PSE&G

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Nuclear Business Unit

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United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Ladies & Gentlemen:

ASME BOILER AND PRESSURE VESSEL CODE
REVISED SUPPLEMENT TO RELIEF REQUEST FOR ALTERNATIVES TO THE WELDING RESTRICTIONS IN THE 1989 EDITION OF THE ASME CODE FOR STATION SERVICE WATER PUMPS
SALEM AND HOPE CREEK GENERATING STATIONS
DOCKET NOS. 50-272, 50-311, AND 50-354

In response to a telecon held on April 23, 1997 between M. Banic of the NRC and Public Service Electric & Gas (PSE&G) representatives, PSE&G is providing the requested revised supplementary information necessary to support approval of PSE&G's relief request dated December 12, 1996. Further, this letter restates all of the original subject matter provided as technical justification which had been previously submitted in a letter dated March 20, 1997.

Specifically, this revised letter is provided to support relief from an existing commitment to Post Weld Heat Treat (PWHT) weld repairs made to SA-351 Grade CD4MCu material for the Service Water pumps at Salem and Hope Creek. This relief request would alternatively allow weld repairs made to SA-351 Grade CD4MCu material in the Service Water pumps to be performed on-site or off-site without PWHT. This relief, if granted, would then be consistent with the 1995 edition of the ASME Code, which neither requires nor prohibits PWHT for weld repairs of CD4MCu material.

Background

PSE&G has installed SA-351 Grade CD4MCu Service Water pumps in place of the originally installed aluminum bronze material due to improved overall corrosion/wear resistance of the service water pumps. This material is currently installed in the Salem Service Water pumps and the Hope Creek Service Water pumps. The Service Water pumps are submerged vertical pumps located in a partial saline (e.g. brackish) environment that exhibits silt content. The potential for corrosion is more probable on the exterior pump surfaces due to the river water chemistry and the lower flow conditions, while the

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pump internals exposed to higher velocity flows are more prone to erosion due to the silt and particulate content of the water.

Based upon a visual inspection of the Salem CD4MCu Service Water pump castings after 18 months of service, PSE&G concluded that the CD4MCu material demonstrated good corrosion/wear resistance to both expected degradation mechanisms.

Reason for Request

The specific circumstances under which PSE&G proposes to perform on-site or off-site weld repairs to CD4MCu material without PWHT are: 1) to support potential emergent plant conditions, and 2) to repair cavities or indications found after machining during the manufacturing process.

To support potential emergent plant conditions, on-site or off-site weld repairs to CD4MCu material without PWHT would be performed to support the expeditious return to service of the Station Service Water System within the Allowed Outage Times (AOT) imposed by the station Technical Specifications and avoid the associated risk of a plant shutdown transient. Although weld repairs of CD4MCu without PWHT potentially reduce corrosion resistance, repairs without PWHT facilitate the timely return to service of the Service Water System within its AOT.

In addition, PWHT at a temperature of 1900-2050°F performed for weld repairs of machined castings could affect the machined tolerances and result in an unusable pump casting. Due to the long lead time to manufacture new castings, weld repair without PWHT would support return of the Station Service Water System to service in a timely manner.

Justification for Request

Post Weld Heat Treatment of weld repairs is performed to restore the optimum toughness and corrosion resistance properties of the CD4MCu duplex phase material, particularly in the Heat Affected Zone (HAZ). PSE&G recognizes that PWHT of weld repairs to CD4MCu is desirable in order to achieve a HAZ with a mix of 50% austenite and 50% ferrite. However, the structural properties (e.g., Ultimate Tensile Strength (UTS), and Yield Strength (YS)) of the CD4MCu material including the weld deposition area and HAZ are not detrimentally affected by weld repairs that are not PWHT for the application of this material at Salem and Hope Creek. The UTS and YS are utilized for the establishment of the design allowable stresses and consequently afford the inherent margins of safety. (See Tables 1 and 2 below.)

Base Metal Characteristics

The tensile test results of the foundry's welding procedure qualification records for the Hope Creek castings are shown in Table 1 below.

Table 1 - Weld Joint Tensile Test Data			
PWHT	UTS (ksi)	YS (ksi)	Break Location
No	121/121	94/96	Base Metal
Yes	111-115	79-84	Base Metal
SA/A 351 Grade CD4MCu specs	100 minimum	70 minimum	

The tests utilized filler metal with compositions similar to that of E2553 electrodes used in the weld repair of CD4MCu castings. The data shows that the strength of the base metal is higher without PWHT, and still meets the base metal mechanical properties. The weld joint tensile specimens broke in the base metal indicating the weld metal and the HAZ are stronger than the base metal.

Filler Metal Characteristics

The filler metal chemical composition is designed to provide the desired 50% ferrite and 50% austenite microstructure and associated mechanical properties in the as-welded condition and the PWHT condition. The tensile tests results of the E2553 filler metal from the Hope Creek material test reports are shown in Table 2 below.

Table 2 - E2553 Filler Metal Tensile Test Data				
PWHT	UTS (ksi)	YS (ksi)	Elongation (%)	Ferrite (%)
Yes	115-123	73-83	28-31	--
No	125-130	87-106	17-27	47-62
SFA 5.4 specs	110 minimum	--	16 minimum	--

The above data was the result of testing of 4 different lots of E2553 filler metal. The tensile strength of the filler metal is higher and elongation is lower without PWHT. The ferrite range in the as welded condition is from 47% to 62% which approaches the desired 50% range. The filler metal's higher nickel content and addition of nitrogen to the filler metal, which are austenite promoters, result in the desired dual phase microstructure in the weld metal. The mechanical properties of the filler metal meet the base metal

requirements for CD4MCu material and the SFA 5.4 Classification E2553 filler metal specifications. Therefore, the structural integrity of the CD4MCu Service Water pump castings would not be compromised by either on-site or off-site weld repairs without PWHT.

Heat Affected Zone (HAZ) Characteristics

The HAZ in the as-welded state contains a narrow zone which may exhibit little or no austenite with a resultant reduction in corrosion resistance and toughness. Regarding toughness, an example of the toughness that can be expected is shown in the foundry's welding procedure qualification records. These records show values of 27-29 ft/lb at +28°F when PWHT was not performed following weld repairs. This toughness exceeds the 1989 and 1995 editions of the ASME III, Class 3, requirement of 20 ft/lb average for the CD4MCu yield strength range.

Based on metallurgy literature, it is reasonable to expect that the principal degradation mechanism (i.e. corrosion) following any weld repairs without subsequent PWHT would first manifest in the localized area of the HAZ as pitting corrosion due to the brackish water chemistry. The dual phase microstructure, ferrite plus austenite, and possible predominately ferrite microstructure in a HAZ without PWHT would preclude IGSCC which is expected in fully austentic stainless steels that have been sensitized. Weld repairs without PWHT should have little effect on erosion due to particulate flow, since the as-welded tensile strength which is related to wear is not reduced. In this postulated condition, the effect is expected to be a localized attack versus a large general surface area reduction of the CD4MCu pump casting.

The SW pumps are low energy systems that operate at ambient (river water) temperatures. Consequently, with the given service conditions and expected degradation mechanisms, there is no evidence to support that there would be any reduction of structural integrity that would lead to a catastrophic consequence.

Alternate to PWHT

Under this proposed relief request, a sample of weld repairs that are performed without PWHT would be visually inspected within the first 18 months following the repair in order to establish corrosion trend information. These visual inspections would be performed directly on the surface areas of the completed weld repairs (i.e., either on the exterior or interior of the pump casting). These inspections would be conducted with or without pump disassembly, depending on the actual location of the weld repairs and the

accessibility to the pump interior without disassembly (e.g., use of mirrors, optical equipment, etc.). Based upon the initial visual examination results and the establishment of degradation trends, if any, subsequent examinations may be continued, reduced in frequency, or discontinued.

Conclusion

The desirable properties of the CD4MCu material are: 1) wear resistance (i.e., abrasion resistance against the silt in the service water), and 2) corrosion resistance from the brackish service water. The wear characteristics are not expected to change as a result of repair without PWHT, since the as-welded strength and hardness are similar to the base metal. However, the corrosion properties may be diminished following weld repairs without PWHT in localized areas associated with the HAZ. A sample of the weld repairs performed on the CD4MCu Service Water pump castings, that have not been PWHT will be visually inspected initially within the first 18 months following installation of the pump casting to establish corrosion trends. Future examinations will be continued, adjusted in frequency or discontinued, based upon established corrosion trend data. PSE&G believes that the above technical justification is appropriate and provides an equivalent level of safety to ensure that the structural integrity of the Service Water pump castings is reliably maintained.

Should there be any questions with regard to this submittal, please do not hesitate to contact us.

Sincerely,

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