November 30, 2007

Mr. James J. Sheppard
President and Chief Executive Officer
STP Nuclear Operating Company
South Texas Project Electric
Generating Station
P. O. Box 289
Wadsworth, TX 77483

SUBJECT: SOUTH TEXAS PROJECT, UNIT 2 - RE: RELIEF REQUEST RR-ENG-2-47 FOR APPROVAL OF TEMPORARY NON-CODE REPAIR AND DEFERRAL OF CODE REPAIR OF DEGRADED ESSENTIAL COOLING WATER SYSTEM PIPING (TAC NO. MD6189)

Dear Mr. Sheppard:

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed and evaluated the information provided by STP Nuclear Operating Company (the licensee) in its letter dated November 15, 2006, as supplemented by letter dated October 23, 2007. Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 55a, paragraph (g)(5)(iii), the licensee requested relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, Article IWA-5250(a)(3), and proposed to defer permanent Code repair of degraded Essential Cooling Water (ECW) system piping at South Texas Project (STP), Unit 2. The ECW system is classified as an ASME Code Class 3 system and the licensee proposed to defer the permanent Code repairs for the ECW system piping until the next Unit 2 refueling outage, scheduled to begin in March 2007.

The Unit 2 refueling outage occurred in March 2007, at which time the degraded ECW piping was restored to ASME Code Class 3 requirements. Therefore, the licensee's requested relief is now moot. However, the deferral would have been acceptable, based on the NRC staff's determination that implementing a permanent ASME Code repair would have resulted in a hardship without a compensating increase in the level of safety and quality, because there was a reasonably high likelihood that the plant would need to be shut down in order to complete the repair, and that the licensee's proposed alternative provided reasonable assurance of structural integrity.

Based on the NRC staff's review of the information provided in the licensee's submittal, the staff concludes that the licensee's proposed alternative prior to completion of the ASME Code repair would have been acceptable. Therefore, the alternative would have been authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for the period from November 15, 2006, through March 2007.

All ASME Code, Section XI, requirements remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector. The NRC staff's safety evaluation is enclosed.

Sincerely,

/RA/

Thomas G. Hiltz, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-498

Enclosure: Safety Evaluation

cc: See next page

All ASME Code, Section XI, requirements remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector. The NRC staff's safety evaluation is enclosed.

Sincerely,

/RA/

Thomas G. Hiltz, Chief
Plant Licensing Branch IV
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Enclosure: Safety Evaluation

cc: See next page

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OFFICE	NRR/LPL4/PM	NRR/LPL4/LA	CPNB/BC	OGC	NRR/LPL4/BC
NAME	MThadani	JBurkhardt*	TChan*	JRund	THiltz Jack Donohew for
DATE	11/26/07	11/13/07	11/26/07	11/30/07	11/30/07

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST RR-ENG-2-47 FOR APPROVAL OF TEMPORARY

NON-CODE REPAIR AND DEFERRAL OF CODE REPAIR OF DEGRADED

ESSENTIAL COOLING WATER SYSTEM PIPING

STP NUCLEAR OPERATING COMPANY

SOUTH TEXAS PROJECT, UNIT 2

DOCKET NO. 50-499

1.0 INTRODUCTION

By letter dated November 15, 2006, as supplemented by letter dated October 23, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML063250344 and ML073100377, respectively), STP Nuclear Operating Company (the licensee) submitted relief request RR-ENG-2-47 for U.S. Nuclear Regulatory Commission (NRC) approval. Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii), the licensee proposed to defer permanent American Society for Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) repair of a degraded Essential Cooling Water (ECW) system piping at its South Texas Project (STP), Unit 2, until adequate time was available for the repair, but no later than the next scheduled refueling outage, which was scheduled to begin March 2007. The licensee requested relief because the proposed temporary non-Code repair deviates from the requirements of ASME Code, Section XI, Article IWA-5250(a)(3).

The licensee stated that a through-wall de-alloying indication was found on the cast aluminum-bronze ECW tee on July 6, 2006, during the periodic examination of ECW large bore piping. Unit 2 was in Mode 1 at 100 percent power when the flaw was found. The ECW system is designed to supply cooling water to various safety-related systems for normal plant operation, normal shutdown, and during and after postulated design-basis accidents. The ECW system is classified as an ASME Code Class 3 system. The ASME Code, Section XI, 1989 Edition, is used for the Repair and Replacement program activities at STP, Unit 2, during its second 10-year inservice inspection (ISI) interval.

2.0 REGULATORY EVALUATION

As specified in 10 CFR 50.55a(g), ISI of nuclear power plant components shall be performed in accordance with the requirements of ASME Code, Section XI, except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Pursuant to 10 CFR 50.55a(a)(3), alternatives to the requirements of paragraph (g) may be used when

authorized by the NRC if (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. As stated in 10 CFR 50.55a(g)(5)(iii), if the licensee has determined that conformance with certain Code requirements is impractical for its facility, the licensee shall notify the Commission and submit, as specified in Section 50.4, information to support the determinations.

The licensee's requested relief is now moot because the Unit 2 refueling outage occurred in March 2007, at which time the degraded ECW piping was restored to ASME Code Class 3 requirements. However, the information provided by the licensee in support of its relief request has been evaluated by the NRC staff.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Relief Request RR-ENG-2-47

3.1.1 Component for Which Relief Was Requested

(a) Description:

Cast aluminum ECW tee connecting lines 10"EW-2106-WT3 (cooling water supply header to standby diesel generator #21) and 4"EW-2129-WT3 (Lube Oil Cooler Supply Line).

(b) Function:

The Essential Cooling Water System is designed to supply cooling water to various safety-related systems for normal plant operation, normal shutdown, and during and after postulated design-basis accidents.

(c) Class:

ASME Code Class 3

(d) Description of the flaw:

An indication of through-wall dealloying was found on the cast aluminum-bronze ECW tee connecting lines 10"EW-2106-WT3 (cooling water supply header to standby diesel generator #21) and 4"EW-2129-WT3 (Lube Oil Cooler Supply Line). The dealloying indication was a spot with residue buildup at the bottom of the tee. The flaw appeared to be porous, dealloyed pipe material, with no measurable leakage.

3.1.2 Applicable Code Edition and Addenda:

ASME Code, Section XI, 1989 Edition.

3.1.3 Applicable Code Requirement:

Relief from the requirements of ASME Section XI IWA-5250(a)(3) was requested so that code repair of the through-wall flaw at this location may be deferred until the next outage of sufficient duration but not later than the next refueling outage provided the conditions of Generic Letter 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2 and 3 Piping," were met.

3.1.4 Flaw Detection

The flaw was identified on July 6, 2006, during the periodic examination of ECW large bore piping. Unit 2 was in Mode 1 at 100% power.

3.1.5 Impracticality Determination

As stated in Generic Letter 90-05, an ASME Code repair is required for Code Class 1, 2, and 3 piping unless specific written relief is granted by the NRC. Relief is appropriate when performing the repair at the time of discovery is determined to be impractical.

A repair is considered to be impractical if:

- The flaw detected during plant operation is in a section of Class 3 piping that cannot be isolated to complete a code repair within the time period permitted by the limiting condition for operation of the affected system as specified in the plant Technical Specifications, and

- Performance of code repair necessitates a plant shutdown.

Performance of code repairs within the allowed outage time for the ECW system, as permitted by the limiting condition for operation, was not practical due to the amount of time required to implement the repair, and the potential for fit-up problems during repair. A plant shutdown may have been necessary to complete the repair. Therefore, relief was requested on the basis of impracticality.

3.1.6 Proposed Alternative and Basis for Use

3.1.6.1 Proposed Alternative

Repair of the defect was deferred until adequate time was available for the repair, i.e., the next Unit 2 refueling outage. The next Unit 2 refueling outage began in March 2007. Compensatory action was implemented to detect changes in the condition of the flaw.

3.1.6.2 Basis for Use

- Scope

  An indication of through-wall dealloying in Unit 2 was identified on the cast aluminum-bronze ECW tee connecting lines 10"2106-WT3 (cooling water supply header to standby diesel generator #21) and 4"W-2129-WT3 (Lube Oil Cooler Supply Line). The flaw was measured to be approximately ½" long at outside surface of the ECW pipe. The flaw appeared to be porous dealloyed structure as the leakage was not readily measurable. There was no active measurable leakage.

- Specific Considerations

  Consequences of potential system interactions, including flooding, spray on equipment, and loss of flow to the system, are addressed in Appendix 9A of the South Texas Project Updated Final Safety Analysis Report, "Assessment of the Potential Effects of Through-Wall Cracks in ECWS Piping."

  The ECW system is a low-pressure system with normal operating pressures of approximately 50 psig [pounds per square inch gauge] and a design pressure of 120 psig. Therefore, the consequences associated with failure of high-energy lines are not applicable to this relief request.

  The structural integrity was monitored by the following methods:

  - Monthly monitoring for qualitative assessment of leakage (quantitative if measurable leaks are observed). There was no measurable leakage.

  - Continuation of large bore ECW piping periodic walkdowns. These walkdowns are regularly scheduled VT-2 examinations. The inspection technique has proven to be an effective means of identifying dealloyed/cracked components prior to deterioration of structural integrity margins below ASME [Code] Section XI requirements.

  Structural integrity and the monitoring frequency were to be re-evaluated if significant changes in the condition of the dealloyed area were found during this monitoring.

- Root Cause Determination

  The root cause of dealloying is a combination of corrosion and stress. The dealloying process normally initiates from a crevice such as the area behind a

backing ring, a fabrication-induced flaw, or a casting flaw. Dealloying in this case is believed to be similar to dealloying seen in other susceptible aluminum-bronze components. The process by which dealloying of aluminum-bronze occurs has been described in previous communications with the NRC [Status of Corrective Actions in the ECW System, M. A. McBurnett to Document Control Desk, dated November 1, 1988 (ST-HL-AE-2748)].

- Flaw Evaluation

In assessing the structural integrity of partially dealloyed aluminum-bronze piping components, a conservative evaluation was performed to assure that adequate margins remain. This was accomplished by evaluating the condition where the dealloyed region is assumed to have lost its load carrying capacity and will behave like a crack-like flaw. Under these conditions, flaw evaluation procedures similar to Section XI of the ASME Code were applied.

Unlike some carbon steels and low-alloy steels, aluminum bronze is inherently ductile and tough. This stems from its crystal structure which is like that of Type 304 stainless steel. Thus, the fracture resistance of aluminum bronze is expected to be high and the affected fittings are relatively insensitive to material flaws such as cracks.

Aluminum-bronze is not expected to behave in a non-ductile manner; however, linear elastic fracture mechanics (LEFM) have established the load carrying capacity of partially dealloyed fittings when treating the dealloyed region as a crack-like flaw. When LEFM principles are applied, flaw tolerance can be quantified in terms of applied stress, flaw size and shape, and the material fracture toughness. Conservative values for fracture toughness and conservative representation of the size and extent of dealloying as a flaw give a conservative determination of the structural capacity.

The structural integrity of the flanged piping was assessed using the “through-wall flaw” evaluation approach provided in Section C.3.a of Enclosure 1 to NRC Generic Letter 90-05. This approach evaluates the flaw stability by LEFM methodology. To summarize the results:

s = predicted bending stress at the flaw location
s = 4.8 ksi (kilopounds per square inch)
K = stress intensity factor
K = 8.1 ksi-in$^{1/2}$

For flaw stability, this methodology specifies “K” should be less than the critical stress intensity factor which represents the fracture toughness of the material. The fracture toughness of the aluminum-bronze ranges from 63.5 to 95.1 ksi-in$^{1/2}$.

Stresses	Pressure + Dead Weight	Faulted	Thermal
Stress (psi)	1187	951	2489
Allowable Stress (psi)	7500	18000	11250
Safety Margin	6.3	18.92	4.5

The calculated safety margins are adequate for the various loading conditions.

- Augmented Inspection

  Augmented monthly inspections were performed to detect changes in the size of the discolored area or leakage. Structural integrity and the monitoring frequency would have been re-evaluated if significant changes in the condition of the dealloyed area were found during this monitoring.

- Licensee's Conclusion

  The licensee has analyzed through-wall flaws in ECW piping and found that degradation progresses slowly. Dealloying produces detectable leakage before flaws reach a limiting size that would affect the operability of the Essential Cooling Water System. Rapid or catastrophic failure due to dealloying is not a concern. Flaws are monitored and inspected to ensure detection of leakage. Continued inspection provides assurance that changes in the condition of the flaws will be identified and assessed for further action as needed. Evaluation of the flaw using the fracture mechanics methodology provided by NRC Generic Letter 90-05 concluded that the structural integrity of the ECW piping was not adversely affected. Operability and functionality of the system were maintained, and deferring repair of the flaw did not affect the health and safety of the public.

3.1.7 Duration of Proposed Alternative

Repair of the defect was deferred until the next Unit 2 refueling outage.

3.2 Staff Evaluation

The licensee stated that on July 6, 2006, a through-wall dealloying indication was found during the periodic examination of the large bore piping on the ECW system at its STP, Unit 2. At the time of finding the flaw, Unit 2 was in Mode 1 at 100 percent power. The flaw was located at the cast aluminum-bronze ECW tee connecting lines 10"EW-2106-WT3 (cooling water supply header to standby diesel generator #21) and 4"EW-2129-WT3 (Lube Oil Cooler Supply Line). The flaw comprised of a circular area about one-half inch in diameter with a residue buildup at

the bottom of the tee. The surface of the flaw had a porous appearance with no measurable leakage. The root cause for the dealloying was attributed to a combination of corrosion and stress. The dealloying most likely was initiated from a crevice such as the area behind a backing ring, a fabrication-induced flaw, or a casting flaw. Dealloying in this case is believed to be similar to dealloying seen in other susceptible aluminum-bronze components. The rate of dealloying progression is generally very slow and therefore, will not lead to a catastrophic failure of the degraded component with proper monitoring.

The licensee implemented augmented monthly inspections to detect changes in the size of the dealloyed area or increase in leakage. Structural integrity and the monitoring frequency would have been re-evaluated if significant changes in the condition of the dealloyed area were found during this monitoring. In its supplemental letter, the licensee stated that further evaluation would have been needed if any of the following occurred: (1) change from residue buildup to active dripping, (2) new indication at a different area on the component; or (3) a substantial change (about 2 times or more) in the size of the original indication. The staff would have found the licensee's temporary non-Code repair acceptable because the leakage is not readily measurable and because the licensee has implemented monthly inspections to detect changes in the size of the flaw or increase in leakage.

To assess the structural integrity of the flawed piping, the licensee evaluated the piping using the "through-wall flaw" evaluation approach as delineated in the NRC Generic Letter 90-05. The results of the licensee's flaw evaluation have shown the presence of substantial safety margins (ranging from 4.5 to 18.92) for the various loading conditions. The licensee also performed the evaluation of flaw stability using linear elastic fracture mechanics (LEFM) methodology. The calculated stress intensity factor at the flaw location (8.1 ksi-in$^{1/2}$) is much less than the critical stress intensity factor of the aluminum bronze material (63.5 ksi-in$^{1/2}$). Therefore, the flaw was not expected to grow to sizes large enough to cause a failure in the period for which the relief was requested. Furthermore, cracks were expected to be detected well before they reached a size sufficient to result in failure. The staff finds the evaluation approach employed by the licensee acceptable, because the structural integrity analysis employs the methods specified in NRC Generic Letter 90-05. The results of the licensee's flaw evaluation showed that there was reasonable assurance that the structural integrity of the degraded component would be maintained with the proposed temporary non-Code repair.

The licensee also stated that the performance of a permanent ASME Code repair may have necessitated a plant shutdown because the allowed outage time (7 days) specified by the limiting condition for operation for the ECW system may not be sufficient to complete the ASME Code repair. This time limitation was projected to arise from the fact that the amount of time that was needed to implement the Code repair could have been longer than 7 days, considering that there was a potential for fit-up problems and other unexpected situations which could have delayed the scheduled completion of the repair. Therefore, the NRC staff would have found that requiring the licensee to perform a permanent ASME Code repair would have resulted in a hardship because there was a reasonably high likelihood that the plant would have needed to be shut down in order to complete the permanent ASME Code repair. In this case, requiring the plant to be shut down for repair would not have been warranted considering the alternative that the licensee proposed, because the shutdown and subsequent restart would unnecessarily

cycle plant systems and components. The unscheduled plant shutdown would have resulted in a reduction of the safety margins in plant operation.

4.0 CONCLUSION

Based on the information provided in the licensee's submittal, the NRC staff concludes that the licensee proposed what would have been an acceptable alternative to the requirements of ASME Code, Section XI, Article IWA-5250(a)(3). Requiring an ASME Code repair immediately could have resulted in plant shutdown, and resulted in hardship or unusual difficulty without a compensating increase in the level of quality or safety. Furthermore, the NRC staff concludes that the proposed alternative would have provided reasonable assurance of structural integrity during the interim period. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the alternative would have been authorized for the STP, Unit 2, for the period from November 15, 2006, through March 2007.

All ASME Code, Section XI, requirements remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: W. Koo

Date: November 30, 2007

South Texas Project, Units 1 & 2

cc:
Senior Resident Inspector
U.S. Nuclear Regulatory Commission
P.O. Box 289
Wadsworth, TX 77483

C. M. Canady
City of Austin
Electric Utility Department
721 Barton Springs Road
Austin, TX 78704

J. J. Nesrsta/R. K. Temple
E. Alercon/Kevin Pollo
City Public Service Board
P.O. Box 1771
San Antonio, TX 78296

INPO
Records Center
700 Galleria Parkway
Atlanta, GA 30339-3064

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011

Steve Winn/Christie Jacobs
Eddy Daniels/Marty Ryan
NRC Energy, Inc.
211 Carnegie Center
Princeton, NJ 08540

Judge, Matagorda County
Matagorda County Courthouse
1700 Seventh Street
Bay City, TX 77414

A. H. Gutterman, Esq.
Morgan, Lewis & Bockius
1111 Pennsylvania Avenue, NW
Washington, DC 20004

E. D. Halpin
Site Vice President
STP Nuclear Operating Company
South Texas Project Electric
Generating Station
P.O. Box 289
Wadsworth, TX 77483

S. M. Head, Manager, Licensing
STP Nuclear Operating Company
P.O. Box 289, Mail Code: N5014
Wadsworth, TX 77483

C. T. Bowman
General Manager, Oversight
STP Nuclear Operating Company
P.O. Box 289
Wadsworth, TX 77483

Marilyn Kistler
Sr. Staff Specialist, Licensing
STP Nuclear Operating Company
P.O. Box 289, Mail Code 5014
Wadsworth, TX 77483

Environmental and Natural Resources
Policy Director
P.O. Box 12428
Austin, TX 78711-3189

Jon C. Wood
Cox, Smith, & Matthews
112 East Pecan, Suite 1800
San Antonio, TX 78205

Director
Division of Compliance & Inspection
Bureau of Radiation Control
Texas Department of State Health Services
1100 West 49th Street
Austin, TX 78756

South Texas Project, Units 1 & 2

Mr. Ted Enos
4200 South Hulen
Suite 422
Ft. Worth, TX 76109

Brian Almon
Public Utility Commission
William B. Travis Building
P.O. Box 13326
1701 North Congress Avenue
Austin, TX 78701-3326

Susan M. Jablonski
Office of Permitting, Remediation
and Registration
Texas Commission on
Environmental Quality
MC-122
P.O. Box 13087
Austin, TX 78711-3087

Ken Coates
Plant General Manager
STP Nuclear Operating Company
South Texas Project Electric
Generating Station
P.O. Box 289
Wadsworth, TX 77483

Mr. Anthony P. Jones
Chief Boiler Inspector
Texas Department of Licensing
and Regulation
Boiler Division
E.O. Thompson State Office Building
P.O. Box 12157
Austin, TX 78711