different systems of prestressing may require different numbers of tests for tendon systems to establish their adequacy for use. One static tensile test, as required by the Code, cannot assess the influence of dimensional variations of anchorages on the strength of a prestressing system. Variations within the tolerance limits of the Construction Specification in material properties and in geometry of anchorages and tendons must be realistically and adequately represented in the system testing. Therefore, Regulatory Position C.4 recommends that any system of prestressing be subjected to sufficient tests to establish its adequacy before it is adopted for use.

## C. REGULATORY POSITION

The requirements and guidelines specified in Article CC-2000, "Materials," of the "Code for Concrete Reactor Vessels and Containments" (ASME Boiler and Pressure Vessel Code, Section III, Divi-

<sup>2</sup> This refers to the article number of the "Code for Concrete Reactor Vessels and Containments."

<sup>3</sup> ACI Proceedings V. 74, No. 1, pp. 1-21, Journal of the American Concrete Institute, January 1977. Copies may be obtained from the American Concrete Institute, Box 19150, Detroit, Mich. 48219.

<sup>4</sup> Hausman, D.A., "Steel Corrosion in Concrete," Materials Protection, November 1967. Copies may be obtained from the National Association of Corrosion Engineers, 2400 West Loop S., Houston, Texas 77027.

sion 2, 1975, also known as ACI Standard 359-74) through its Winter 1976 Addenda are acceptable to the NRC staff for material used in the construction of concrete containments of nuclear power plants subject to the following:

### 1. CC-2232.1 Introduction

To item CC-2232.1(a), "conformance with the concrete strength requirements" should be added:

"as demonstrated by the strength tests of CC-2232.2".

### 2. CC-2232.2 Strength Tests

To paragraph CC-2232.2(a) should be added:

"The range of variation allowed for the air content shall be within  $\pm 0.5$  percent and for the slump within  $\pm 0.75$  in. of the maximums permitted by the specifications."

### 3. CC-2243.3 Chemical Requirements

Instead of item CC-2243.3(a), the following should be used:

"(a) Chlorides ( $Cl^-$ ) shall not exceed 100 ppm when the pH value of the grout is in between 11.6 and 12 and shall not exceed 200 ppm when the pH value is greater than 12. The pH value of the grout shall not be less than 11.6."

The method of calculating the quantity of chloride (or nitrate) in grout constituents is to sum the chloride (or nitrate) content in the constituents of the grout before mixing and then to express the total as parts per million parts of water.

### 4. CC-2463.1 Static Tensile Test

Instead of "CC-2463.1 Static Tensile Test. One static tensile test. . .", the following should be used:

"CC-2463.1 Static Tensile Tests. Static tensile tests. . ."

Any system of prestressing should be subjected to sufficient tests to establish its adequacy.

## D. IMPLEMENTATION

The purpose of this section is to provide information to applicants regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which the applicant proposes an alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used in the evaluation of submittals for construction permit applications docketed after July 30, 1978.

If an applicant wishes to use this regulatory guide in developing submittals for applications docketed on or before July 30, 1978, the pertinent portions of the application will be evaluated on the basis of this guide.