January 17, 2008

Mr. Bruce H. Hamilton
Vice President, Oconee Site
Duke Power Company LLC
7800 Rochester Highway
Seneca, SC 29672

SUBJECT: OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3 – RELIEF FROM USE OF PREEMPTIVE WELD OVERLAY AND ALTERNATIVE EXAMINATION TECHNIQUES ON DECAY HEAT REMOVAL LINE TO HOT LEG NOZZLE WELDS (TAC NOS. MD6731, MD6732, MD6733)

Dear Mr. Hamilton:

By letter dated September 13, 2007, you submitted Request for Relief No. 07-ON-004 concerning the preemptive weld overlay and inspection of the decay heat removal line to hot leg nozzle welds in the reactor coolant system at Oconee Nuclear Station, Units 1, 2, and 3. You proposed the use of full structural preemptive weld overlays with temper bead welding for repair and the Performance Demonstration Initiative program for inspection as alternatives to the requirements of American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code*, Section XI.

We have reviewed and evaluated your submittal and conclude that the proposed alternatives provide an acceptable level of quality and safety. Therefore, pursuant to Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.55a(a)(3)(i), the proposed alternatives are authorized for the subject welds for each unit's fourth 10-year inservice inspection interval.

On November 27, 2007, we granted verbal relief for Unit 3.

Sincerely,

/ra/

John Stang, Acting Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

Enclosure:
Safety Evaluation

cc w/encl: See next page

January 17, 2008

Mr. Bruce H. Hamilton
Vice President, Oconee Site
Duke Power Company LLC
7800 Rochester Highway
Seneca, SC 29672

SUBJECT: OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3 – RELIEF FROM USE OF PREEMPTIVE WELD OVERLAY AND ALTERNATIVE EXAMINATION TECHNIQUES ON DECAY HEAT REMOVAL LINE TO HOT LEG NOZZLE WELDS (TAC NOS. MD6731, MD6732, MD6733)

Dear Mr. Hamilton:

By letter dated September 13, 2007, you submitted Request for Relief No. 07-ON-004 concerning the preemptive weld overlay and inspection of the decay heat removal line to hot leg nozzle welds in the reactor coolant system at Oconee Nuclear Station, Units 1, 2, and 3. You proposed the use of full structural preemptive weld overlays with temper bead welding for repair and the Performance Demonstration Initiative program for inspection as alternatives to the requirements of American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code*, Section XI.

We have reviewed and evaluated your submittal and conclude that the proposed alternatives provide an acceptable level of quality and safety. Therefore, pursuant to Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.55a(a)(3)(i), the proposed alternatives are authorized for the subject welds for each unit's fourth 10-year inservice inspection interval.

On November 27, 2007, we granted verbal relief for Unit 3.

Sincerely,

/ra/

John Stang, Acting Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

Enclosure:
Safety Evaluation

cc w/encl: See next page
Distribution:

PUBLIC	RidsAcrsAcnwMailCenter
LPL2-1 R/F	RidsRgn2MailCenter (JMoorman)
RidsNrrLAMO'Brien (hard copy)	RidsNroDeCib2 (TSteingass)
RidsNrrPMLOlshan (hard copy)	S. Campbell, EDO, Rgn II
RidsNrrDorlLpl2-1	RidsOgcRp

Accession Number: ML073460027 *SE transmitted by memo dated

OFFICE	NRR/LPL2-1/PM	NRR/LPL2-1/LA	OGC	NRO/DE/CIB2/BC	NRR/LPL2-1/BC
NAME	LOlshan (JStang for)	MO'Brien	EWilliamson	TChan	JStang
DATE	01/09/08	01/09/08	01/15/2008	12/5/07	01/17/08

OFFICIAL RECORD COPY

Oconee Nuclear Station, Units 1, 2, and 3

cc:

Mr. Bruce H. Hamilton
Vice President, Oconee Site
Duke Power Company LLC
7800 Rochester Highway
Seneca, SC 29672

Ms. Lisa F. Vaughn
Associate General Counsel and Managing Attorney
Duke Energy Carolinas, LLC
526 South Church Street - EC07H
Charlotte, North Carolina 28202

Manager, LIS
NUS Corporation
2650 McCormick Dr., 3rd Floor
Clearwater, FL 34619-1035

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
7812B Rochester Highway
Seneca, SC 29672

Mr. Henry Porter, Director
Division of Radioactive Waste Management
Bureau of Land and Waste Management
Dept. of Health and Env. Control
2600 Bull St.
Columbia, SC 29201-1708

Mr. Michael A. Schoppman
Framatome ANP
1911 North Ft. Myer Dr.
Suite 705
Rosslyn, VA 22209

Mr. B. G. Davenport
Regulatory Compliance Manager
Oconee Nuclear Site
Duke Energy Corporation
ON03RC
7800 Rochester Highway
Seneca, SC 29672

Mr. Leonard G. Green
Assistant Attorney General
NC Department of Justice
P.O. Box 629
Raleigh, NC 27602

Mr. R. L. Gill, Jr.
Manager - Nuclear Regulatory Issues and Industry Affairs
Duke Power Company LLC
526 S. Church St.
Mail Stop EC05P
Charlotte, NC 28202

Division of Radiation Protection
NC Dept of Environment, Health, & Natural Resources
3825 Barrett Dr.
Raleigh, NC 27609-7721

Mr. Peter R. Harden, IV
VP-Customer Relations and Sales
Westinghouse Electric Company
6000 Fairview Road
12th Floor
Charlotte, NC 28210

Mr. Henry Barron
Group Vice President, Nuclear Generation and Chief Nuclear Officer
P.O. Box 1006-EC07H
Charlotte, NC 28201-1006

Mr. Charles Brinkman
Director, Washington Operations
Westinghouse Electric Company
12300 Twinbrook Parkway, Suite 330
Rockville, MD 20852

Ms. Kathryn B. Nolan
Senior Counsel
Duke Energy Carolinas, LLC
526 South Church Street - EC07H
Charlotte, NC 28202

SAFETYY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST 07-ON-004,

DECAY HEAT REMOVAL LINE TO HOTLEG NOZZLE WELDS

DUKE POWER COMPANY, LLC

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

DOCKET NOS. 50-269, 50-270, AND 50-287

1.0 INTRODUCTION

By letter dated September 13, 2007 (Agencywide Document Access and Management System (ADAMS) ML No. 072620149) Duke Power Company LLC, (the licensee) submitted Relief Request (RR) No. 07-ON-004, requesting relief pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(a)(3)(i) from the repair requirements of the American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code* (Code) Cases N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1 (N-504-2)," N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique (N-638-1)," and Appendix VIII, Supplement 11 to the 1995 edition including 1996 addenda of ASME Code, Section XI. The alternative, which includes modifications to N-504-2 and N-638-1, would be used to perform preemptive full structural weld overlays on decay heat removal (DHR) line to hot leg nozzle welds in the reactor coolant systems at Oconee Nuclear Station, Units 1, 2, and 3 (ONS).

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must 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 (ISI) 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) twelve months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ISI Code of record for ONS Units 1, 2, and 3 for the fourth 10-year ISI interval is the 1998 edition of the ASME Code through the 2000 addenda. In accordance with 10 CFR 50.55a(g)(6)(ii)(C)(1), the implementation of Supplements 1 through 8, 10, and 11 of Appendix VIII to Section XI, 1995 edition with the 1996 addenda of the ASME Code, was required on a phased schedule ending on November 22, 2002.

Supplement 11 was required to be implemented by November 22, 2001. Additionally, 10 CFR 50.55a(g)(6)(ii)(C)(2) requires licensees implementing the 1989 edition and earlier editions of paragraph IWA-2232 of Section XI of the ASME Code to implement the 1995 edition with the 1996 addenda of Appendix VIII and supplements to Appendix VIII of Section XI of the ASME Code.

Pursuant to 10 CFR 50.55a(g)(4)(iv), ISI items may meet the requirements set forth in subsequent editions and addenda of the ASME Code that are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed therein, and subject to Commission approval. Portions of editions and addenda may be used provided that related requirements of the respective editions and addenda are met.

Pursuant to 10 CFR 50.55a(a)(3) alternatives to requirements may be authorized by the Nuclear Regulatory Commission (NRC) if the licensee demonstrates that: (i) the proposed alternative provides 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. The licensee submitted the subject relief request pursuant to 10 CFR 50.55a(a)(3)(i) to propose alternatives to the implementation of the ASME Code, Section XI, Appendix VIII, Supplement 11, and alternatives that are modifications to N-504-2 and N-638-1 for the application of preemptive full structural weld overlays.

3.0 PROPOSED ALTERNATIVES

3.1 Licensee's Reason for Requesting the Alternative

Dissimilar metal welds (DMW) primarily consisting of nickel based Alloy 82/182 weld metal are frequently used in pressurized-water reactor (PWR) construction to connect stainless steel pipe and safe ends to vessel nozzles, generally constructed of carbon or low alloy ferritic steel. These welds have shown a propensity for primary water stress corrosion cracking (PWSCC) degradation, especially in components subjected to higher operating temperatures, such as the pressurizer. No evidence of PWSCC has been found in the welds of the ONS hot legs, however, PWSCC is difficult to detect in DMW except when the inspection is performed in accordance with the stringent requirements of ASME Code, Section XI, Appendix VIII. Some of the DMWs included in this request have been evaluated and found not to meet the surface or geometric requirements to enable examination per Appendix VIII. Rather than risk multiple cycles of inspection and modification, the licensee is proposing to take proactive measures by applying a preemptive full structural weld overlay (PWOL) to the DMWs of the hot leg components listed in Section 1.0 of its September 13, 2007, submittal.

3.2 Code Requirements for which Relief is Requested

The Code requirements for which relief is requested are N-638-1 and N-504-2, with conditions as specified in Regulatory Guide (RG) 1.147, Revision 14, and ASME Code, Section XI, 1995 edition including addenda through 1996, and Appendix VIII, Supplement 11, which is required to be implemented per 10 CFR 50.55a(g)(6)(ii)(c).

3.3 Licensee's Proposed Modifications to N-504-2

The licensee proposed to use N-504-2 as an alternative to the mandatory ASME Code repair provisions with the following modifications for full structural weld overlays:

- Use of a nickel-based alloy weld material, Alloy 52M/52MS rather than the low carbon (0.035 percent maximum) austenitic stainless steel.

- Relaxation from the requirement to perform delta ferrite measurements to meet the 7.5 Ferrite Number (FN) requirement of N-504-2. The FN requirement cannot be met because the Alloy 52M/52MS weld material is 100-percent austenitic and contains no delta ferrite.

- In lieu of a hydrostatic test, a system leakage test and an ultrasonic (UT) examination will be performed in accordance with ASME Code, Section XI, IWA-4540(a)(2), as modified by Appendix Q.

3.4 Licensee's Basis for Relief

The licensee stated that the weld overlay has been designed consistent with the requirements of N-504-2 with the specific thickness and length computed according to the guidance provided in the subject Code Case. The licensee stated that Alloy 52M/52MS material is highly resistant to primary water stress corrosion cracking (PWSCC) and that industry operational experience has shown that PWSCC in Alloy 82/182 will blunt at the interface with stainless steel base metal, ferritic base metal, or Alloy 52M/52MS weld metal. The 360° structural weld overlay will control growth in any PWSCC crack and maintain weld integrity. The weld overlay will induce compressive stress in the weld, thus impeding growth of any reasonably shallow cracks.

The weld metal used will be Alloy 52M/52MS, which is an austenitic nickel alloy. These filler materials were selected for their improved resistance to PWSCC. Alloys 52M/52MS contain about 28 to 31.5 percent chromium that imparts excellent corrosion resistance. The existing Alloy 82/182 weld and the Alloy 52M/152S overlay are nickel based and have ductile properties and toughness similar to austenitic stainless steel piping welds at PWR operating temperature. These filler materials are suitable for welding over the ferritic nozzle, Alloy 82/182 weld and the austenitic stainless steel materials.

Paragraph (e) of N-504-2 requires as-deposited delta ferrite measurements of at least 7.5 FN for the weld reinforcement. The licensee proposed that delta ferrite measurements will not be performed for this overlay because the deposited Alloy 52M/52MS is 100-percent austenitic and contains no delta ferrite due to the high nickel composition (approximately 60-percent nickel).

The licensee stated that application of IWA-4540(a)(2) for a system leakage test in lieu of a system hydrostatic test requires performance of nondestructive examination (NDE) in accordance with the methods and acceptance criteria of the applicable Subsection of the 1992 edition of ASME Code, Section III. ASME Code, Section III, Subsection NB, Article 5000 for examination does not address the structural weld overlay type configuration. The NDE requirements of Nonmandatory Appendix Q will be followed for the required NDE in lieu of ASME Code, Section III. Code Case N-504-2 and Nonmandatory Appendix Q provide

appropriate examination requirements including examination volume, acceptance criteria, and examination methods per Appendix VIII.

3.5 NRC Staff's Evaluation of Modifications to N-504-2

Under IWA-4420, in editions and addenda up to and including the 1998 edition with the 2000 addenda, repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and addenda of the Construction Code, or of Section III, either in their entirety or portions thereof, and Code Cases may be used. In addition to the above requirements, defects shall be removed or reduced in size in accordance with IWB-3640. Alternatively, the component may be evaluated and accepted in accordance with the design rules of either the Construction Code, or Section III, when the Construction Code was not Section III. N-504-2 is being used by the licensee to perform full structural weld overlays on the ONS DHR line welds listed in Section 1.0 of its September 13, 2007, submittal as a preemptive measure against cracking due to PWSCC.

N-504-2 was conditionally approved by the NRC staff for use under RG 1.147, Revision 14. The condition specified the use of Nonmandatory Appendix Q, which provides the NDE methods, volume and acceptance criteria for the weld overlay. Therefore, the use of the modified N-504-2 as an alternative to the mandatory ASME Code repair provisions is acceptable to the NRC staff, provided that all conditions and provisions of N-504-2, which is currently approved by the NRC staff under RG 1.147, Revision 14, are complied with. The licensee has proposed modifications to N-504-2.

The first proposed modification to the N-504-2 provisions involves the use of a nickel-based alloy weld material, rather than the low carbon austenitic stainless steel. The licensee stated that paragraph (b) of N-504-2 requires that the reinforcement weld material shall be low carbon (0.035 percent maximum) austenitic stainless steel. In lieu of the stainless steel weld material, Alloy 52M/52MS, which is a consumable welding wire highly resistant to PWSCC, was proposed for the overlay weld material. The NRC staff notes that the use of Alloy 52M/52MS material is consistent with weld filler material used to perform similar weld overlays at operating PWR facilities and that the licensee is performing a full structural overlay on dissimilar metal welds made of Alloy 182 material. For material compatibility in welding, the NRC staff considers Alloy 52M/52MS a better choice of filler material than austenitic stainless steel material for this weld joint configuration. Alloy 52M/52MS contains about 28 to 30 percent chromium, which would provide excellent resistance to PWSCC in the reactor coolant environment. This material is identified as F-No. 43 Grouping for Ni-Cr-Fe, classification UNS N06052 Filler Metal and has been previously approved by the NRC staff for similar applications. Therefore, the licensee's proposed use of Alloy 52M/52MS for the weld overlays as a modification to the requirements of N-504-2, paragraph (b) is authorized as it will provide an acceptable level of quality and safety.

The second proposed modification to the N-504-2 provisions involved paragraph (e) of N-504-2 that requires as-deposited delta ferrite measurements of at least 7.5 FN for the weld reinforcement. The licensee proposed that delta ferrite measurements will not be performed for this overlay because the deposited Alloy 52M/52MS material is 100-percent austenitic and contains no delta ferrite due to the high nickel composition (approximately 60-percent nickel). N-504-2 allows the use of weld overlay repair by deposition of weld reinforcement on the outside surface of the pipe in lieu of mechanically reducing the defect to an acceptable flaw size. However, N-504-2 is only applicable to weld overlay repair of austenitic stainless steel piping.

Therefore, the material requirements regarding the carbon content limitation (0.035% maximum) and the delta ferrite content of at least 7.5 FN, as delineated in N-504-2, paragraph (e), apply to austenitic stainless steel weld overlay materials. These requirements are not applicable to Alloy 52M/52MS, a nickel-based material that the licensee will use for the weld overlays. Based on the discussion above, the NRC staff concludes that the modification to paragraph (e) of N-504-2 will provide an acceptable level of quality and safety, and is, therefore, authorized.

The third modification requested by the licensee is to use a system leakage test versus a system hydrostatic test in accordance with ASME Code, Section XI, IWA-4540(a)(2). A system leakage test in accordance with IWA-5000 is allowed provided the requirement under IWA-4540(a)(2)(a) is met, which requires NDE acceptance criteria of the 1992 edition or later of Section III be met prior to return to service. The licensee's proposed modification of performing a system leakage test versus a hydrostatic test is supported by the NRC staff's position with respect to Code Case N-416-3. The NRC staff notes that Code Case N-416-3, "Alternative Pressure Test Requirement for Welded or Brazed Repairs, Fabrication Welds or Brazed Joints for Replacement Parts and Piping Subassemblies, or Installation of Replacement Items by Welding or Brazing, Classes 1, 2, and 3, Section XI, Division 1 (N-416-3)," was unconditionally approved for use in RG 1.147, Revision 14. N-416-3 states that "a system leakage test may be used provided the following requirements are met." Paragraph (a) states: "NDE shall be performed on weld or brazed repairs and fabrication and installation joints in accordance with the methods and acceptance criteria of the applicable subsection of the 1992 Edition of Section III." The acceptance criteria in Section III do not allow the presence of cracks, regardless of length, and is geared more toward construction-type welds.

The licensee's modification, which is a system pressure test with the use of the post-repair NDE requirements of N-504-2 and Appendix Q, utilizing the appropriate Electric Power Research Institute (EPRI) Performance Demonstration Initiative (PDI) procedures, as discussed later in this safety evaluation, is acceptable. The post-repair examination volume includes the full thickness of the weld overlay plus 25 percent of the underlying base metal thickness. The specimen sets for PDI qualification for weld overlay examinations include construction type flaws. Use of PDI qualified personnel and procedures for the examination of the weld overlay will result in the reliable detection of construction type flaws and meets the intent of compliance with the applicable subsection of the 1992 edition of Section III, and, therefore, provide an acceptable level of quality and safety.

Based on the discussion above, the NRC staff concludes that the modifications to N-504-2 will provide an acceptable level of quality and safety, and therefore, are authorized.

3.6 Licensee's Proposed Modifications to N-638-1

The licensee proposed to use N-638-1 as an alternative to the mandatory ASME Code repair provisions with the following modifications for full structural weld overlays:

- The maximum area of an individual weld based on the finished surface over the ferritic material will be approximately 173 in^2.

- Full UT of the 1.5T band on the ferritic side of the overlay(s) will not be performed. UT will be performed on the actual weld overlay, meeting the requirements of ASME Code, Section XI, Nonmandatory Appendix Q.

- In lieu of the 48-hour hold time from ambient temperature for the start of post weld NDE, the NDE may start following completion of the third temperbead layer.

- In lieu of weld-attached thermocouples and recording instruments, process temperatures will be monitored with non-attached devices, such as contact pyrometers.

3.7 Licensee's Basis for Relief

For the first modification, the licensee stated that the one-half base metal thickness limitation, which also includes the 100 in^2 surface area limitation under 1.0(a) of N-638-1, applies only to excavations and repairs, and is not applicable to the weld overlays that are the subject of this relief request. Therefore, the 100-in^2 surface area limitation is not applicable to this configuration. The licensee also stated that the maximum area of the WOL for the decay heat nozzles will be approximately 173 in^2 over the ferritic material. An ASME white paper providing technical justification for extending the area limitation to 500 in^2 was published by the ASME Code Committees and has been submitted to the NRC for NRC use.

In addition to the above, Section 6.0 of the submittal addresses analyses of the residual stress profiles in the PWOL that indicated that beneficial compressive stresses resulted at the inside surface. Fracture mechanics analyses also demonstrated that if any cracks were present, they would not grow beyond the ASME Code allowable 75-percent through-wall depth. Shrinkage due to application of the PWOL will be measured during the overlay application and will be evaluated to ensure there are no adverse stresses at other locations in the piping system. Finally, the total added weight due to the PWOL was evaluated under ONS calculation OSC-8745.06 and was found acceptable.

For the second modification, the licensee stated that in lieu of the requirement to perform an ultrasonic examination of the 1.5T band next to the overlay, the post overlay nondestructive examinations will be performed in accordance with the requirements of N-504-2. The licensee stated that N-638-1 applies to any type of welding where a temper bead technique is to be employed and is not specifically written for a weld overlay repair. The licensee stated that if the cracking were to occur, it would be beneath the weld overlay instead of the 1.5T area that is not covered by the overlay. The nondestructive examination (NDE) acceptance criteria would be ASME Code, Section XI preservice inspection acceptance standards, as specified in Appendix Q. These standards are consistent with the highly sensitive ultrasonic examination procedures being used, which are qualified in accordance with ASME Code, Section XI, Appendix VIII, Supplement 11, as implemented via the PDI. The ASME Code, Section XI flaw acceptance standards are based on fracture mechanics principles that evaluate the potential effect of flaw indications on the safe operation of a component. ASME Code, Section III ultrasonic standards, on the other hand, are derived from radiographic standards in earlier construction codes and tend to be workmanship-based, addressing flaws occurring in the original construction process that are likely to be detected by radiography. The licensee stated that it is not reasonable or technically logical to reject such indications based on outdated, workmanship-based standard when found by much more sensitive examination techniques that were not required by the Construction Code.

For the third modification, the licensee stated that EPRI Report 1013558, "48-Hour Hold Requirement for Ambient Temperature Temperbead Welding," provides justification for deviation

from the 48-hour hold requirements of N-638-1. The licensee also stated that the ferritic nozzle base material region is the only area susceptible to delayed heat affected zone cracking and the area and volume is tested under the requirements of N-504-2 and Appendix Q. This testing requires liquid penetrant examination prior to installation of the full structural WOL, which requires a clean surface that would not leave surface contamination necessary to start the hydrogen cracking. Finally, the use of low hydrogen electrodes in the Alloy 52M/52MS has a high affinity for hydrogen, therefore protecting the ferritic portion of the structural weld overlay.

For the fourth modification, the licensee stated that temperatures will be monitored with a temporarily attached or contact pyrometer and the proposed technique provides data equivalent to that obtained from the weld attached thermocouples to monitor interpass temperature.

3.8 NRC Staff's Evaluation of Modification to N-638-1

N-638-1 limits the size of the repair to a maximum of 100 in^2 and a depth not greater than ½ the ferritic base metal thickness or 3/8 of an inch. Some of the reasons for these limits are distortion of weld and base metal, cracking in the weld and base metal, and high residual stresses when a large repair excavation is being performed in the ferritic material of a dissimilar metal weld. In the application of the PWOL for this relief request, there is no large excavation in the ferritic portion of the material, therefore, relaxation of the 100-in^2 limitation does not significantly contribute to cracking when the ferritic material is overlaid rather than excavated.

The licensee also evaluated the post-PWOL stress effects on other welds in the lines and the effects of the weight added to the piping line due to the overlay. The evaluation concluded that there were no adverse effects to the neighboring piping welds due to either shrinkage stresses or the added weight of the PWOL on the line. Based on the information provided by the licensee and the discussion above, the NRC staff concludes that the maximum overlay deposit of 173 in^2 will provide reasonable assurance of the structural integrity of the weld, and is acceptable.
The second modification requested by the licensee is that full UT of the 1.5T band required under paragraph 4.0(b) will not be performed. The NRC staff notes that the post weld overlay examination area, as defined under Appendix Q, is ½ inch on either side of the overlay for surface examination and the completed overlay for UT examination. Appendix Q is a condition to the use of N-504-2, imposed by the NRC staff under RG 1.147, Revision 14, with which the licensee specifically states that it will comply in its submittal. The issue of cracking and/or distortion of the weld and base metal were not specifically addressed in the code case development work. Since the weld overlays are fabricated from austenitic materials with inherent toughness, no cracking in the overlays is expected to occur due to the shrinkage associated with the weld overlay. With respect to the ferritic portion of the overlays, many temper bead weld overlays have been applied in the nuclear industry to nozzle-to-safe end locations. In no instance has there been any reported cracking due to the weld overlay application. The stiffness and high toughness inherent in the low alloy steel material is expected to protect against any cracking and limit any distortion that might occur in the low alloy steel material.

With respect to NDE acceptance criteria, many flaws that are not detected or accurately sized with radiography have a high likelihood of being detected and sized with UT, depending on orientation. These flaws are normally detected with UT during the ASME Code, Section XI preservice inspection. Also, the preservice UT is used to characterize flaws detected during the ASME Code, Section III radiography examination. The flaws of concern are the ones that can

cause failure immediately or grow to failure in the future. The ASME Code, Section Xl preservice acceptable flaw standards were developed to consider the materials in which the flaw indications are detected, the orientation and size of the indications, and ultimately the potential structural impact of the flaw on the component. The flaws detected during preservice inspections are subjected to periodic inservice inspections as established in Appendix Q, Q-4300. This includes inspection frequencies for monitoring existing crack growth and identifying new cracks. Thus, the established preservice NDE acceptance criteria in Code Case N-504-2/Appendix Q for weld overlays made with Alloy 52M/52MS weld metal should also be applied to the portion of the weld overlay made during the application of N-638-1 so that an acceptable level of safety and quality will be maintained. Based on the above discussion, the NDE acceptance criteria as stated in the N-504-2/Appendix Q are acceptable to the NRC staff.

In its submittal the licensee stated that it will be measuring and evaluating axial shrinkage for impact on the materials and on the piping system after the weld overlay is deposited, which is in accordance with the requirements of N-504-2(g)(2) and (g)(3). Also, any cracking that might occur should be detected by the final NDE of the weld overlay required under Appendix Q, which provides additional assurance of the deposition of a defect-free, structurally sound overlay. The assessment of the shrinkage stresses on the piping, plus post-weld NDE volumes under Appendix Q, provide reasonable assurance that defect-free welds will result in maintaining the structural integrity of the piping. The NRC staff concludes that the testing under Appendix Q will provide an acceptable level of quality and safety, therefore, the NRC staff finds the proposed modification to the 1.5T band ultrasonic examination requirement under N-638-1 acceptable.

The licensee's third modification changed the 48-hour hold time from ambient temperature for post weld NDE to start the 48-hour hold time from the completion of the third temperbead layer. The NRC staff has reviewed EPRI Report 1013558, "48-Hour Hold Requirement for Ambient Temperature Temperbead Welding," and finds the assumptions drawn in the report to be reasonable for the purposes of the commencement of the 48-hour hold time. The NRC staff agrees that the combination of 150°F and 350°F interpass temperatures for the first three and fourth through subsequent layers provide an effective combination to ensure high HAZ toughness and protection against sensitization. In addition to the above, post-weld hydrogen delayed cracking is most susceptible in the ferritic materials, but the use of Alloy 52M/52MS weld material, with its high affinity for monatomic hydrogen will protect the ferritic material from cracking. Finally, the post-weld PT examination will provide reasonable assurance that if the cracking were to occur, it would be detected. The acceptance criteria in Appendix Q does not allow for the presence of any cracking, therefore, if discovered, it would be removed and repaired prior to placing the material in service. Based on the above discussion, the NRC staff concludes that the information provided by the licensee and the EPRI supporting documentation provide reasonable assurance of the structural integrity and is acceptable.

The fourth modification requested by the licensee is to manually record process temperatures using calibrated instruments such as contact pyrometers. Paragraph 4.0(c) of N-638-1 states that when weld-attached thermocouples and recording instruments are used, the area from which the thermocouples have been removed will be ground and examined using a surface examination. Published literature clearly identifies grinding as a method of cold working which acts as a crack initiation site for PWSCC sensitive materials. The opportunity to reduce the amount of cold work in these materials is considered an effective tool to prevent cracking. The licensee's modification to monitor process temperatures with contact instrumentation that eliminates welding and grinding is considered a good practice and an effective remedy to

minimize cold work. Based on the discussion above, the NRC staff concludes that the modification to monitor process temperatures with calibrated contact temperature monitoring devices will provide an acceptable level of quality and safety, and, therefore, is acceptable.

Based on the discussion above, the NRC staff concludes that the modifications to N-638-1 will provide an acceptable level of quality and safety, and are, therefore, authorized.

3.9 ASME Code, Section XI, Appendix VIII, Supplement 11 Alternatives

The NDE will meet the requirements of Enclosure 1 of the alternative request, excluding UT examination of the completed full structural PWOL. The UT examination of the completed PWOL will be performed in accordance with ASME Code, Section XI, 1998 edition including addenda through 2000, Appendix VIII, Supplement 11 with the alternatives used for complying with the PDI program (See Table A2 of the alternative request) for ONS.

UT examination requirements for the weld overlays are provided in Section 3 per Enclosure 1 of the alternative request, which specifies that UT examination is to be performed in accordance with Section XI of the ASME code. Unlike ASME Section III requirements, the ASME Section XI UT examination is qualified based on PDI for both personnel and procedures, and it has been proven to be capable for this application by that process. Therefore, in this application, UT examination in accordance with ASME Section XI requirements with the licensee proposed alternatives is more appropriate than UT examination using ASME Section III requirements.

3.10 NRC Staff's Evaluation of Modifications to Appendix VIII, Supplement 11

The U.S. nuclear utilities created the PDI program to implement performance demonstration requirements contained in Section XI, Appendix VIII, of the ASME Code. Moreover, the PDI program is designed for qualifying equipment, procedures and personnel to examine weld overlays in accordance with the UT criteria of Appendix VIII, Supplement 11. Preceding the Supplement 11 program, EPRI maintained a performance demonstration program for weld overlay qualification under the Tri-party Agreement[1]. In lieu of having two programs with similar objectives, the NRC staff recognized the PDI program[2] for weld overlay qualifications as an acceptable alternative to the Tri-party Agreement.

---

1 The Tri-party Agreement is between NRC, EPRI, and the Boiling Water Reactor Owners Group (BWROG), ACoordination Plan for NRC/EPRI/BWROG Training and Qualification Activities of NDE (Nondestructive Examination) Personnel,@ July 3, 1984.

2 US NRC Letter from William H. Bateman to Michael Bratton, A Weld Overlay Performance Demonstration Administered by PDI as an Alternative for Generic Letter 88-01 Recommendations,@ January 15, 2002 (ML020160532).

The PDI program is routinely assessed by the NRC staff for consistency with the current ASME Code and proposed changes. The PDI program does not fully comport with the existing requirements of Supplement 11. PDI presented the differences at public meetings in which the NRC participated[3, 4]. The differences involve flaw location within test specimens and fabricated flaw tolerances. The changes in flaw location permitted using test specimens from the Tri-party Agreement and the changes in fabricated flaw tolerances provide UT acoustic responses similar to responses associated with intergranular stress corrosion cracking. The differences between the PDI program and Supplement 11 are presented in Table A2, "PDI Program Modifications to Appendix VIII Supplement 11," of Enclosure 1 of the submittal.

The NRC staff evaluated the differences identified in the PDI program with Supplement 11 in the September 13, 2007, submittal. The NRC staff concludes that the differences provide an acceptable level of quality and safety and are acceptable.

4.0 CONCLUSION

Based on the discussion above, the NRC staff concludes that the Code Case N-504-2 and N-638-1 modifications proposed for the preemptive full structural overlay of the welds listed in its September 13, 2007, submittal will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR Part 50, Section 50.55a(a)(3)(i), the NRC staff authorizes the proposed modifications for the remaining service life of the subject welds.

Secondly, based on the discussion above, the NRC staff concludes that the alternatives to ASME Appendix VIII, Supplement 11, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternatives for the remainder of the fourth 10-year ISI interval at ONS.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: T. Steingass

Date: January 17, 2008

---

3 US NRC Memorandum from Donald G. Naujock to Terence Chan, A Summary of Public Meeting Held June 12 through June 14, 2001, with PDI Representatives,@ November 29, 2001 (ML013330156).

4 US NRC Memorandum from Donald G. Naujock to Terence Chan, A Summary of Public Meeting Held January 31 - February 2, 2002, with PDI Representatives,@ March 22, 2002 (ML010940402).