



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO THE RELIEF FROM CERTAIN RADIOGRAPHIC REQUIREMENTS

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

TENNESSEE VALLEY AUTHORITY

DOCKET NOS. 50-327 AND 50-328

1.0 INTRODUCTION

In a letter dated May 4, 1999, the Tennessee Valley Authority (TVA) submitted a request for relief from certain radiographic image quality indicator (IQI or penetrameter) requirements at the Sequoyah Nuclear Plant (SQN), Units 1 and 2. TVA proposed an alternative to the plaque-type penetrameters specified by the 1989 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), which is the applicable edition for the Sequoyah second 10-year Inservice Inspection (ISI) interval. The penetrameters are used to ensure that the desired sensitivity, definition, and contrast has been achieved in radiographic examination of materials.

2.0 BACKGROUND

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2 and 3 components (including supports) must meet the requirements, except design and access provisions and preservice examination requirements, set forth in Section XI of editions of the Code and Addenda that become effective subsequent to the editions specified in paragraphs (g)(2) and (g)(3) of this section and that are incorporated by reference in paragraph (b) of this section, to the extent practical within the limitations of design, geometry and materials of construction of the components.

2.1 Code Requirements

As noted above, the applicable ASME Section XI Code for the SQN second 10-Year ISI interval is the 1989 Edition with no addenda. In a submittal dated November 21, 1995, TVA proposed to use ASME Code Case N-416-1, "Alternate Pressure Test Requirement for Welded Repairs or Installation of Replacement Items by Welding, Class 1, 2, and 3, Section XI, Division 1," for SQN Units 1 and 2. TVA's proposed alternative to the Code was authorized in a letter from the U.S. Nuclear Regulatory Commission (NRC) dated April 27, 1998, with its approval of the second 10-year ISI interval program. Specifically, TVA was authorized to use ASME Code Case N-416-1. This Code case requires that non-destructive examination of welds be performed in accordance with the applicable Subsection of the 1992 Edition (no addenda) of Section III of the Code.

ENCLOSURE

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The use of penetrameters is contained in paragraphs NB-5111 and NC-5111 to Section III of the 1992 Edition of the Code, that state in part "...Radiographic examination shall be in accordance with Section V, Article 2, except that... the penetrameters of Table NB-5111-1 (and NC-5111-1) shall be used in lieu of those shown in Table T-276 [of Section V]." Tables NB-5111-1 and NC-5111-1 specify only plaque-type penetrameters.

2.2 Request for Approval of an Alternative

Section 10 CFR 50.55a(a)(3) states that

Proposed alternatives to the requirements of paragraphs (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:

- (i) the proposed alternatives would provide an acceptable level of quality and safety, or
- (ii) compliance with the specified requirements of this section would result in hardship of unusual difficulty without a compensating increase in the level of quality and safety.

TVA has requested approval for an alternative to the penetrometer requirements in paragraphs NB-5111 and NC-5111 to Section III of the 1992 Edition of the Code as cited above. Specifically, TVA proposes to use wire-type image quality indicators (i.e., penetrameters) for radiographic examinations as provided for in ASME Code, Section III, 1992 Edition with 1993 Addenda.

2.3 Basis for Alternative

TVA believes that plaque-type penetrameters are difficult to use due to their physical placement and radiographic characteristics. The placement of flat plaques on curved surfaces of pipe components usually need some form of shimming. After positioning the plaque on test material and performing a radiographic examination, the recorded radiographic characteristics of the essential T hole is often obscured or distorted due to specimen anomalies, part geometry, or film artifacts outside the area of interest. These difficulties create re-shoot conditions. The re-shoots have an adverse as-low-as-reasonably-achievable impact due to the additional radiation exposure to the radiography crew.

TVA believes that the wire-type IQI is superior to the plaque-type IQI for nuclear piping component applications. Wire IQIs can be placed directly across the area of interest, thus encompassing the object's range of density and geometry. The 1-inch minimum length of the essential IQI wire eliminates the problem of indicator loss due to distortion, anomalies, and part geometry. The wire-type IQIs provide the same function as the plaque-type penetrameters by indicating a change in thickness and spatial resolution of the image without the use of shim blocks and pipe standards.

Wire IQIs have been shown to provide quality and sensitivity equivalent to plaque-type penetrameters as documented in Table 4 of American Society for Testing and Materials (ASTM)

E 747-87. Equivalent sensitivity has also been demonstrated in ASME Section V, Article 22, Standard SE-747. Because of the equivalent sensitivity, the proposed alternative (i.e., wire IQIs) provides results that are equivalent to the current testing method of plaque-type penetrameters. Therefore, the quality of the inspection and resulting safety of the plant, based on the inspection results, are not impacted by this proposed alternative, thus providing an acceptable level of quality and safety.

3.0 EVALUATION

Volume 17 of the Ninth Edition of the Metals Handbook, published in 1989, states that wire-type penetrameters are widely used in Europe, and a standard design is used in the United Kingdom, Germany, the Netherlands, and Scandinavia and by the International Organization for Standardization and the International Institute of Welding. The handbook goes on to state that wire penetrameters specified in ASTM E 747-87 are widely used in the United States. ASTM developed this specification using a public forum with approval by public consensus. The ASTM Standard E 747-87 referenced in the Metals Handbook is identical to the 1989 Edition of ASME's Standard SE-747-87.

Wire penetrameters were not included in Section III of the Code until the 1992 Edition with 1993 Addenda. Although the 1992 Edition with 1993 Addenda of the Code has not been endorsed at this time by NRC, it was developed through the consensus-building process used by Section III of the Code. The NRC participates in these forums.

In the staff's review of TVA's proposed alternative, the staff assembled a table for wire penetrameters from standards that are currently being used in industry. To assemble the table, plaque number and essential hole size from Table 4 to SE-747 to Section V was merged with the same from Table NB-5111-1 (NC-5111-1) to the 1992 Edition of Code. The wire diameters from Table 4 to SE-747 to Section V was compared against the wire diameters from Table NB-5111-1 (NC-5111-1) to Section III of the 1992 Edition with 1993 Addenda of the Code. The comparison showed that wire diameters were essentially the same. Of the 18 wire diameters in the newly created table, two wire diameters were more conservative (smaller diameters), two wire diameters interpolated from two known values were less conservative (larger diameters), and 14 wire diameters were identical to the wire diameters in Table NB-5111-1 (NC-5111-1) to the 1992 Edition with 1993 Addenda of the Code. Based on the above comparison of commonly used industry references and the widespread use of wire penetrameters in industry, the staff believes that wire penetrameters listed in Table NB-5111-1 (NC-5111-1) to the 1992 Edition with 1993 Addenda of the Code will provide an acceptable level of quality and safety.

4.0 CONCLUSION

Based on the above evaluation, the staff concludes that the proposed alternative to use IQIs for radiography examinations as provided for in ASME Section III, 1992 Edition with 1993 Addenda, provides an acceptable level of quality and safety. Therefore, the staff authorizes the use of the proposed alternative pursuant to 10 CFR 50.55a(a)(3)(i).

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