Bryce L. Shriver
Senior Vice President and
Chief Nuclear Officer

PPL Susquehanna, LLC
769 Salem Boulevard
Berwick, PA 18603
Tel. 570.542.3120 Fax 570.542.1504
blshriver@pplweb.com

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U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station OP1-17
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SUSQUEHANNA STEAM ELECTRIC STATION
PROPOSED RELIEF REQUEST NO. 29 TO THE
SECOND 10-YEAR INSERVICE INSPECTION PROGRAM
FOR SUSQUEHANNA SES UNIT 1
PLA-5740 **Docket No. 50-387**

This letter requests NRC approval of Relief Request No. 29 in support of the current refueling and inspection outage to complete the Inservice Inspection repair plan within the scope of Generic Letter 88-01. This relief is requested under the provisions of 10 CFR 50.55a(a)(3)(i). The repair plan per the requirements of Generic Letter 88-01 for the recirculation outlet reactor pressure vessel (RPV) nozzle to safe-end weld will be used as an alternative to 10 CFR 50.55a(c)(3)(iv). The repair plan uses a weld overlay repair that represents an alternative to "American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code," Section XI Code repair.

A weldment associated with the recirculation outlet nozzle (N1B) has been inspected during the current refueling and inspection outage (U1 13th RIO). An indication has been identified and characterized as a circumferential planar flaw located in the Alloy 182 weld metal. A repair plan has been developed to restore the weldment to be able to meet or exceed original Code design requirements.

The repair plan includes use of ASME Code Cases N-638 and N-504-2. Certain exceptions taken to these two Code Cases have been approved by the ASME and have been approved by the Nuclear Regulatory Commission (NRC) in Regulatory Guide 1.147, Revision 13. Exceptions to Code Case N-504-1 (an earlier version of N-504-2), which are similar to PPL's request contained in this proposed Relief Request, have been approved by the NRC for the Duane Arnold Energy Center (NRC letter dated November 19, 1999), and more recently for Nine Mile Point Unit 2 (NRC letter dated March 30, 2000). This proposed Relief Request is similar to those submitted by Pilgrim on October 2, 2003 and by TMI on November 3, 2003. The repair plan presented by PPL in the Relief Request is an alternative to the requirements of 10 CFR 50.55a(c)(3)(iv).

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Based on the evaluations contained in the Relief Request, PPL has concluded that this alternative provides an acceptable level of quality and safety and that strict adherence to the specified requirements would result in unusual difficulty without a compensating increase in the level of quality and safety. Therefore, this proposed alternative satisfies the requirements of 10 CFR 50.55a(c)(3)(i) and 10 CFR 50.55a(c)(3)(iii).

Review and approval of the proposed Relief Request is requested by April 12, 2004.

There are no new commitments made in this letter. If you have any questions, please contact Mr. C. T. Coddington at (610) 774-4019.

Sincerely,

B. L. Shriver

Attachment – Relief Request No. RR-29

copy: NRC Region I
Mr. R. V. Guzman, NRC Project Manager
Mr. S. Hansell, NRC Sr. Resident Inspector
Mr. R. Janati, DEP/BRP

ATTACHMENT TO PLA-5740

RELIEF REQUEST NO. RR-29

PPL SUSQUEHANNA, LLC
SUSQUEHANNA SES UNIT 1
SECOND 10-YEAR INTERVAL
RELIEF REQUEST NO. RR-29

COMPONENT IDENTIFICATION

A full structural weld overlay repair is proposed for the N1B recirculation system outlet nozzle. The current configuration of this nozzle is described below.

The N1B recirculation outlet nozzle to safe-end configuration consists of a SA336 F8 safe-end welded to a SA 508 Cl 2 nozzle. The end of the nozzle was buttered with Alloy 182 weld deposit and subsequently joined with a weld having an Alloy 82 root and hot passes with Alloy 182 fill.

EXAMINATION AND REPAIR REQUIREMENTS

A weld overlay repair has been designed consistent with the requirements of NUREG 0313 Revision 2 (which was implemented by Generic Letter 88-01), ASME Code Case N-504-2, and ASME, Section XI, Paragraph IWB-3640, 1989 Edition with Appendix C (1989 Addenda).

WELDER QUALIFICATION AND WELDING PROCEDURES

All welders and welding procedures will be qualified in accordance with ASME Section IX and any special requirements from Section XI or applicable code cases. A manual shielded metal arc weld (SMAW) procedure will be qualified to facilitate localized repairs and to provide a seal weld, prior to depositing the overlay, should the defect be deep enough to be near through-wall or through-wall and leaking. This procedure will make use of SMAW electrodes ENiCrFe-7, UNS W86152, F No. 43, known commercially as Alloy 152. The weld overlay repair will be performed by qualified personnel from WSI. Welding Procedure Specification (WPS 03-08-T-801, Rev. 0) for welding ERNiCrFe-7, UNS N06052, F No. 43 (commercially known as Alloy 52) will be used.

Welding Wire Filler Material

A consumable welding wire highly resistant to intergranular stress corrosion cracking (IGSCC) and interdendritic stress corrosion cracking (IDSCC) was selected for the overlay material. This material, designated UNS N06052 F No. 43 is a nickel-based weld filler material, commonly referred to as Alloy 52, and will be applied using the GTAW (Gas Tungsten Arc Welding) Machine TIG process. Alloy 52 is identified in ASME Section II, Part C as SFA-5.14, ERNiCrFe-7, classification UNS N06052 F No. 43 Filler Material. Alloy 52 contains a nominal 30% Cr that imparts excellent resistance to IGSCC. Where localized repairs are required, Alloy 152 may be used. Alloy 152 is identified in ASME Section II, Part C as SFA-5.11, ENiCrFe-7, classified as UNS W86152. Alloy 152 also contains a nominal 30% Cr that imparts excellent resistance to IGSCC.

Weld Overlay Design

The weld overlay will extend around the full circumference of the safe end to nozzle location in accordance with NUREG 0313 Rev. 2, Code Case N504-2, and Generic Letter 88-01. The overlay length will extend across the projected indication intersection with the outer pipe surface. The design thickness and length will be computed according to guidance provided in ASME Section XI, Code Case N-504-2 and ASME Section XI Paragraph IWB-3640, 1989 Edition with Appendix C (1989 Addenda). The overlay completely covers the defect location and other Alloy 182 susceptible material areas with the highly corrosion resistant Alloy 52 material. A temper bead welding approach will be used for this repair, because it will be necessary to weld on the P3 Group 3 low alloy steel (LAS) nozzle material. ASME Code Case N-638 will be applied because it provides for machine (GTAW) temper bead weld repairs to P3 Group 3 materials at ambient temperature using dissimilar materials and without need for post weld heat treatment. The temper bead approach was selected because temper bead welding supplants the requirement for post weld heat treatment (PWHT) of heat affected zones in welded low alloy steel (LAS) material. Temper bead techniques produce excellent toughness and ductility in heat affected zones of the LAS. This approach provides a comprehensive weld overlay repair, and increases the volume of material under the overlay that can be inspected. The weld overlay length will conform to the guidance of Code Case N-504-2, which satisfies the stress requirements.

Examination Requirements

The examination requirements for the weld overlay repairs are summarized in the following table. *Note: No post weld inspections may be performed until after a 48 hour waiting period has elapsed after completing the weld. This is required to be able to identify any possible hydrogen delayed cracking that might occur.*

EXAMINATION REQUIREMENTS			
Examination Description	**Method**	**Technique**	**Reference**
Weld and Safe-End Overlay Surface Preparation Exam	PT	Visible Dye	N-504-2
Thickness Measurements	UT	0° Long.	N-504-2
As-Found Exam	Auto UT	45° Ref. Long. 60° Ref. Long. 70° Ref. Long.	IWB-3514
As-Found Sizing	Auto UT	60° Ref. Long. 70° Ref. Long.	IWB-3514
First Weld Overlay Layer Surface Exam	PT	Visible Dye	N-504-2
First Weld Overlay Thickness Checks	UT	0° Long, or Hand Meas.	N-504-2
Surface Exam of Nozzle within 1.5 t of Weld overlay	PT	Visible Dye	NB-5350 N-638
Surface Exam of Completed Overlay	PT	Visible Dye	N-504-2
Exam of Completed Overlay for Lack-of-Bond and Thickness	UT	0° Long.	IWB-3514 N-504-2
Volumetric Exam of Nozzle within 1.5 t of Weld Overlay	UT	In accordance with Appendix I. Nozzle geometry may limit this examination.	IWB-3500 N-638
Volumetric Exam of Completed Overlay	UT	Angle beam exam in accordance with qualified P.D.I. procedure implementing Appendix VIII.	IWB-3514 N-504-2
Pre-Service Exam of Completed Overlay and the Outer 25% of the underlying pipe wall to identify the original flaws.	UT	Angle beam exam in accordance with qualified P.D.I. procedure implementing Appendix VIII.	IWB-3514 N-504-2

General Note: The Edition and Addenda for the ASME Section XI acceptance criteria is the 1989 Edition with no Addenda. The weld overlay examinations comply with the recommendations of NUREG-0313, Revision 2, and also with Code Case N-504-2.

There is no ASME Section III Subsection that directly applies to inspection acceptance criteria for weld overlays. NUREG-0313 and Code Case N-504-2 specify an ultrasonic volumetric examination, using methods and personnel qualified through the EPRI NDE Center. Furthermore, NUREG-0313 states that the ultrasonic examinations should be performed in accordance with the requirements of the applicable edition of the ASME Code. The Code of record for the current 10-year in-service inspection interval is the 1989 edition of ASME Section XI with no Addenda. Therefore, the acceptance criteria that will be used for the volumetric examinations will be those of IWB-3514, "Standards for Examination Category B-F, Pressure Retaining Dissimilar Metal Welds, and Examination Category B-J, Pressure Retaining Welds in Piping."

Pressure Testing

The completed repair shall be given a system leakage, in-service or functional test in accordance with ASME Section XI, IWA-5000, provided the system pressure boundary has not been penetrated.

If for some reason the system pressure boundary is penetrated (such as a leaking crack or weld penetration to the crack tip) Code Case N-416-1 will be invoked with the following exception. N-416-1 requires NDE performed to the methods and acceptance criteria of the applicable Subsection of the 1992 Edition of Section III. As stated previously, there are no ASME Section III examination methods and acceptance criteria that directly apply to weld overlays. Therefore, the NDE will be performed using the methods and acceptance criteria specified by Code Case N-504-2 and this repair plan. N-416-1 requires a system leakage test in conjunction with a visual examination (VT-2) using 1992 Edition of Section XI in accordance with Paragraph IWA-5000 at normal operating pressure and temperature. Finally, use of this Code Case is to be documented on a NIS-2 Form.

Unusual Difficulty in Meeting Specified Requirements

Preheat and post weld heat treatments (PWHT) are required for welding on P3 Group 3 LAS nozzle material by ASME Section III, Subparagraph NB4622.7. These requirements are impractical without draining the reactor vessel, and may even distort the P3 components involved (nozzle and reactor pressure vessel). To drain the vessel requires a full-core fuel offload. If the vessel were drained, the radiation dose rates around the nozzle would increase significantly, resulting in additional personnel exposure. Therefore, consistent with ALARA practices and prudent utilization of outage personnel, there will be no vessel drain down for this repair. The weld overlays will be completed with water on the inside surface of the nozzles and connected piping. This approach (i.e., no vessel drain down) minimizes fuel movement and thereby enhances nuclear safety.

The alternative, as described below, provides an acceptable level of quality and safety while neither draining the reactor vessel nor applying preheat and post weld heat treatments. Therefore, the alternative alleviates the impracticality of following certain code requirements for this repair activity.

ALTERNATIVE FROM REPAIR REQUIREMENTS

The repair will utilize ASME Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping," and Code Case N-638, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper bead Technique," with the following exceptions and clarifications.

Clarification of Code Case N-504-2 for Applicability to Nickel-based Austenitic Steel

Code Case N-504-2 was prepared specifically for austenitic stainless steel material. An alternate application to nickel-based austenitic materials (i.e. Alloy 52) is requested due to the specific configuration of the nickel-based austenitic weldment.

Exception to Code Case N-504-2 Paragraph (b)

Code Case N-504-2 paragraph (b) requires that the reinforcement weld metal shall be low carbon (0.035% maximum) austenitic stainless steel. A nickel-based filler is required and Alloy 52 has been selected in place of low carbon austenitic stainless steel.

Exception to Code Case N-504-2 Paragraph (e)

Code Case N-504-2 paragraph (e) requires as-deposited delta ferrite measurements at least a 7.5 FN for the weld reinforcement. These measurements are not to be performed for this overlay, as the nickel filler is a fully austenitic material, containing no ferrite.

Exception to Code Case N-504-2 Paragraph (h)

Code Case N-504-2 paragraph (h) requires a system hydrostatic test of completed repairs if the repaired flaw penetrated the original pressure boundary or if there is any observed indication of the flaw penetrating the pressure boundary during repairs. A system leak test of completed repairs will be used in lieu of a hydrostatic test.

Clarification of Code Case N-638 Applicability

Code Case N-638 shall be applied to the P3 Group 3 LAS nozzle material.

Exception to Code Case N-638 Paragraph 1(a)

Code Case N-638 paragraph 1(a) requires the maximum area of an individual weld based on the finished surface shall be 100 square inches. The area for the temper bead weld in this weld overlay design will be approximately 300 square inches.

BASIS FOR THE ALTERNATIVE

Clarification of Code Case N-504-2 for Applicability to Nickel-based Austenitic Steel

The weldment being addressed is austenitic material having a mechanical behavior similar to austenitic stainless steel. The weldment is designed to be highly resistant to IGSCC and is compatible with the existing weldment and base metal materials. Accordingly, this alternative provides an acceptable level of quality and safety. Therefore, Code Case N-504-2 should be interpreted to apply equally to both materials.

Exception to Code Case N-504-2 Paragraph (b)

A consumable welding wire highly resistant to IGSCC was selected for the overlay material. This material, designated UNS N06052 F No. 43 is a nickel-based alloy weld filler material, commonly referred to as Alloy 52, and will be applied using the GTAW process. Alloy 52 contains nominally 30% chromium that imparts excellent corrosion resistance to IGSCC. By comparison, Alloy 82, is identified as an IGSCC resistant material in NUREG 0313 Revision 2 and contains nominally 20% chromium while Alloy 182 has a nominal chromium composition of 15% chromium. Alloy 52 with its high chromium content provides a high level of resistance to IGSCC consistent with the requirements of the code case. Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-504-2 Paragraph (e)

The composition of nickel-based Alloy 52 is such that delta ferrite does not form during welding. Ferrite measurement requirements were developed for weld deposits of the 300 series stainless steels that require delta ferrite to develop resistance to IGSCC. Welds of Alloy 52 or Alloy 152 are 100% austenitic and contain no delta ferrite due to the high nickel composition (approximately 60% nickel and low iron content). Alloy 52 with its high chromium content provides a high level of resistance to hot cracking and IGSCC consistent with the purpose for the delta ferrite requirements for stainless steels of the code case. Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-504-2 Paragraph (h)

In lieu of the hydrostatic pressure test requirements defined in Code Case N-504-2, the required pressure test shall be performed in accordance with the Second 10-year Interval ISI Program Plan and Code Case N-416-1 with the exception that the volumetric examination performed shall be an ultrasonic examination of the weld overlay.

Clarification of Code Case N-638 Applicability

Code Case N-638 was developed for temper bead applications to similar and dissimilar metals. It permits the use of machine (GTAW) welding at ambient temperature without the use of preheat or PWHT on Class 1, 2, and 3 components.

Temper bead welding methodology is not new. Numerous applications over the past decade have demonstrated the acceptability of temper bead technology in nuclear environments. Temper bead welding achieves heat affected zone (HAZ) tempering and grain refinement without subsequent PWHT. Excellent HAZ toughness and ductility are produced. Use of Code Case N-638 has been accepted in Regulatory Guide 1.147 Revision 13 as providing an acceptable level of quality and safety.

A 48-hour post weld hold prior to acceptance inspection is required by Code Case N-638 and will be done to assure that no delayed cracking occurs.

Exception to Code Case N-638 Paragraph 1(a)

Cold Case N-638 specifies a limit of 100 square inches for a temper bead weld. Because of the diameter of nozzle N1B (30 3/32"), this restriction would limit the weld overlay length to 1 1/16" on the LAS nozzle material. This distance could be justified as adequate axial length to provide for load redistribution from the weld overlay back into the nozzle without violating applicable stress limits of Section III for primary local and bending stresses and secondary peak stresses. However, this axial length will not permit a complete examination of the outer 25% of the nozzle thickness as required by Code Case N-504-2. In order to perform a qualified exam of the required volume, the axial length of the overlay on the LAS nozzle will be extended to 3 1/8", encompassing an area of 300 square inches for the temper bead weld.

CONCLUSION

Weld overlays involve the application of weld metal circumferentially around the pipe in the vicinity of the flawed weld to restore ASME Section XI margins. Weld overlays have been used in the nuclear industry as an acceptable method to repair flawed welds. The use of overlay filler material, which provides excellent resistance to IGSCC, develops an effective barrier to crack extension by corrosion processes.

The piping and other components have been evaluated (to the original ASME design code requirements) for the effects due to shrinkage induced into the system during installation of the overlay. The actual shrinkage will be measured. All required documents will be reconciled to the original design code, and updated to reflect these as-built values.

The design of the overlay for the nozzle safe-end uses methods that are standard in the industry for size determination of pipe-to-pipe overlays. There are no new or different approaches used in this overlay design which are considered first of a kind or inconsistent with previous approaches. The overlay is designed as a full structural overlay in accordance with the recommendation of NUREG 0313 Revision 2, which was implemented by Generic Letter 88-01 and by Code Case N-504-2 and ASME Section XI Paragraph IWB-3640, 1989 Edition with Appendix C (1989 Addenda).

Temper bead techniques, as defined by Code Case N-638, will produce the tough corrosion resistant overlay deposit that meets or exceeds all code requirements for the weld overlay.

PPL concludes that the repair plan is justified and presents an acceptable level of quality and safety to satisfy the requirements of 10 CFR 50.55a(c)(3)(i). Furthermore, this evaluation demonstrates that compliance with the 1989 Edition of ASME Section XI with no addenda (the current Code of record for Susquehanna Unit 1) would result in unusual difficulty without a compensating increase in the level of quality and safety pursuant to 10 CFR 50.55a(c)(3)(ii)

A similar proposed alternative to the requirements of 10 CFR 50.55a(c)(3)(iv) has been approved previously by the NRC for the Duane Arnold Energy Center by NRC letter dated November 19, 1999 and for Nine Mile Point Unit 2 by NRC letter dated March 30, 2000. Also, a similar proposed alternative to the requirements of 10 CFR 50.55a(c)(3)(iv) has been submitted by Pilgrim on October 2, 2003 and by TMI on November 3, 2003,

DURATION OF PROPOSED ALTERNATIVE

The proposed alternative applies to the repairs of RPV nozzle to safe-end weld for the scheduled outage and for the remaining service life of this weld.