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

# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

# RELATED TO THE RELIEF REQUEST TO USE ASME CODE CASE N-498-1 FOR

# PERIODIC HYDROSTATIC TESTING OF ASME CLASS 3 PIPING

# SOUTH CAROLINA ELECTRIC AND GAS COMPANY

# VIRGIL C. SUMMER NUCLEAR STATION

# DOCKET NUMBER 50-395

## 1.0 INTRODUCTION

The Code of Federal Regulations, 10 CFR 50.55a, requires that inservice inspection (ISI) of American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 systems be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code and applicable Addenda, except where the Commission grants specific written relief pursuant to 10 CFR 50.55a(g)(6)(i). 10 CFR 50.55a(a)(3) indicates that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements that become effective subsequent to editions specified in 10 CFR 50.55a(g)(2) and (g)(3), except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. Paragraph (g)(4)(ii) requires that inservice examination of components and system pressure tests conducted during successive 120-month inspection intervals comply with the requirements of the latest edition and addenda of the Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The second 10-year interval for the V. C. Summer Nuclear Station (VCSNS) began on January 1, 1994, and ends on December 31, 2003. The licensee's ISI program is based on the 1989 edition of ASME Code Section XI. The components (including supports) may meet the requirements set forth in subsequent editions and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed therein and subject to Commission approval.

Pursuant to 10 CFR 50.55a(g)(5)(iii), if the licensee determines that conformance with an examination requirement of Section XI of the ASME Code is impractical for its facility, information shall be submitted to the Commission in support of that determination. After evaluation of the determination, pursuant to 10 CFR 50.55a(g)(6)(i), the Commission may grant relief and may impose alternative requirements that are determined to be authorized by law; will not endanger life, property, or the common defense and security; and are otherwise in the public interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed.

South Carolina Electric and Gas Company's (SCE&G's) July 1, 1998, letter proposed an alternative examination to the requirements of the ASME Boiler and Pressure Code, Section XI. SCE&G requested approval to implement the alternative rules of ASME Section XI Code Case N-498-1, dated May 11, 1994, "Alternative Rules for 10-Year System Hydrostatic Testing for Class 1, 2, and 3 Systems" pursuant to 10 CFR 50.55a(a)(3)(i) for 10-year hydrostatic testing on Class 1, 2, and 3 systems. We have reviewed and evaluated the licensee's request and supporting information to use Code Case N-498-1 as a proposed alternative to the Code requirements for VCSNS.

## 2.0 EVALUATION

### 2.1 Licensee's Request

SCE&G requested relief from performing the Code-required hydrostatic test, and requested full implementation of Code Case N-498-1 for Class 1, 2 and 3 systems.

#### 2.1.1 Licensee's Component Identification

This request is for all ISI Class 1, 2, or 3 system hydrostatic tests during each remaining ISI inspection interval.

#### 2.1.2 ASME Code, Section XI, Requirements

Section XI, Table IWB-2500-1, Categories B-P, Table IWC-2500-1, Categories C-H, and IWD-2500-1, Categories D-A, D-B, and D-C contain the requirements for system hydrostatic and leakage testing. The Code requires system hydrostatic testing once per 10-year interval, at or near the end of the interval.

#### 2.1.3 Licensee's Proposed Alternative Testing

SCE&G proposed performing alternative examinations in accordance with ASME Code Case N-498-1, a system leakage test, in lieu of hydrostatic testing as follows:

- A system pressure test will be conducted during each inspection interval of Inspection Program B.

- System pressure testing will extend to all Class 3 components included in those portions of systems required to operate or support the safety system function up to and including the first normally closed valve, including a safety or relief valve, or valve capable of automatic closure when the safety function is required.

- The system will be pressurized to nominal operating pressure for at least 4 hours for insulated systems, and 10 minutes for non-insulated systems. The system will be maintained at nominal operating pressure during the performance of the VT-2 visual examination.

- The VT-2 visual examination will include all components within the boundary identified above.

2.1.4 Licensee's Basis for Relief

The licensee's basis for relief is as follows:

> Currently the ASME Code requires that a hydrostatic test be performed on all Class 1, 2 and 3 systems once each 10-year interval as a part of the inservice inspection plan. Even at the higher hydrostatic test pressures, the contribution of the pressure component to the overall design loads is relatively small. Based on this, the ASME, industry, and NRC, have realized that the hydrostatic test is not intended to be a test of structural integrity but, rather, an enhanced leakage test. The value of hydrostatic testing in determining structural integrity is negligible.
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> Industry experience indicates that leaks are not being discovered where the leak originated due to hydrostatic test pressures causing a pre-existing flaw to propagate through-wall. Instead, the industry experience shows that the majority of all leaks discovered were leaks which originated at normal operating pressures. Therefore, compared to a hydrostatic test, a normal pressure leakage test is equally effective for discovering through-wall flaws.
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> Currently, licensees incur the cost of considerable time, radiation exposure and dollar resources carrying out hydrostatic test requirements. A significant effort may be necessary, depending on the system or plant configuration, system Code Class and other factors, to temporarily remove or disable Code safety and/or relief valves to meet test pressure requirements. The safety assurance provided by the enhanced leakage gained from a slight increase in system pressure during a hydrostatic test is offset by having to gag or remove Code safety and/or relief valves, placing the system in an off-normal state, erecting

temporary supports in steam lines, possible extension of refueling outages and resource requirements to set up testing with special equipment and gages.

2.1.5 Evaluation

Information prepared in conjunction with ASME Code Case N-498-1 notes that the system hydrostatic test is not solely a test of system structural integrity, but also provides a means to enhance leakage detection. A paper by S. H. Bush and R. R. Maccary, *"Development of In-Service Inspection Safety Philosophy for U.S.A. Nuclear Power Plants,"* ASME, 1971, indicated that this was the original intent. Piping components are designed for a number of loadings that would be postulated to occur under the various modes of plant operation. Hydrostatic testing only subjects the piping components to a small increase in pressure over the design pressure. It does not present a significant challenge to pressure boundary integrity. Piping dead weight, thermal expansion, and seismic loads, which may present far greater challenge to the structural integrity of a system than fluid pressure, are not part of the loading imposed during a hydrostatic test. Water is used as a test medium in the hydrostatic test. Because water is highly incompressible, any small leak from a high-pressurized water-solid system can be readily detected by a sharp decline in system pressure, or by continual pumping required to maintain the system pressure. As such, hydrostatic pressure testing is primarily regarded as a means to enhance leakage detection during the examination of components under pressure. Hydrostatic pressure testing provides good indication of any system leakages, especially those that might originate from small through-wall cracks of the pressure boundary. Consequently, this Code-required in-service hydrostatic pressure test enhances the possibility of timely discovery of small through-wall flaws which, because of a tiny leak size, might not be readily detected by any other means such as system walkdowns or installed leak-detection systems.

SCE&G requested approval to implement the alternative rules of ASME Section XI Code Case N-498-1, in lieu of 10-year hydrostatic testing of Class 1, 2, and 3 systems. The licensee may already use N-498, "Alternative Rules for 10-Year System Hydrostatic Testing for Class 1, and 2 Systems," since NRC Regulatory Guide 1.147, Rev. 11 approves the use of Code Case N-498 for Class 1 and 2 systems. The rules for Code Class 1 and 2 in N-498-1 are unchanged from those in N-498. The staff found N-498 acceptable because the alternative of performing a test at a system pressure that is slightly lower than the hydrostatic pressure provided adequate assurance, and because compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Code Case N-498-1 was revised from N-498 to encompass Class 3 components, and specifies requirements for Class 3 that are identical to those for Class 2 components. In lieu of 10-year hydrostatic pressure testing at or near the end of the 10-year interval, Code Case N-498-1 requires a visual examination (VT-2) be performed in conjunction with a system leakage test in accordance with paragraph IWA-5000. A system leakage test may be conducted to demonstrate that leaks from pressure boundary that may originate from through-wall flaws do not exist. This would meet the intent of the hydrostatic test as noted above.

Class 3 systems do not normally receive the amount or type of non-destructive examinations that Class 1 and 2 systems receive. While Class 1 and 2 system failures are relatively uncommon, Class 3 system leaks occur more frequently, and the failure mode typically differs. Based on a review of Class 3 system failures requiring repair for the last 5 years in Licensee Event Reports and the Nuclear Plant Reliability Data System databases, the most common causes of failures are erosion-corrosion (EC), microbiologically induced corrosion (MIC), and general corrosion. Licensees generally have programs in place for prevention, detection, and evaluation of EC and MIC. Leakage from general corrosion is readily apparent to inspectors when performing a VT-2 examination during system pressure tests.

Since a hydrostatic test provides only a minimal amount of increased assurance over a system leakage test, and the system pressure test provides adequate assurance, the staff finds that the proposed alternatives provide an acceptable level of quality and safety. Accordingly, the licensee's proposed alternative to use Code Case N-498-1 is authorized for VCSNS for the current interval, pursuant to 10 CFR 50.55a(a)(3)(i).

## 3.0 CONCLUSIONS

The staff evaluated SCE&G's information in support of its request for relief. Based on the information submitted, the alternative for hydrostatic testing contained in the licensee's proposal is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for Class 1, 2, and 3 systems. The staff concludes that alternative rules of ASME Section XI Code Case N-498-1, in lieu of 10-year hydrostatic testing of Class 1, 2, and 3 systems, provide an acceptable level of quality and safety. The SCE&G alternative is authorized for the duration of the currently approved ISI program plan, or until the Code Case is approved for general use by reference in Regulatory Guide 1.147.

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Date: October 21, 1998