



U.S. ATOMIC ENERGY COMMISSION

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# REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

## REGULATORY GUIDE 3.9

### CONCRETE RADIATION SHIELDS

#### A. INTRODUCTION

Section 20.101 of 10 CFR Part 20, "Exposure of Individuals to Radiation in Restricted Areas," states that no licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual in a restricted area to receive a dose in excess of the limits specified therein. Paragraph (c) of § 20.1 provides that licensees, in addition to complying with the requirements set forth in Part 20, make every reasonable effort to maintain radiation exposures as far below the limits specified in this part as practicable.

Concrete radiation shields can be installed in nuclear facilities such as hot laboratories, radiochemical plants, experimental facilities, and nuclear fuel fabrication plants to provide a barrier between personnel and radiation sources for the purpose of reducing doses of ionizing radiation received by personnel to as low as practicable levels. This guide describes practices for the construction of concrete radiation shielding structures for such nuclear facilities, which are acceptable to the Regulatory staff as methods of complying, in part, with Commission regulations with regard to reducing radiation exposures. Much of the information included may be applicable to shielding structures for reactors and other nuclear and nonnuclear facilities which require concrete radiation shields.

#### B. DISCUSSION

Subcommittee ANS-11, Radioactive Materials Handling Facilities and Specialized Equipment, of the American Nuclear Society has developed a standard presenting requirements and recommended practices for the construction of concrete radiation shielding structures and for certain elements of design that relate to problems unique to this type of structure. This standard was approved by the American National Standards Committee N101, Atomic Industry Facility

Design, Construction and Operation Criteria, and it was subsequently approved by the American National Standards Institute (ANSI) on December 22, 1972, and designated ANSI N101.6-1972. The standard discusses aggregates, design of concrete mixtures and forms, placement of concrete, design and installation of penetrations, embedments, metal liners, and penetration plugs and outlines testing and quality assurance provisions needed to verify that the desired quality of design and construction has been achieved. The standard does not include detailed treatments of structural design or determination of shield thickness.

#### C. REGULATORY POSITION

The requirements and recommended practices contained in ANSI N101.6-1972, "Concrete Radiation Shields,"<sup>1</sup> are acceptable for the construction of radiation shielding structures for hot laboratories, radiochemical plants, experimental facilities, and nuclear fuel fabrication plants subject to the following:

1. Section 2 of ANSI N101.6-1972 lists applicable documents which are intended to supplement this standard. The specific applicability or acceptability of these listed documents has been or will be covered separately in other regulatory guides or in Commission regulations, where appropriate.

2. Section 4.8 of ANSI N101.6-1972 delineates special precautions to be observed in the construction of concrete radiation shields. Where steel or other metals are used as aggregate to increase the density of the concrete, the metal should be of such type that it will not cause hydrogen or other explosive gases to be generated by reaction with the cement.

<sup>1</sup>Copies may be obtained from the American Nuclear Society, 244 East Ogden Avenue, Hinsdale, Illinois 60521.

#### USAEC REGULATORY GUIDES

Regulatory Guides are issued to describe and make available to the public methods acceptable to the AEC Regulatory staff of implementing specific parts of the Commission's regulations, to delineate techniques used by the staff in evaluating specific problems or postulated accidents, or to provide guidance to applicants. Regulatory Guides are not substitutes for regulations and compliance with them is not required. Methods and solutions different from those set out in the guides will be acceptable if they provide a basis for the findings requests to the issuance or continuance of a permit or license by the Commission.

Published guides will be revised periodically, as appropriate, to accommodate comments and to reflect new information or experience.

Copies of published guides may be obtained by request indicating the divisions desired to the U.S. Atomic Energy Commission, Washington, D.C. 20545. Attention: Director of Regulatory Standards. Comments and suggestions for improvements in these guides are encouraged and should be sent to the Secretary of the Commission, U.S. Atomic Energy Commission, Washington, D.C. 20545. Attention: Chief, Public Proceedings Staff.

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3. Section 6.4 of ANSI N101.6-1972 does not explain how some of the variables which are used in the equations for bending moment and tensile stress are to be determined. Therefore this section should not be used as a substitute for detailed thermal stress analysis in the design of temperature reinforcement for control of cracking in specific concrete radiation shields.

4. Section 8.7.1 of ANSI N101.6-1972 states, in part, that reinforcing steel or other means be provided for transferring shear forces through a construction joint. This requirement is not sufficient. Provision should be made for adequate means of transferring shear and other forces through the joint.