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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

ON ASME CODE CASES N-498-1 AND N-416-1

WISCONSIN ELECTRIC POWER COMPANY

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-266 AND 50-301

1.0 INTRODUCTION

The Technical Specifications for the Point Beach Nuclear Plant (PBNP) state that the inservice inspection and testing of the American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 components shall be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code and applicable Addenda as required by 10 CFR 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Part 50.55a(a)(3) of Title 10 of Code of Federal Regulations states 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 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 that become effective subsequent to editions specified in 10 CFR 50.55a(g)(2) and (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. 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 applicable edition of Section XI of the ASME Code for PBNP is the 1986 Edition, for the third 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.

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 should 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.

By letter dated July 19, 1995, the Wisconsin Electric Power Company (WEPCo, the licensee), requested approval for the implementation of the alternative rules of: (1) 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) for 10-year hydrostatic testing on Class 3 systems for PBNP's third ISI interval; and (2) ASME Section XI 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," in conjunction with additional nondestructive examination (NDE) of Class 3 components, pursuant to 10 CFR 50.55a(a)(3) for PBNP's third ISI interval.

The NRC staff has reviewed and evaluated the licensee's request and supporting information to use Code Cases N-498-1 and N-416-1 as proposed alternatives to the Code requirements for PBNP.

2.0 EVALUATION

2.1 PTP-3-05, CODE CASE N-498-1

Component Identification

ASME Class 3 pressure retaining components.

ASME Code, Section XI, Requirements

10-Year Hydrostatic tests required by Table IWD-2500-1, Categories D-A, D-B, and D-C.

Licensee's Basis for Relief

WEPCo submitted the following information by letter dated July 19, 1995:

> Satisfying this provision of the Code requires significant resources to address operational concerns and personnel and plant safety issues related to placing the plant in a nonconventional configuration to support, isolate, and/or obtain the above normal operating pressure required for hydrostatic testing. During hydrostatic testing, the affected system is unavailable to support plant operations, even if called upon to perform its safety function, during the time required to isolate and align the system; perform fill and vent operations; connect an external hydro pump and provide for pressure relief capability for the test volume; maintain pressure for at least 4 hours for insulated systems; install and remove blank flanges and/or spool pieces; remove and reinstall system relief valves; recalibrate instrumentation; and realign the system for service; etc.

Although hydrostatic testing is performed with the utmost of care utilizing detailed procedures and highly trained personnel, there is a very small possibility of damaging equipment or experiencing some other unforeseen incident which could affect plant safety.

Information prepared in conjunction with ASME Code Case N-498-1 notes that the system hydrostatic test is not a test of the structural integrity of the system, but rather an enhanced leakage test. This was the original intent 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 the number of loadings that are postulated to occur under the various modes of plant operation. Hydrostatic testing only subjects the piping components to a relatively small increase in pressure over the design pressure, and thus, does not present a significant challenge to pressure boundary integrity. Piping dead weight, thermal expansion, and seismic loads, all of which may present a far greater challenge to the structural integrity of the system than fluid pressure, are not part of the loading imposed during hydrostatic testing. Accordingly, hydrostatic testing is primarily regarded as a means to enhance leakage detection during the examination of components under pressure, rather than as a measure of the structural integrity of the components.

The alternate pressure tests permitted by Code Case N-498-1 fulfill the same purpose as a hydrostatic pressure test, (i.e., a check for component leakage) at a reduced cost. Additionally, plant safety is increased when the alternative rules are utilized over hydrostatic testing in that the ability of the affected system to be able to perform its safety function is not challenged as it is during the hydrostatic testing process. Considering the negligible amount of increased assurance provided by the elevated pressure associated with a hydrostatic test in comparison to the pressure seen during a system leakage test, versus the hardship associated with the ASME Section XI 10-year hydrostatic testing requirements, compliance with the Section XI 10-year hydrostatic testing requirements results in hardship and/or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, relief may be granted under 10 CFR 50.55a(a)(3)(ii).

It should be noted that the alternative rules specified in ASME Code Case N-498-1 for ASME Class 1 and 2 systems are effectively already available for use. These alternative rules are equivalent to those called out under ASME Code Case N-498 (approved by the ASME on May 13, 1991), which is listed in NRC Regulatory Guide (RG) 1.147 as being available to all licensees. As a result, this request for relief (PIP-2-05) is written to apply only to ASME Class 3 systems.

Proposed Alternative Testing

The licensee proposes to use the alternative rules specified in ASME Section XI Code Case N-498-1.

Evaluation/Conclusions

Information prepared in conjunction with ASME Code Case N-498-1 notes that the system hydrostatic test is not a test of the structural integrity of the system, but rather an enhanced leakage test. 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 or liquid is used as a test medium in the hydrostatic test. Since 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. Therefore, hydrostatic pressure testing provides enhanced leakage detection during examination of components under pressure and is sensitive to any system leakages, especially those that might originate from small through-wall cracks of the pressure boundary. Accordingly, hydrostatic pressure testing is regarded as a means to enhance leakage detection, rather than as a measure to determine the structural integrity of the components.

WEPCo 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" in lieu of 10-year hydrostatic testing of Class 3 systems (WEPCo may use Code Case N-498 for Class 1 and 2 systems as it is approved in Regulatory Guide (RG) 1.147 Rev. 11). 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 (which is slightly lower than hydrostatic pressure) provided adequate assurance of detecting leakage 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 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 pressure test in accordance with paragraph IWA-5000. However, the test boundary subject to pressurization and test condition holding time are still identical to those of a hydrostatic system test.

Currently, licensees expend considerable effort and incur considerable radiation dose 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 outweighed 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 five 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 as provided by Code Case N-498-1.

Giving consideration to the minimal amount of increased assurance provided by the increased pressure associated with a hydrostatic test, the leakage detection capability associated with the proposed system pressure test and VT-2 examination, 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. Accordingly, the licensee's proposed alternative to use Code Case N-498-1 for Code Class 3 systems, is authorized for PBNP pursuant to 10 CFR 50.55a(a)(3)(ii). Use of Code Case N-498-1 is authorized until such time as the Code Case is published in a future revision of Regulatory Guide 1.147. At that time, if the licensee intends to continue to implement this Code Case, the licensee is to follow all provisions in Code Case N-498-1, with limitations issued in Regulatory Guide 1.147, if any.

2.2 PTP-3-06, CODE CASE N-416-1

Component Identification

ASME Class 1, 2, and 3 pressure retaining components.

ASME Code Section XI Requirements

IWA-5214 Repairs and Replacements

(a) A component repair or replacement shall be pressure tested prior to resumption of service if required by IWA-4400 and IWA-4600.

(b) The test pressure and temperature for a system hydrostatic test subsequent to the component repair or replacement shall comply with the system test pressure and temperature specified in IWB-5222, IWC-5222, and IWD-5223, as applicable to the system which contains the repaired or replaced component.

Licensee's Basis for Request

WEPCo submitted the following information by letter dated July 19, 1995:

Satisfying this provision of the Code requires significant resources to address operational concerns and personnel and plant safety issues related to placing the plant in a nonconventional configuration to support, isolate, and/or obtain the above normal operating pressure required for hydrostatic testing. During hydrostatic testing, the affected system is unavailable to support plant operations, even if called upon to perform its safety function, during the time required to isolate and align the system; perform fill and vent operations; connect an external hydro pump and provide for pressure relief capability for the test volume; maintain pressure for at least 4 hours for insulated systems; install and remove blank flanges and/or spool pieces; remove and reinstall system relief valves; recalibrate instrumentation; and realign the system for service; etc. Although hydrostatic testing is performed with the utmost of care utilizing detailed procedures and highly trained personnel, there is always a very small possibility of damaging equipment or experiencing some other unforeseen incident which could affect plant safety.

Piping components are designed for the number of loadings that are postulated to occur under the various modes of plant operation. Hydrostatic testing only subjects the piping components to a relatively small increase in pressure over the design pressure, and thus, does not present a significant challenge to pressure boundary integrity. Piping dead weight, thermal expansion, and seismic loads, all of which may present a far greater challenge to the structural integrity of the system than fluid pressure are not part of the loading imposed during hydrostatic testing. Accordingly, hydrostatic testing is primarily regarded as a means to enhance leakage detection during the examination of components under pressure, rather than as a measure of the structural integrity of the components.

Nuclear industry experience indicates that leaks are not being discovered as a result of hydrostatic test pressures propagating a preexisting flaw through the wall. Rather, leaks in most cases are detected with the system at normal operating pressure. To a large extent, this is due to the fact that hydrostatic testing is required relatively infrequently in comparison to routine inspections conducted at normal operating pressures. Considering the NDE performed on ASME Class 1 and 2 systems and that the relatively infrequent hydrostatic testing rarely, if ever, detects leakage which could not have been found by a pressure test at normal operating pressure, the increased assurance provided by the elevated pressure associated with a hydrostatic test

results in hardship and/or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, relief may be granted under 10 CFR 50.55a(a)(3)(ii).

With respect to ASME Class 3 components, it is acknowledged that some additional compensatory measures are needed due to the nature of the NDE requirements, or lack thereof, for ASME Class 3 components. However, when the additional NDE requirements for ASME Class 3 components, as discussed in the Proposed Alternative Requirement action below, are taken into consideration, the increased assurance provided by the elevated pressure associated with a hydrostatic test on ASME Class 3 components results in hardship and/or unusual difficulty without a compensating increase in the level of quality and safety. Again as before, relief may be granted under 10 CFR 50.55a(a)(3)(ii).

Proposed Alternative Examination

The licensee proposes to apply Code Case N-416-1 in conjunction with additional NDE of Class 3 components as alternative rules for welded repairs or installation of replacement items by welding in Class 1, 2, and 3 piping. The additional NDE will consist of either a surface examination or volumetric examination of the final weld of the root (pass) layer of socket and butt welds on the pressure retaining boundary of ASME Class 3 components.

Evaluation/Conclusions

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 system leakage testing, 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 are the latest editions 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 has 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, but use of this change 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 gages, and the need for individual valve lineups can cause the testing to be on a 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. They indicate 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 during system walkdowns by plant operators, 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 only requires 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 eliminating the hydrostatic pressure testing, and only performing system pressure testing is an acceptable alternative to hydrostatic testing without compensatory measures. Therefore, the additional examinations proposed by the licensee for butt and socket welds on the pressure retaining boundary of Class 3 components are appropriate.

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.

With this provision applied to Code Class 3 components, the staff concludes that compliance with the Code hydrostatic testing requirements for welded repairs or replacements of Code Class 1, 2, and 3 components would result in hardships without a compensating increase in the level of quality and safety. Accordingly, the licensee's proposed alternative to use Code Case N-416-1 in conjunction with the proposed additional NDE of Class 3 components is authorized for PBNP, pursuant to 10 CFR 50.55a(a)(3)(ii). Use of Code Case N-416-1, with provision as noted above, is authorized until such time as the Code Case is published in a future revision of Regulatory Guide 1.147. At that time, if the licensee intends to continue to implement this Code Case, the licensee is to follow all provisions in Code Case N-416-1, with limitations issued in Regulatory Guide 1.147, if any.

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