



U.S. ATOMIC ENERGY COMMISSION

# REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

## REGULATORY GUIDE 1.15

### TESTING OF REINFORCING BARS FOR CATEGORY I CONCRETE STRUCTURES<sup>1</sup>

#### A. INTRODUCTION

General Design Criterion 1 of Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants," requires that structures, systems and components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed. This guide describes an acceptable method for implementing this criterion with regard to tests and inspections of reinforcing bars for Category I concrete structures.<sup>2</sup> The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

#### B. DISCUSSION

The tensile strength of concrete structures important to safety depends upon reinforcing bars imbedded in the concrete. The contribution of the concrete to the tensile strength of the structure is minimal and thus generally disregarded. The tensile strength of reinforcing bars is usually tested in accordance with ASTM A-615-72, "Standard Specification for Deformed Billet-Steel Bars for Concrete Reinforcement", American Society for Testing and Materials. This specification permits the tensile test specimens to be either of full bar diameter or of a reduced diameter. Comparison of test data obtained with both full bar diameter and reduced diameter

specimens indicates that the tensile and yield strengths of the full diameter bars may be lower than the values that are obtained using reduced diameter specimens. The variations are generally greater in bar sizes No. 14 and larger. Thus, the evaluation of the design margin of safety in the structure may not be conservative if it is based upon test results obtained from reduced diameter specimens.

ASTM A-615-72 requires only one tension test specimen per heat if all bars from a single heat differ in size by less than three designation numbers; only two specimens are required in other cases. Because each heat may contain from 50 to 250 tons of steel, the fraction of the reinforcing bars that are tested may vary by a factor of 5. A more consistent basis for sampling can be obtained by choosing the test specimens on the basis of the number of reinforcing bars or the weight of reinforcing.

Special chemistry requirements have occasionally been placed on some reinforcing bars, and checks should be made that any such requirements are being met.

Since some mechanical splice configurations may require deformations that exceed the minimum requirements set forth in ASTM A-615-72, it is important to inspect the deformations to assure that they will permit a reliable mechanical splice to be made.

#### C. REGULATORY POSITION

##### 1. Yield Strength and Tensile Strength Tests

Reinforcing bars used for concrete structures important to safety should be tested to verify their yield strength and tensile strength as follows:

<sup>1</sup> This guide is a revision of former Safety Guide 15. As such, it is applicable to water-cooled nuclear power reactors.

<sup>2</sup> Structures, systems, and components of a nuclear power plant are designated as Category I if they are designed to withstand the effects of the Safe Shutdown Earthquake (SSE) and remain functional. See Safety Guide 29, "Seismic Design Classification."

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a. At least one full-diameter specimen from each bar size should be tested for each 50 tons or fraction thereof of reinforcing bars that are produced from each heat and used in Category I structures.

b. The test procedures should be in accordance with ASTM A-370-68, "Standard Methods and Definitions for Mechanical Testing of Steel Products," American Society for Testing and Materials.

c. The acceptance standards should be in accordance with ASTM A-615-72, "Standard Specification for Deformed Billet-Steel Bars for Concrete Reinforcement," American Society for Testing and Materials, including Supplemental Requirement (S-1), using full sections of the bars as rolled.

d. Where any material property such as yield-strength-to-tensile-strength ratio, ductility, weldability or other similar property is relied upon by the designer

or constructor, the reinforcing bar chemistry should be controlled to the extent required to achieve the desired material property, and confirmatory testing should be performed.

## 2. Deformation Inspections

Deformations on the reinforcing bars should be inspected to assure their compliance with ASTM A-615-72 and with the licensee's specifications pertinent to bonding and other purposes which are dependent on the deformation characteristics.<sup>3</sup>

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<sup>3</sup>Adequacy of deformations for splicing will be demonstrated by the tensile tests of the mechanical splice. See Safety Guide 10, "Mechanical (Cadmold) Splices in Reinforcing Bars of Category I Concrete Structures."