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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE INSPECTION REQUEST FOR RELIEF

LICENSE NOS. DPR-44 AND DPR-56

PHILADELPHIA ELECTRIC COMPANY

PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3

DOCKET NOS. 50-277 AND 50-278

1.0 INTRODUCTION

The Technical Specifications for Peach Bottom Atomic Power Station, Units 2 and 3, state that the inservice inspection of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Code (Code) Class 1, 2, and 3 components shall be performed in accordance with Section XI of the ASME Code and applicable Addenda as required by 10 CFR 50.55a(g), except where relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i) and (a)(3). As stated in 10 CFR 50.55a(a)(3), 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 difficulties 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, 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," that became effective subsequent to editions specified in 10 CFR 50.55a(g)(2) and (g)(3), to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval, and subsequent intervals, comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) on the date 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The 1980 Edition through Winter 1981 Addenda of Section XI is the applicable edition of the ASME Code for Peach Bottom Atomic Power Station's second 10-year inservice inspection (ISI) interval. 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.

In a letter dated February 27, 1995, as revised by letter dated July 21, 1995, Philadelphia Electric Company (PECO, the licensee), proposed alternative examinations to the requirements of the ASME Code, Section XI for Peach Bottom Atomic Power Station. The licensee proposed a relief request that contains two code cases that apply to Units 2 and 3 (i.e., RR-14, Revision 4). In RR-14, the licensee requested approval for the implementation of 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, Section XI, Division 1" and Code Case N-416-1, dated February 15, 1994, entitled "Alternative Pressure Test Requirement for Welded Repairs or Installation of Replacement Items by Welding Class 1, 2, and 3, Section XI, Division 1," pursuant to 10 CFR 50.55a(a)(3) to be applied to the second 10-year interval of the ISI program for Peach Bottom Atomic Power Station, Units 2 and 3.

2.0 EVALUATION

2.1 RR-14, Revision 4 (for Units 2 and 3) - Code Case N-498-1

2.1.1 Licensee's Request

This submittal is requesting approval pursuant to 10 CFR 50.55a(a)(3)(ii) for use of Code Case N-498-1.

2.1.2 Licensee's Component Identification

Class 1, 2, and 3 systems.

2.1.3 ASME Code, Section XI Requirements

Section XI, Table IWB-2500-1, Category B-P (for Class 1), Table IWC-2500-1, Category C-H (for Class 2), and Table IWD-2500-1, Categories D-A, D-B, and D-C (for Class 3) 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.

2.1.4 Licensee's Proposed Alternative Testing

The licensee proposed to use the alternative contained in Code Case N-498-1, a system leakage test, in lieu of hydrostatic testing, for Class 1, 2 and 3 systems.

2.1.5 Licensee's Basis for Relief

The licensee stated the following basis for relief:

> "The burden imposed by the higher test pressures associated with the current 10 year hydrostatic test requirement, is not

commensurate with the increase in safety benefit. Hydrostatic pressure tests are performed at elevated pressures which require special maintenance activities for isolation of components to be tested, such as: temporary gagging or removal of relief valves installed to prevent overpressurization, leaktight repair of valving which does not normally serve a pressure isolation function, and installation of portable hydrostatic pressure pumps. The higher pressures imposed on the pressure boundary components during hydrostatic testing do not challenge the structural integrity of the material, and produce only a slight enhancement in leak detection capability. The additional leakage, above that which occurs during a system pressure test at nominal operating pressure, is inconsequential in determining pressure boundary integrity. Therefore, the additional burden, and in some instances additional radiological dose to personnel associated with these maintenance activities, can be avoided. The experience gained by the performance of these tests indicates that the goal of the test (i.e. to discover pressure boundary leakage or evidence of structural distress) will still be achieved at lower test pressures.

Adoption of this Code Case will allow substitution of a system pressure test, conducted at nominal operating pressure, for the ten year hydrostatic test, currently required for Class 1, 2, and 3 systems."

2.1.6 Evaluation

Information prepared in conjunction with ASME Code Case N-498-1 notes that the system hydrostatic test is not solely a test of the structural integrity of the system, but also provides a means to enhance leakage detection. That this was the original intent is indicated in 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. 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 and, therefore, does not present a significant challenge to pressure boundary integrity since 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 highly 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 since such a test provides good indication of any system leakages, especially those that might originate from small through-wall cracks of the pressure boundary. Consequently, this in-service hydrostatic pressure test required by the Code 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.

The licensee requested approval for the implementation of the alternative rules of ASME, Section XI, Code Case N-498-1 for Peach Bottom Atomic Power Station, Units 2 and 3. The staff has previously approved (in Regulatory Guide 1.147, Revision 11) the use of Code Case N-498 for Class 1 and 2 systems. The staff found N-498 acceptable because the alternative 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. The rules for Code Class 1 and 2 in N-498-1 are unchanged from N-498.

Code Case N-498-1 was revised from Code Case N-498 to encompass Class 3 components and specifies requirements for Class 3 components 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 system leakage testing in accordance with paragraph IWA-5000. A system pressure 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.

Currently, licensees incur considerable time, radiation exposure, and dollar expenditure carrying out hydrostatic test requirements. A significant amount of effort may be necessary (depending on system, plant configuration, Code class, etc.) 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 or negated by the following factors: 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.

Class 3 systems do not normally receive the amount and/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 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.

Giving consideration to the minimal amount of increased assurance provided by the increased pressure associated with a hydrostatic test versus the pressure for the system leakage test and the hardship associated with performing the ASME Code-required hydrostatic test, the staff finds that compliance with the Section XI hydrostatic testing requirements results in hardship and/or unusual difficulty for the licensees without a compensating increase in the level of quality and safety.

2.2 RR-14, Revision 4 (for Units 2 and 3) - Code Case N-416-1

2.2.1 Licensee's Request

This submittal is requesting approval pursuant to 10 CFR 50.55a(a)(3)(ii) for use of Code Case N-416-1.

2.2.2 Licensee's Component Identification

Class 1, 2, and 3 systems.

2.2.3 ASME Code Section XI Requirements

ASME Section XI, 1980 Edition, Winter 1981 Addenda, Article IWA-4000 and IWA-5000 hydrostatic pressure test requirements.

2.2.4 Licensee's Proposed Alternative Examination

The licensee proposed the following alternative examinations in lieu of performing the hydrostatic pressure test required per paragraph IWA-4400:

The requirements of Code Case N-416-1 will be implemented as alternate provisions to the ASME Section XI Code, 1980 Edition with Addenda through Winter 1981, for Class 1, 2 and 3 pressure boundary component welded repairs and installation welds for replacement items.

In addition, Nondestructive Examination (NDE) of Class 1, 2 and 3 repair or replacement butt weld shall be performed in accordance with the UFSAR license commitments, which will equal or exceed the NDE methods and accertance criteria of the applicable Subsection of the 1992 Edition of ASME Section III. In the absence of volumetric examination requirements, a surface examination of the root pass of the butt weld shall be performed.

Surface examination of Class 1, 2 and 3 repair or replacement socket welds shall be performed on the final pass of the socket weld. The above provisions provide an equivalent level of safety to that associated with hydrostatic testing and are consistent with ALARA good practice.

Use of this Code Case shall be documented on the applicable Code Form and included in the ISI Summary Report.

2.2.5 Licensee's Basis for Relief

The licensee stated the following basis for relief:

> "The above articles require that hydrostatic pressure testing be performed after welded repair or installation of replacement items by welding on ASME Class 1, 2 and 3 pressure boundary components.
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> The burden imposed by the process of hydrostatic testing is not commensurate with the increased of safety achieved. Hydrostatic

pressure tests are performed at elevated pressures which require special maintenance activities for isolation of components to be tested, such as: temporary gagging or removal of relief valves installed to prevent overpressurization, leaktight repair of valving which does not normally serve a pressure isolation function, and installation of portable hydrostatic pressure pumps. The higher pressures imposed on the pressure boundary components during hydrostatic testing do not challenge the structural integrity of the material, and produce only a slight enhancement in leak detection capability. The additional leakage, above that which occurs during a system pressure test at nominal operating pressure, is inconsequential in determining pressure boundary integrity. Therefore, the additional burden, and in some instances additional radiological dose to personnel associated with these maintenance activities, can be avoided.

Adoption of this Code Case will allow substitution of a system leakage test, conducted at nominal operating pressure, for the post-repair/replacement hydrostatic test, currently required for Class 1, 2, and 3 systems."

2.2.6 Evaluation

In lieu of hydrostatic pressure testing for welded repairs or installation of replacement items by welding, Code Case N-416-1 requires a visual examination (VT-2) be performed in conjunction with a system leakage test using the 1992 Edition of Section XI, in accordance with paragraph IWA-5000, at nominal operating pressure and temperature. This Code Case also specifies that NDE of the welds be performed in accordance with the applicable Subsection of the 1992 Edition of Section III.

The 1989 Edition of Sections XI and III is the latest edition referenced in 10 CFR 50.55a. The staff has compared the system pressure test requirements of the 1992 Edition of Section XI to the requirements of IWA-5000 of the 1989 Edition of Section XI. In summary, the 1992 Edition imposes a more uniform set of system pressure test requirements for Code Class 1, 2, and 3 systems. The terminology associated with the system pressure test requirements for all three Code Classes has been clarified and streamlined. The test frequency and test pressure conditions associated with these tests have not been changed. The hold times for these tests have either remained unchanged or increased. The corrective actions with respect to removal of bolts from leaking bolted connections have been relaxed in the 1992 Edition, and this relaxation has been accepted by the staff in previous safety evaluations. The post-welded repair NDE requirements of the 1992 Edition of Section III remain the same as the requirements of the 1989 Edition of Section III. Therefore, the staff finds this aspect of Code Case N-416-1 to be acceptable.

Hardships are generally encountered with the performance of hydrostatic testing performed in accordance with the Code. For example, since hydrostatic test pressure would be higher than nominal operating pressure, hydrostatic pressure testing frequently requires significant effort to set up and perform.

The need to use special equipment, such as temporary attachment of test pumps and gauges. and the need for individual valve lineups can cause the testing to be time consuming and on critical path.

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 and, therefore, does not present a significant challenge to pressure boundary integrity. Accordingly, hydrostatic pressure testing is primarily regarded as a means to enhance leakage detection during the examination of components under pressure, rather than solely as a measure to determine the structural integrity of the components.

The industry experience has demonstrated that leaks are not being discovered as a result of hydrostatic test pressures propagating a preexisting flaw through-wall. This experience indicates that leaks in most cases are being found when the system is at normal operating pressure. This is largely due to the fact that hydrostatic pressure testing is required only upon installation and then once every 10-year inspection interval, while system leakage tests at nominal operating pressures are conducted a minimum of once each refueling outage for Class 1 systems and each 40-month inspection period for Class 2 and 3 systems. In addition, leaks may be identified by plant operators during system walkdowns which may be conducted as often as once a shift.

Following the performance of welding, the Code requires volumetric examination of repairs or replacements in Code Class 1 and 2, but would also allow only a surface examination of the final weld pass in Code Class 3 piping components. There are no ongoing NDE requirements for Code Class 3 components except for visual examination for leaks in conjunction with the 10-year hydrostatic tests and the periodic pressure tests.

Considering the NDE performed on Code Class 1 and 2 systems and considering that the hydrostatic pressure tests rarely result in pressure boundary leaks that would not occur during system leakage tests, the staff believes that increased assurance of the integrity of Class 1 and 2 welds is not commensurate with the burden of performing hydrostatic testing. However, considering the nature of NDE requirements for Code Class 3 components, the staff does not believe that elimination of the hydrostatic pressure testing while only performing system pressure testing is an acceptable alternative to hydrostatic testing unless additional surface examinations are performed on the root pass layer of butt and socket welds on the pressure retaining boundary of Class 3 components when the surface examination method is used in accordance with Section III. In its July 21, 1995 letter, the licensee committed to perform this additional examination. The staff finds this commitment acceptable provided the surface examination method is used in accordance with Section III.

For clarification, it should be noted that, consistent with the Code Case requiring performance of NDE in accordance with the methods and acceptance criteria of the 1992 Edition of Section III, the scope of examination should

also be in accordance with the 1992 Edition of Section III. The additional surface examination of the root layer of Class 3 pressure retaining welds should be performed only when those pressure retaining welds are required to have a surface examination performed in accordance with the 1992 Edition of Section III. For those Class 3 welds receiving radiography in lieu of a surface examination in accordance with Section III, no additional surface examination of the root layer needs to be performed.

3.0 CONCLUSION

3.1 RR-14, Revision 4 (for Units 2 and 3) - Code Case N-498-1

The staff evaluated the information provided by the licensee 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)(ii) as compliance with the specified hydrostatic testing requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Use of Code Case N-498-1 for Code Class 1, 2, and 3, is authorized for Peach Bottom Atomic Power Station, Units 2 and 3, through the duration of the currently approved ISI program.

3.2 RR-14, Revision 4 (for Units 2 and 3) - Code Case N-416-1

The staff evaluated the information provided by the licensee in support of its request for reliefs. Based on the information submitted, the licensee's proposed alternative is authorized for Peach Bottom Atomic Power Station, Units 2 and 3, pursuant to 10 CFR 50.55a(a)(3)(ii). Use of Code Case N-416-1, with provisions as noted in the licensee's alternate provisions section above, is authorized through the duration of the currently approved ISI program.

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