



South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

January 12, 2017  
NOC-AE-16003428  
10 CFR 54  
File No. G25

U. S. Nuclear Regulatory Commission  
Attention: Document Control Desk  
Washington, DC 20555-0001

South Texas Project  
Units 1 and 2  
Docket Nos. STN 50-498, STN 50-499  
Request for Additional Information for the  
Review of the South Texas Project License Renewal Application  
(TAC Nos. ME4936 and ME4937)

References:

1. Letter; G. T. Powell to the NRC Document Control Desk; "License Renewal Application", NOC-AE-10002607; dated October 25, 2010. (ML103010257)
2. Letter; From the NRC, Lois M. James to STP Nuclear Operating Company, G.T. Powell; "Request for Additional Information for the Review of the South Texas Project License Renewal Application (TAC Nos. ME4936 and ME4937)"; dated December 5, 2016. (ML16340A102)
3. Letter; From STP Nuclear Operating Company, Michael P. Murray to Lois M. James, NRC; "Extension Request – STPNOC Review and Comment of License Renewal Application Safety Evaluation Report with Open Items (CAC Nos. ME4936 and ME4937)"; NOC-AE-16003423, dated November 9, 2016. (ML16326A258)

By Reference 1, STP Nuclear Operating Company (STPNOC) submitted a License Renewal Application (LRA). In Reference 2, the NRC requested additional information for the review of the South Texas Project License Renewal Application. In Reference 3, STPNOC requested additional time for responding to the request for additional information in Reference 2. Enclosure 1 to this letter provides STPNOC's response to the request for additional information, and Enclosure 2 provides line in/line out revisions to the License Renewal Application.

Enclosure 3 provides regulatory commitment changes.

There are no other commitments in this letter.

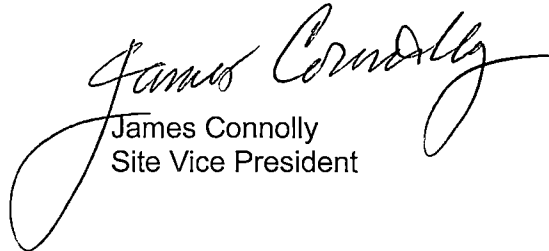
A147  
NRR

STI: 34418627

If there are any questions regarding this submittal, please contact Arden Aldridge, STP License Renewal Project Lead, at (361) 972-8243 or Rafael Gonzales, STP License Renewal Project regulatory point-of-contact, at (361) 972-4779.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on January 12, 2017  
Date

  
James Connolly  
Site Vice President

rjg

Enclosures:

- 1) STPNOC License Renewal Application Response to Request for Additional Information
- 2) STPNOC License Renewal Application Appendix A and B Line in/out Sections
- 3) STPNOC Regulatory Commitment Changes

cc:

(paper copy)

Regional Administrator, Region IV  
U.S. Nuclear Regulatory Commission  
1600 East Lamar Boulevard  
Arlington, TX 76011-4511

Lisa M. Regner  
Senior Project Manager  
U.S. Nuclear Regulatory Commission  
One White Flint North (MS 8 G9A)  
11555 Rockville Pike  
Rockville, MD 20852

NRC Resident Inspector  
U. S. Nuclear Regulatory Commission  
P. O. Box 289, Mail Code: MN116  
Wadsworth, TX 77483

Lois James  
License Renewal Project Manager (Safety)  
One White Flint North (MS O11-F1)  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

Tam Tran  
License Renewal Project Manager  
(Environmental)  
One White Flint North (MS O11F01)  
U. S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

(electronic copy)

Morgan, Lewis & Bockius LLP  
Steve Frantz

U.S. Nuclear Regulatory Commission  
Lisa M. Regner  
Lois James  
Tam Tran

NRG South Texas LP  
Chris O'Hara  
Jim von Suskil  
Skip Zahn

CPS Energy  
Kevin Pollo  
Cris Eugster  
L. D. Blaylock

City of Austin  
Elaina Ball  
John Wester

Texas Dept. of State Health Services  
Helen Watkins  
Robert Free

**Enclosure 1**

**STPNOC License Renewal Application Response to Request for Additional Information**

**RAI B2.1.37-8****Background:**

As amended by letter dated September 28, 2016, the "corrective actions" program element of the Selective Leaching of Aluminum Bronze Program states that if the results of a structural integrity evaluation are unacceptable, the following will be conducted:

- An operability determination.
- An extent of condition review to determine the cause of the structural integrity analysis failure and determine other locations requiring examination.
- Additional examinations focused on locations with stress margins less than or equal to that of the structurally unacceptable weld.
- Monthly walkdowns to conduct visual inspections of aboveground piping and yard walkdowns to conduct inspections for evidence of leakage.
- Volumetric inspections of 25 additional welds within 6 months.
- Five additional volumetric weld examinations for each weld not meeting acceptance criteria until no additional unacceptable welds are detected.
- An evaluation to "[d]etermine a repair or replacement program of the susceptible weld(s) based on the cause of the structural integrity evaluation failure, results of the additional volumetric examinations and the extent of condition."

The "corrective actions" program element also states that if a destructive examination does not meet the acceptance criteria, five additional destructive examinations will be conducted until no unacceptable loss of material due to selective leaching or non-continuous microstructure phase distributions are found.

In addition, the acceptance criteria for destructive examinations state the following:

- (1) No loss of material due to selective leaching penetrating 80% of the root-pass region; (2) Found selective leaching is non-propagating (surrounded by a non-continuous resistant phase distribution); and (3) The microstructure of the weld root region shall exhibit [sic] a non-continuous phase distribution consistent with the metallurgical technical basis report.

During a call on November 3, 2016, a new volumetric examination technique was discussed that could be capable of characterizing the extent of selective leaching in aluminum bronze welds.

**Issue:****Examination Technique Capable of Characterizing the Extent of Selective Leaching in Aluminum Bronze Welds**

The staff lacks sufficient information to conclude that the examination technique will be capable of effectively characterizing the extent of selective leaching in aluminum bronze welds. The staff seeks information related to: (a) a description of the method; (b) how the method will be demonstrated; (c) the information and resolution of the data provided by the technique; and (d) personnel qualifications. For example, in regard to demonstrating the process, will the

examination technique be used on welds that will be removed for destructive examination? This could provide valuable insights into the effectiveness of the examination technique.

Based on a review of CR-12-29261-109, "STP Nuclear Operating Company Overview and Bases for License Renewal Aging Management Program Outlined in License Renewal Application Appendix A1.37, B2.1.37, and PSALBZ 'Selective Leaching of Aluminum Bronze,'" dated May 31, 2016, there could be over 2000 susceptible pipe-to-pipe welds in the ECW systems subsequent to the replacement of the susceptible fittings.

The staff recognizes that an unacceptable structural integrity evaluation result could occur due to localized conditions where the stress levels (e.g., pressure, deadweight, seismic) are much higher than in other locations in the essential cooling water system (ECW). In this case, it might be possible to conduct follow-on analyses (using the same as-found data) that could demonstrate that many of the remaining susceptible in-service welds would meet structural integrity requirements. However, the staff lacks sufficient information to conclude that there is reasonable assurance that the ECW system will meet its intended function(s) because there could be in-service welds in critical locations (e.g., main supply header, upstream of heat exchangers) that would not meet structural integrity requirements.

The staff recognizes that a volumetric examination technique capable of characterizing the extent of selective leaching in aluminum bronze welds (hereinafter referred to as a UT examination), as identified during a November 3, 2016, teleconference, could provide the information necessary to conduct an effective extent of condition review. This UT examination technique is different than that performed to detect weld defects. This RAI is based on the assumption that these UT examinations will be conducted in conjunction with the actions described in the Background.

The staff has the following concerns in regard to the statement that, "[v]olumetric inspections of 25 additional welds within 6 months" will be conducted:

- A maximum of 25 inspections is cited in several sampling-based GALL Report Aging Management Programs. The staff established this threshold of inspections based on the assumption that it would be used to either establish that an aging effect was not occurring or the progression of degradation is such that the intended function of the component would be met throughout the period of extended operation. Corrective actions are taken when an intended function would not be met. Corrective actions could include replacement of all components exposed to the same environment and susceptible to the aging effect or periodic inspections to establish that there is still reasonable assurance that the intended function is being met. The staff has concluded that 25 inspections is insufficient to establish reasonable assurance when structural integrity requirements have not been met. Given that there will be a large number of welds in critical locations for which the extent of dealloying is not known, a larger number of UT examinations would be prudent. For example, one failure out of a population of 2000 welds could result in the need to conduct 42 to 633 UT examinations to establish reasonable assurance. If a subsequent failure to meet structural integrity requirements were detected, the degree of degradation leaves the realm of a sampling-based program.
- Deferring the completion of the examinations for 6 months when multiple welds in multiple trains could be affected does not provide reasonable assurance that the intended function(s) of the ECW system will be met.
- The staff considers the failure to meet structural integrity requirements potentially consequential enough to warrant periodic UT examinations. This is similar to the recommendation in the "corrective actions" program element in GALL Report AMP XI.M33, "Selective Leaching," which states, "[u]nacceptable inspection findings result in

additional inspection(s) being performed which may be on a periodic basis, or in component repair or replacement.” The staff recognizes that the weld that did not meet structural integrity requirements would have been replaced; however, many other welds could be degraded to the point where structural integrity requirements might not be met.

- The corrective actions for not meeting the acceptance criteria for destructive examinations includes performing additional destructive examinations and a structural integrity evaluation. The staff considers the failure to meet destructive examination acceptance criteria potentially consequential enough to warrant periodic UT examinations. Failure to meet these acceptance criteria would be indicative of the weld root pass not acting as an effective barrier for the subsequent weld passes that are more susceptible to loss of material due to selective leaching. In contrast to a scenario where structural integrity requirements are not met, not meeting the destructive examination criteria might not necessitate as high a number of inspections. However, given that the root pass has been challenged, an inspection sample size of 25 UT examinations is insufficient.

The staff recognizes that the output of the volumetric examinations could provide the input for subsequent structural integrity analyses. However, the acceptance criteria for the UT examination results and associated corrective actions for results that do not meet acceptance criteria have not been formalized.

The staff lacks sufficient information to understand how the UT examination results will be integrated into other acceptance criteria. One of the acceptance criteria for destructive examinations is: “[n]o loss of material due to selective leaching penetrating 80% of the root-pass region.” If a UT examination were to reveal loss of material due to selective leaching extending beyond the root-pass region, the staff has concluded that the examination result is equally as impactful as if the result was found during a destructive examination. As a result, if a UT examination reveals loss of material due to selective leaching that does not meet the destructive examination acceptance criterion; the associated corrective actions (additional destructive examinations) should be implemented.

Buried piping is exposed to different loadings than aboveground piping and as a result, there might be more or less structural margin for the buried piping. Buried piping will not be as readily available for followup UT examinations as aboveground piping. The staff lacks sufficient information to conclude whether buried piping has more or less margin than aboveground piping.

The staff noted that with the incorporation of this new technique into the Selective Leaching of Aluminum Bronze Program, the UT examinations might be considered as a replacement for destructive examinations in that the UT examinations can characterize the extent of potential loss of material due to selective leaching. However, this would be contrary to the purpose of the destructive examinations, which is to verify the susceptibility of the welds to selective leaching. The absence of selective leaching conducted by UT examination does not confirm that the phase distribution within the weld is consistent with basis document submitted by letter dated May 31, 2016. Given that it is unlikely that the hundreds of buried susceptible welds will be inspected by this technique, the destructive examinations are necessary to provide reasonable assurance that the ECW system will be capable of meeting its intended function(s).

#### Acceptance Criteria

During its review of the acceptance criteria for destructive examinations, the staff noted a criterion that might be stated in an inaccurate manner. Specifically criterion 2 states: “[f]ound selective leaching is non-propagating (surrounded by a non-continuous resistant phase

distribution)." The staff does not understand the intent of the "non-continuous resistant phase" statement. Any loss of material due to selective leaching should be surrounded by a continuous resistant phase.

**Request:**

1. State the approximate number of susceptible aboveground and buried welds that will be in-service subsequent to the replacements proposed in the scope of program element of the Selective Leaching of Aluminum Bronze Program.
2. State the following in relation to the UT technique capable of characterizing the extent of selective leaching in aluminum bronze welds:
  - A description of the method.
  - How the effectiveness of the technique will be demonstrated.
  - Type of information and resolution provided by the technique.
  - The qualifications of the individuals conducting the examinations and evaluating the examination results.
3. State the acceptance criteria for the UT examination results and associated corrective actions for results that do not meet acceptance criteria.
4. In regard to a failed structural integrity analysis result, state: (a) how many UT examinations will be conducted; (b) the timing of the UT examinations; (c) the periodicity and quantity of periodic examinations; (d) location selection criteria; (e) the basis for the above inspection parameters; and (f) the actions that will be taken if the results of a subsequent inspection does not meet structural integrity requirements.
5. In regard to a destructive examination not meeting acceptance criteria, state: (a) how many UT examinations will be conducted; (b) the timing of the UT examinations; (c) the periodicity and quantity of periodic examinations; (d) location selection criteria; and (e) the basis for the above inspection parameters.
6. State how the results of the UT examinations will be incorporated into the existing acceptance criteria for destructive examinations and the associated corrective actions.
7. Provide an evaluation demonstrating the structural integrity margins of buried piping as compared to aboveground piping.
8. State the intent of criterion 2 associated with the acceptance criteria for destructive examinations, if the wording is not changed to, "(surrounded by a continuous resistant phase distribution)."



**NRC Request:**

1. State the approximate number of susceptible aboveground and buried welds that will be in-service subsequent to the replacements proposed in the scope of program element of the Selective Leaching of Aluminum Bronze Program.

**STPNOC Response:****Table 1: Best estimate of susceptible (butt) welds after replacement**

Size	Above Ground Welds with Backing Ring		Above Ground Welds with No Backing Ring		Below Ground Welds with Backing Ring		Below Ground Welds with No Backing Ring		Welds		Total Butt Welds
	Unit 1	Unit 2	Unit 1	Unit 2	Unit 1	Unit 2	Unit 1	Unit 2	w/BR	No BR	
1*			6	6						12	12
2#			9	9						18	18
3	66	82	87	71					148	158	306
4	63	41	67	89					104	156	260
6	123	83	48	88	3	3	6	6	212	148	360
8	22	25	27	24					47	51	98
10	40	34	78	84	64	12	154	196	150	512	662
14	2	13	9	0					15	9	24
24	3	6	18	15					9	33	42
30	37	38	41	40	135	140	527	697	350	1305	1655
<b>Total@</b>	<b>356</b>	<b>322</b>	<b>390</b>	<b>426</b>	<b>202</b>	<b>155</b>	<b>687</b>	<b>899</b>	<b>1035</b>	<b>2402</b>	<b>3437</b>

\* 1-inch welds were performed by the CCW HX manufacturer for vent connections

# 2-inch welds include welds performed by the CCW HX manufacturer for drain connections

@ total reflects the best estimate of susceptible welds following replacement of the susceptible castings and their attachment welds

**NRC Request:**

2. State the following in relation to the UT technique capable of characterizing the extent of selective leaching in aluminum bronze welds:
  - a. A description of the method.
  - b. How the effectiveness of the technique will be demonstrated.
  - c. Type of information and resolution provided by the technique.
  - d. The qualifications of the individuals conducting the examinations and evaluating the examination results.

**STPNOC Response:**

## a. A description of the method.

An ultrasonic (UT) Time-of-Flight Diffraction (TOFD) technique for examining aluminum/bronze (Al-Bz) cast base material was proven to be an effective and reliable tool for detection and characterization of selective leaching. In a TOFD system, a pair of ultrasonic probes sit opposite each other. One of the probes (transmitter) emits an ultrasonic pulse that is received by the opposite probe (receiver). Three primary wave types are used in a TOFD technique: lateral wave, backwall reflection, and tip diffraction (Figures 1 and 2 below). One or more of these wave types can be used to detect selective leaching. Increased backwall reflection, detection of tip signals, and lack of lateral wave detection are indications of potential selective leaching.

Figure 1 - TOFD principle

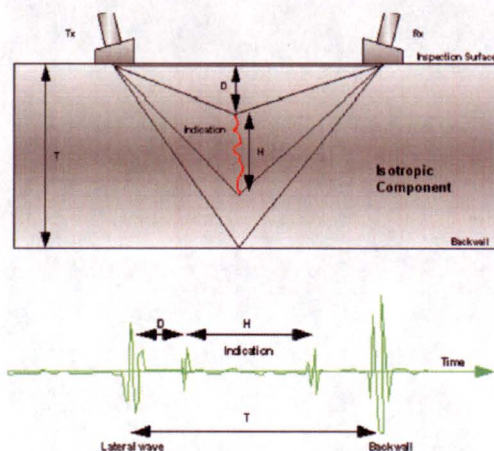
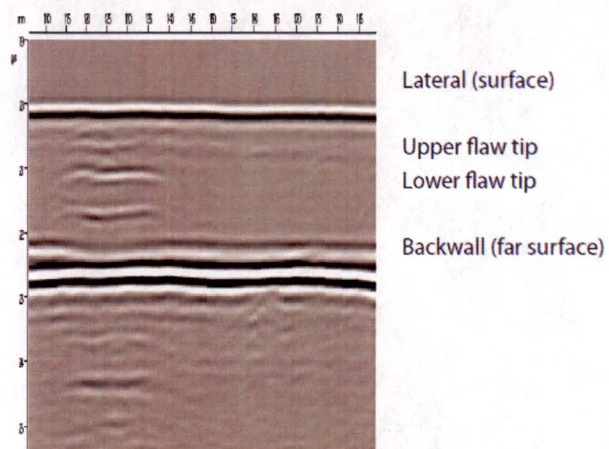


Figure 2 - scan to grey-level plot



Selective leaching does not possess the same acoustic characteristics as a planar flaw (or crack), but the UT waves of the TOFD technique are sensitive to changes in the microstructure of material where selective leaching has occurred. TOFD was found to be effective for detection of selective leaching in Al-Bz due to its ability to detect both back wall time-shift and parabolic diffraction signals from the selective leaching boundary (see Figure 3).

## b. How the effectiveness of the technique will be demonstrated.

The TOFD examination technique meets the requirements for Low Rigor level qualification to identify and characterize selective leaching in Al-Bz piping systems. The technical justification report is in accordance with the 2004 Edition of American Society of Mechanical Engineers Boiler & Pressure Vessel Code (BPVC) Section V, (no addendum) Article 14 and is applicable to procedure Ultrasonic Technical Instruction, UTI-TOFD-AB-001 Rev. 0 "Ultrasonic Examination of Aluminum Bronze Cast Base Metal for Selective Leaching Using Time-of-Flight Diffraction (TOFD) Technique."

A UT TOFD examination was completed on an Al-Bz flange removed from service at STP. The test specimens consisted of a pipe-to-flange configuration made from



aluminum bronze alloy. A TOFD examination of the heat affected zone on the flange side of the test specimen was performed to detect selective leaching and characterize the extent of the degradation. Additional Al-Bz samples with known selective leaching were also included in the demonstration of the technique.

A demonstration of the TOFD technique was performed at various stages during the STP procedure development by the STP NDE UT Level III for the Authorized Nuclear Inservice Inspector and Engineering. Final technique and procedure demonstration was performed by a third party.

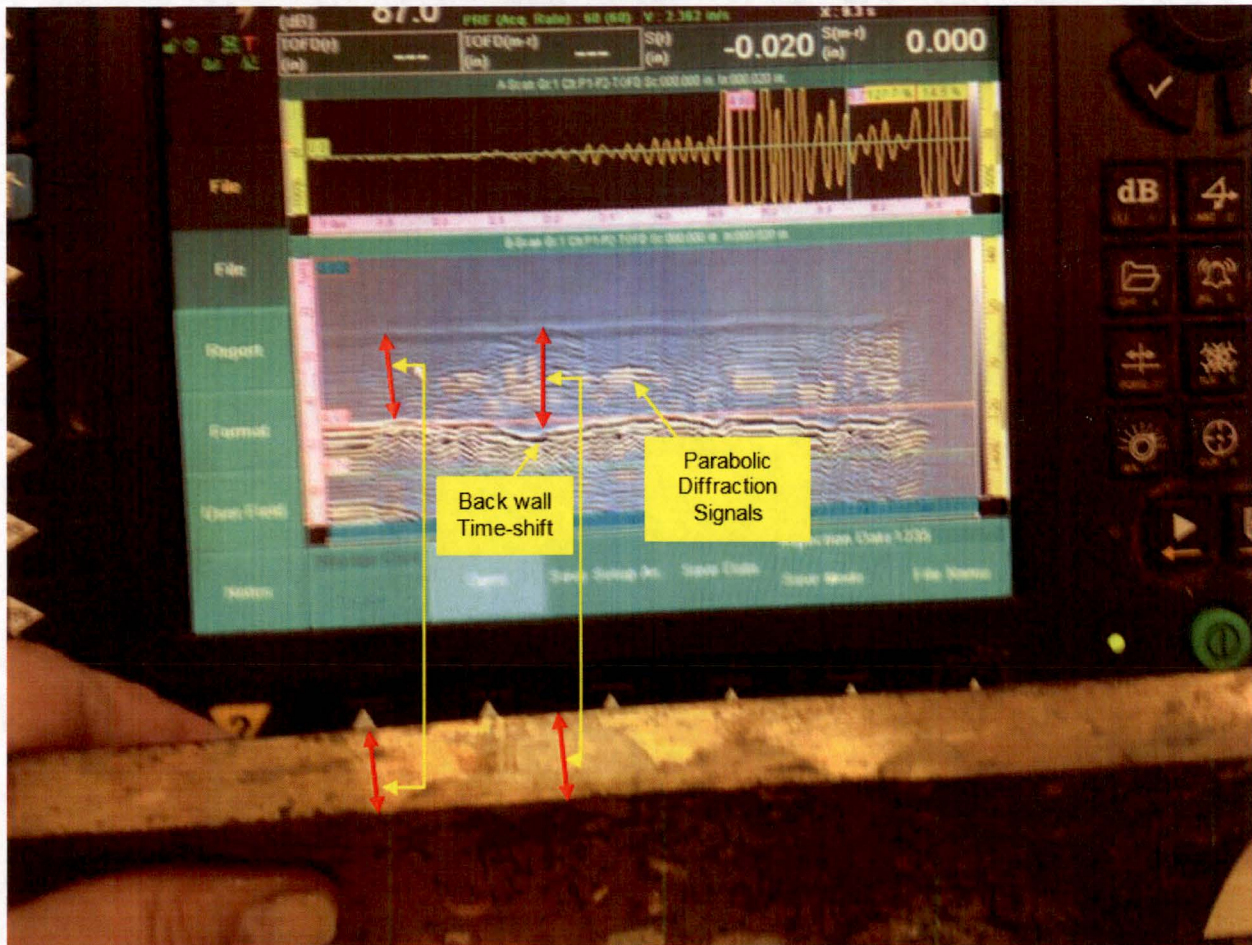
STP chose ASME Section V, Article 14, Low Rigor level of qualification based on the requirements in Paragraph -2500 of ASME Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1." 10CFR50.55a imposes additional requirements for the UT qualification in ASME Code Case N-729-1 similar to those of ASME Section XI Appendix VIII. However, the level of effort for an Appendix VIII type qualification for a unique material and degradation at one plant in a system with much less safety significance than the Reactor Closure Head penetration is not warranted. STP has demonstrated the TOFD effectiveness with a blind demonstration of the procedure, equipment, and personnel on a specimen with varying depths of selective leaching and no selective leaching.



- c. Type of information and resolution provided by the technique.

Figure 3 shows a photograph of an aluminum bronze sample containing selective leaching along with un-encoded TOFD results representing a TOFD scan across the top surface near the cut edge. The edge has been etched to show the difference between the sound material and the leached region.

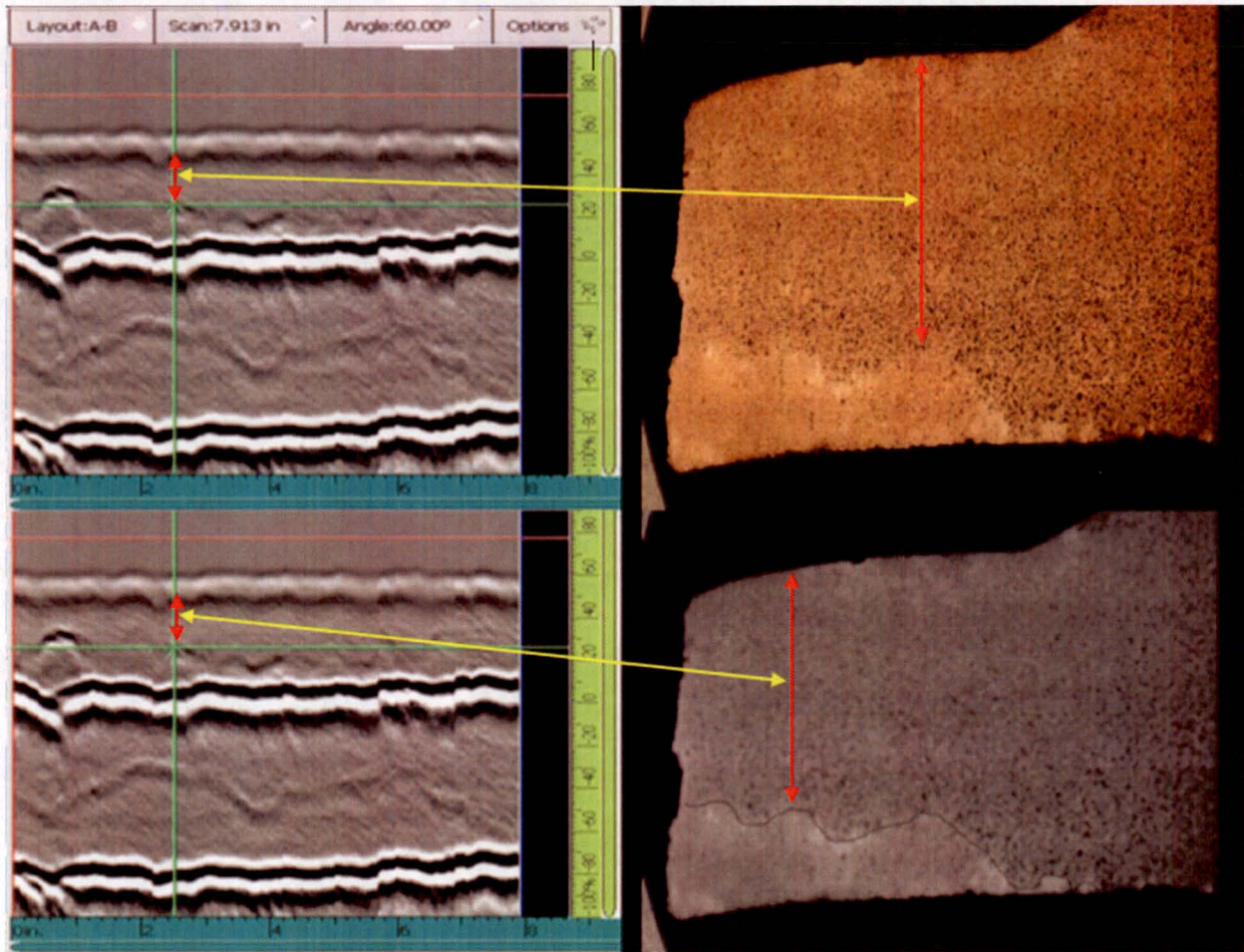
Resolution of selective leaching is a characterization of the amount of selective leaching material between the OD of the pipe and the maximum depth of the selective leaching material. The through-wall sizing accuracy is 8-10 mils. Actual characterization of selective leaching will apply this tolerance in a conservative manner to evaluate the structural integrity of the material. In addition, the length of selective leaching in the circumferential direction of the material is conservatively characterized because of a grouping effect.



**Figure 3**



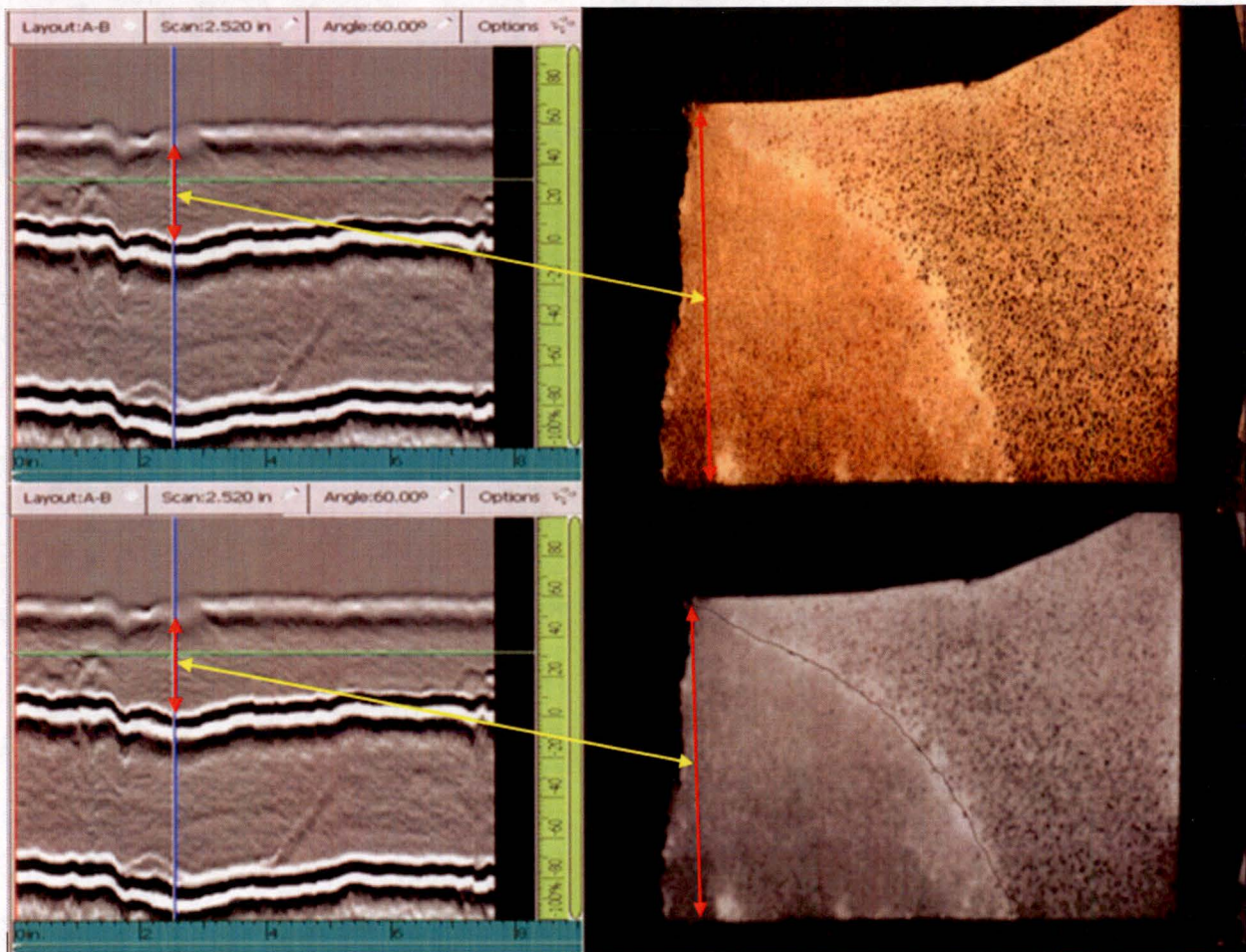
Figure 4 shows the TOFD results taken on a sample of aluminum bronze that contained selective leaching that had grown to about 32 percent of through-wall. The TOFD results are shown in the left two panels and the destructive analysis results are given in the right two panels.



**Figure 4**



Figure 5 shows similar results for another region of aluminum bronze that has been leached to 100 percent through-wall.



**Figure 5**

- d. The qualifications of the individuals conducting the examinations and evaluating the examination results.

Non Destructive Examination personnel conducting and evaluating examination results are qualified in accordance with STPNOC Procedure 0PEP10-ZA-0001 (Non Destructive Examination Written Practice). Only level II and level III ultrasonic examination personnel will perform TOFD examinations on the Al-Bz piping welds. In addition, the ultrasonic examination personnel have an additional 80 hours of TOFD training and have demonstrated detection and sizing of selective leaching using this procedure. Training, qualification, and certification of UT examination personnel performing TOFD examinations will also meet the requirements of ASME Section XI Appendix VIII (2004 Edition).

**NRC Request:**

3. State the acceptance criteria for the UT examination results and associated corrective actions for results that do not meet acceptance criteria.

**STP Response:**

The acceptance criteria is any loss of material due to selective leaching resulting in not meeting ASME Section XI Code required margins imposed by ASME Section XI structural factors, i.e. for normal/upset and emergency/faulted conditions.

Corrective actions are addressed in responses 4 and 5 below.

**NRC Request:**

4. In regard to a failed structural integrity analysis result, state: (a) how many UT examinations will be conducted; (b) the timing of the UT examinations; (c) the periodicity and quantity of periodic examinations; (d) location selection criteria; (e) the basis for the above inspection parameters; and (e) the actions that will be taken if the results of a subsequent inspection does not meet structural integrity requirements.

**STP Response:**

- a. How many (TOFD) UT examinations will be conducted (to assure extent of condition determination)
  - Perform TOFD UT examination on the remaining above ground weld population using a sample with a 95/95 confidence until no additional weld indication not meeting the acceptance criteria and within structural integrity is found. The weld population used to determine the 95/95 confidence sample will be based on the above ground weld types (i.e., with or without backing rings) and locations that would not meet code allowable margins when evaluated against the failed components degraded load carrying capability.
  - If a second weld is found that does not meet structural integrity, 100 percent of the remaining above ground welds will be TOFD UT examined and an evaluation will be performed of the below ground weld margins to identify locations requiring examination.
  - The TOFD UT examinations will be prioritized by examining the weld locations with the least structural integrity margin and with the highest consequence of failure first.

b. Timing of completing the examinations:

- Planning and preparations for performing TOFD UT extent of condition examinations following one weld not meeting structural integrity will commence upon discovery of the condition. The examinations will commence at the next ECW train outage and will sequence through all the ECW trains during each ECW train outage. The examinations will be completed within 90 days. This allows for timely planning and execution of sequenced train by train examinations during first available train work windows.
- Following a second weld not meeting structural integrity, the TOFD UT extent of condition examinations will be expanded to include 100 percent of the remaining above ground welds and an evaluation will be performed of the below ground weld margins to identify locations requiring examination. The NRC will be informed of the examination plan, schedule, and bases.

c. Periodicity and quantity of periodic examinations:

- The periodic TOFD UT examinations will be performed every 5 years until all above ground welds have been TOFD UT examined.
- A 95/95 confidence sample TOFD UT examination will be performed on the remaining above ground welds that have not been TOFD UT examined.

d. Location selection criteria:

- The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) not meeting acceptance criteria, considering construction, size distributions, structural integrity margins, and consequence of failure.

e. Basis for the above inspection parameters:

- Sample is based on a confidence level of 95 percent with a margin of error of 5 percent.
- Selection criteria considers risk and variability of construction, structural integrity margins, and consequence of failure.
- Periodic examinations frequency and quantity to assure detection and correction prior to exceeding design limits.
- Selective leaching is a slow mechanism.



- The 95/95 confidence sample is calculated using the following equation.

$$n = \frac{\frac{(z^2 * p * (1 - p))}{e^2}}{\left(1 + \left(\frac{z^2 * p * (1 - p)}{e^2 * N}\right)\right)}$$

where      n = sample size  
               z = z-score of 1.96 for a 95% Confidence Interval  
               p = 0.5 standard of deviation  
               N = Population  
               e = 5% margin of error

The sample size for the above ground weld with backing ring is 246 and the sample size for the above ground weld without backing ring is 262.

- f. Actions if results of subsequent inspections do not meet Structural integrity:
- Develop examination plan, schedule and bases for the examination of the remaining above ground welds. Inform the NRC of the examination plan, schedule, and bases.
  - Perform TOFD UT examinations on 100 percent of the remaining above ground welds to determine extent of condition.
  - Perform an evaluation of the below ground weld margins to identify locations requiring inspection. The evaluation will focus on below ground locations where structural integrity could be challenged based on the relative stress margins and the inspection results obtained on the above ground structurally unacceptable weld(s).
  - Inform the NRC of the examination plan, schedule, and bases.
  - Repair or replacement program of the susceptible weld(s).

#### **NRC Request:**

5. In regard to a destructive examination not meeting acceptance criteria, state: (a) how many UT examinations will be conducted; (b) the timing of the UT examinations; (c) the periodicity and quantity of periodic examinations; (d) location selection criteria; and (e) the basis for the above inspection parameters.

#### **STP Response:**

Destructive examinations will be performed on the sample populations as described in the Aging Management Program scope. Following the completion of this scope, further destructive examinations will be replaced with TOFD examinations if required due to one or more of the destructive examinations not meeting acceptance criteria.

A destructive examination not meeting acceptance criteria would provide evidence that the welds are susceptible to selective leaching through the root pass. The following describes the required periodic monitoring, corrective actions, and tracking and trending requirements to assure on-going selective leaching is managed.

- a. How many TOFD examinations will be conducted (loss of material due to selective leaching):
  - Within 60 days, perform five TOFD examinations for each weld not meeting acceptance criteria (destructive examination, or periodic TOFD examination) until no additional weld indication not meeting the acceptance criteria is found. Welds for examination will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) considering variability of construction, size distributions, structural integrity margins, and consequence of failure.
  - Every 5 years, perform periodic TOFD monitoring of any welds previously found to not meet acceptance criteria. These welds shall be monitored until 3 consecutive examinations identify no additional propagation of the selective leaching.
  - Perform periodic TOFD examinations of an additional 10% sample of the remaining above ground weld types every 5 years.
- b. Timing of completing the TOFD examinations:
  - The examination to be completed within 60 days of identifying acceptance criteria not met.
- c. Periodicity and quantity of periodic examinations:
  - Change the one time destructive examination to periodic TOFD examinations to be performed every 5 years.
  - Perform periodic TOFD monitoring of any welds found to not meet acceptance criteria. These welds shall be monitored until three consecutive examinations identify no additional propagation of the selective leaching.
  - Perform periodic TOFD examination of an additional 10% sample of the remaining above ground weld types.
- d. Location selection criteria:
  - Previously identified weld locations not meeting acceptance criteria.
  - The additional 10% sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) not meeting acceptance criteria, considering construction, size distributions, structural integrity margins, and consequence of failure.
- e. Basis for the above inspection parameters:
  - The destructive examination is replaced by periodic TOFD UT examinations to track and trend potential degradation.
  - Selection criteria considers risk and variability of construction, structural integrity margins, and consequence of failure.
  - Periodic Examinations frequency and quantity to assure detection and correction prior to exceeding design limits.
    - Selective leaching is a slow mechanism.
    - Maintains code and structural integrity margins.

- The 10% sample size is consistent with ASME Code Case N-578-1, Risk-Informed Requirements for Class 1, 2 or 3 Piping, for component with a risk category of 5 where the consequence of failure is medium and the potential for failure is medium. The sample size for the above ground weld with backing ring is 68 and the sample size for the above ground weld without backing ring is 82.

**NRC Request:**

6. State how the results of the UT examinations will be incorporated into the existing acceptance criteria for destructive examinations and the associated corrective actions.

**STP Response:**

Addressed in question 3, 4, and 5 above.

**NRC Request:**

7. Provide an evaluation demonstrating the structural integrity margins of buried piping as compared to aboveground piping.

**STP Response:**

To demonstrate structural integrity margins of the below ground Essential Cooling Water (ECW) piping compared to the above ground ECW piping, Tables 2 and 3 provided below summarize the maximum unintensified bending stress for each of the respective locations broken down by nominal pipe size:

**Table2: Summary of Maximum Unintensified Bending Stresses for Below Ground ECW Piping**

Nominal Pipe Size	Component	Maximum Total Unintensified Bending Stress (psi)
30	Straight Pipe	2167
	Elbows	5152
	Tee	7074
10	Straight Pipe	3281
	Elbows	3281
	Tee	4776

Note: Nominal pipe sizes are in inches.

**Table 3: Summary of Maximum Unintensified Bending Stresses for Above Ground ECW Piping**

Nominal Pipe Size	Maximum Total Unintensified Bending Stress (psi)
30	15049
24	13690
14	11179
10	15068
8	15080
6	15459
4	5352
3	2613
2.5	2869

Note: Nominal pipe sizes are in inches.

The maximum stress for flaw evaluation purposes is defined as the maximum value of unintensified bending stress at a location by the summation:

Maximum Total Unintensified Bending Stress = (Highest of Equations 8, 9B, or 9D, minus their respective pressure components) + (Equation 10)

In the above referenced equations, the geometric stress intensification factors are removed wherever they appear. The use of unintensified stresses in the flaw evaluation procedures is stated in Paragraph C-3310 of Appendix C of the ASME Code, Section XI. Equations 8, 9B, 9D, and 10 refer to the standard equations for Class 3 piping design as given in the ASME Code, Section III, Subsection ND, Paragraph ND-3652. Equation 8 refers to the design stress conditions for sustained loads, Equation 9 to the stress requirements for occasional loads, and Equation 10 to the stress requirement for thermal expansion. Equations 9B and 9D refer to the service levels in accordance with the ASME Code, Section III, Paragraph ND-3250.

Based on the tables given above, considering the worst case conditions, the above ground 30" ECW piping has stress levels approximately twice that of the below ground piping; the above ground 10" ECW piping has stress levels approximately three times that of the below ground piping. In terms of flaw tolerance, for the maximum bending stresses discussed above, a comparison of the limiting through-wall flaw lengths for meeting structural integrity (L) for the below and above ground piping are given below (Table 4):

**Table 4: limiting through-wall flaw lengths for meeting structural integrity (L) for the below and above ground piping**

Nominal Pipe Size (inches)	Below Ground Piping	Above Ground Piping	Flaw Margin (Below/Above)
30	L = 24.15"	L = 12.33"	1.96
10	L = 19.87"	L = 10.86"	1.83

Note: The limiting through wall flaw lengths given above are based on a maximum operating pressure of 50 psig and a lower bound fracture toughness of Al-Bz weld metal of 127 ksi in<sup>1/2</sup>.

Based on the above structural limits, considering the worst case conditions, the below ground piping has margins on flaw size that is approximately twice that of the above ground piping.

**NRC Request:**

8. State the intent of criterion 2 associated with the acceptance criteria for destructive examinations, if the wording is not changed to, "(surrounded by a continuous resistant phase distribution)."

**STP Response:**

The acceptance criteria for destructive examinations are:

1. No loss of material due to selective leaching penetrating 80% of the root-pass region.
2. Found selective leaching is non-propagating (surrounded by a resistant phase distribution).
3. The microstructure of the weld root region shall exhibit a resistant phase distribution consistent with the metallurgical technical basis report.

**Enclosure 2**  
**STPNOC License Renewal Application Appendix A and B Line in/out Sections**

<b>Affected LRA Section</b>
A1.37
B2.1.37

**A1.37 SELECTIVE LEACHING OF ALUMINUM BRONZE**

The Selective Leaching of Aluminum Bronze program manages loss of material and cracking due to selective leaching of aluminum bronze (copper alloy with greater than 8 percent aluminum) components and welds exposed to raw water within the scope of license renewal. The program also validates phase distribution characteristics of the microstructure.

All aluminum bronze castings susceptible to selective leaching, including attachment welds related to the castings, and aluminum bronze root valves with adapter socket welds will be replaced prior to the period of extended operation with material that is not susceptible to selective leaching. Extruded piping tees with aluminum bronze weld repairs, where the repair size is such that failure of the repair would affect the structural integrity of the component, will be replaced prior to the period of extended operation.

STP uses copper alloy piping with less than 8 percent aluminum content, which is not susceptible to selective leaching. However, there are welds in which the filler metal is copper alloy with greater than 8 percent aluminum. The final composition of welds and process used to fabricate the welds results in a reduction in the susceptibility of the root pass filler material to selective leaching.

The Selective Leaching of Aluminum Bronze program directs that prior to the period of extended operation 20 percent with a maximum of 25 welds of the above ground weld population with no backing rings are examined one-time volumetrically to manage cracking. If a weld indication that does not meet the acceptance criteria is found during the one-time inspection of welds with no backing rings, periodic volumetric examinations of 20 percent with a maximum of 25 welds will be performed every 10 years thereafter.

The Selective Leaching of Aluminum Bronze program directs that 20 percent with a maximum of 25 welds of the above ground weld population with backing rings are examined volumetrically to manage cracking prior to the period of extended operation and every 10 years thereafter.

Discovery of a weld indication that does not meet the acceptance criteria requires expansion of the volumetric examination sample population. Each weld found with a weld indication not meeting the acceptance criteria requires five additional volumetric examinations to be performed until no additional weld indication not meeting the acceptance criteria is found.

The Selective Leaching of Aluminum Bronze program directs that prior to the period of extended operation 20 percent with a maximum of 25 welds of the above ground weld population with no backing rings and 20 percent with a maximum of 25 welds of the above ground weld population with backing rings be examined one-time destructively to detect loss of material due to selective leaching and verify microstructure phase distribution.

If selective leaching or microstructure phase distribution that does not meet the acceptance criteria are found the following will be performed.

1. Five Time-of-Flight Diffraction (TOFD) UT examinations within 60 days for each weld not meeting acceptance criteria until no additional weld not meeting the acceptance criteria is found. Welds for examination will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) consider variability of construction, size distributions, structural integrity margins, and consequence of failure.

2. Periodic TOFD UT monitoring every 5 years on any welds not removed and previously found to not meet acceptance criterion but met structural integrity capability. These welds shall be monitored until 3 consecutive examinations identify no additional propagation of the selective leaching.
3. Periodic TOFD UT examinations of an additional 10% sample of the remaining above ground weld types (with or without backing ring) every 5 years. The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring), considering variability of construction, size distributions, structural integrity margins, and consequence of failure.

~~, periodic destructive examinations of 20 percent with a maximum of 25 welds of the above ground weld population with no backing rings and 20 percent with a maximum of 25 welds of the above ground weld population with backing rings will be performed every 10 years thereafter.~~

~~Discovery of unacceptable selective leaching or continuous microstructure phase distribution requires five additional destructive examinations to be performed until no unacceptable selective leaching or non-continuous microstructure phase distribution are found.~~

Yard walkdowns are performed in the areas above the buried piping with aluminum bronze welds to look for changes in ground conditions that would indicate leakage. If a leak from a buried pipe weld is discovered by surface water monitoring or during a buried ECW piping inspection, a section of each leaking piping weld will be removed for destructive examination. Visual inspections are performed every six months of the external surfaces of the above ground welds for evidence of through wall leakage.

The Buried and Underground Piping and Tank program, B2.1.18, includes the visual inspection of the buried aluminum bronze exterior pipe coatings for visible breaks, gaps, and discontinuities which could indicate cracking of the welds and defines the acceptance criterion for buried pipe coatings.

The acceptance criterion for volumetric examination of aluminum bronze welds is no detected planar indication that is surface connected (exposed to the ECW environment) unless the depth of the indication is contained within the 80% of the weld root pass region. An indication not connected to the surface (not exposed to the ECW environment) is acceptable.

The acceptance criterion for visual inspection of the aluminum bronze welds and adjacent copper alloy piping during the walkdowns is no through wall leakage.

The acceptance criteria for destructive examinations are:

1. No loss of material due to selective leaching penetrating 80% of the root-pass region.
2. Found selective leaching is non-propagating (surrounded by a ~~non-continuous~~ resistant phase distribution).
3. The microstructure of the weld root region shall exhibit a resistant ~~non-continuous~~ phase distribution consistent with the metallurgical technical basis report.

The acceptance criterion for TOFD UT examination is no loss of material due to selective leaching resulting in not meeting ASME Section XI Code required margins imposed by ASME Section XI structural factors for normal/upset and emergency/faulted conditions.



The acceptance criterion for buried aluminum bronze exterior pipe coating is defined in the Buried Piping and Tanks Inspection Aging Management Program B2.1.18. An external surface examination capable of detecting selective leaching will be performed on the buried ECW piping welds in the vicinity of degraded coatings to detect loss of material due to selective leaching. The acceptance criterion for extent of loss of material on the external surface is that upon removal of the selective leaching the minimum wall thickness is maintained. Corrective action (e.g. surface conditioning) is performed until no selective leaching is detected. If unacceptable wall thickness is found following surface conditioning, the buried ECW piping is repaired or replaced.

An aluminum-bronze weld found to have an indication that does not meet the acceptance criteria or has through wall leakage is removed and destructively examined to determine the extent of cracks, extent of selective leaching and the microstructure phase distribution. The condition is documented in the corrective action program and a structural integrity analysis is performed to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.

An unacceptable structural integrity evaluation requires:

1. A determination of operability.
2. An extent of condition evaluation to determine the cause of the structural integrity evaluation failure and identify other locations requiring examination.
3. Monthly aboveground walkdowns of the aluminum bronze welds.
4. Monthly yard walkdowns to verify no through-wall leakage is occurring.
5. Volumetric examination of an additional 25 above ground welds within the next six months to look for cracking. Perform TOFD UT examination on the remaining above ground weld population using a sample with a 95/95 confidence until no additional weld indication not meeting the acceptance criteria and within structural integrity is found. The weld population used to determine the 95/95 confidence sample will be based on the above ground weld types (with or without backing rings) and locations that would not meet code allowable margins when evaluated against the failed components degraded load carrying capability.

The TOFD UT examinations are prioritized by examining the weld locations with the least structural integrity margin and with the highest consequence of failure first. Planning and preparations for performing TOFD UT extent of condition examinations following one weld not meeting structural integrity will commence upon discovery of the condition. The examinations will commence at the next ECW train outage and will sequence through all the ECW trains during each ECW train outage. The examinations will be completed within 90 days. This allows for timely planning and execution of sequenced train by train examinations during first available train work windows.

If a second weld is found that does not meet structural integrity;

- Develop examination plan, schedule and bases for the examination of the remaining above ground welds. Inform the NRC of the examination plan, schedule, and bases.
- Perform TOFD UT examinations on 100 percent of the remaining above ground welds to determine extent of condition.

- Perform an evaluation of the below ground weld margins to identify locations requiring inspection. The evaluation will focus on below ground locations where structural integrity could be challenged based on the relative stress margins and the inspection results obtained on the above ground structurally unacceptable weld(s). Inform the NRC of the examination plan, schedule, and bases for below ground weld inspections.
6. Perform periodic 95/95 confidence sample TOFD UT examinations every 5 years on the remaining welds which have not been TOFD UT examined. The population used to determine the 95/95 confidence sample will be based on the above ground weld types (with or without backing rings). The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring), considering construction, size distributions, structural integrity margins, and consequence of failure. Five additional volumetric examinations for each weld found with a weld indication not meeting the acceptance criteria until no additional weld indication not meeting the acceptance criteria is found.
  7. Perform repair or replacement program of the susceptible weld(s).

## **B2.1.37 SELECTIVE LEACHING OF ALUMINUM BRONZE**

### **Program Description**

The Selective Leaching of Aluminum Bronze program manages loss of material and cracking due to selective leaching for aluminum bronze (copper alloy with greater than eight percent aluminum) components and welds exposed to raw water within the scope of license renewal. The program also validates phase distribution characteristics of the microstructure. The selective leaching of aluminum bronze is applied in addition to the Open-Cycle Cooling Water program (B2.1.9).

All aluminum bronze castings susceptible to selective leaching, including attachment welds related to the castings and aluminum bronze root valve adapter socket welds, will be replaced prior to the period of extended operation with material that is not susceptible to selective leaching. Extruded piping tees with aluminum bronze weld repairs, where the repair size is such that failure of the repair would affect the structural integrity of the component, will be replaced prior to the period of extended operation.

STP uses copper alloy piping with less than 8 percent aluminum content, which is not susceptible to selective leaching. However, there are welds in which the filler metal is copper alloy with greater than 8 percent aluminum. The final composition of welds and process used to fabricate the welds results in a reduction in the susceptibility of the root pass filler material to selective leaching.

The Selective Leaching of Aluminum Bronze program directs that prior to the period of extended operation 20 percent with a maximum of 25 welds of the above ground weld population with no backing rings are examined one-time volumetrically to manage cracking. If a weld indication that does not meet the acceptance criteria is found during the one-time inspection of welds with no backing rings, periodic volumetric examinations of 20 percent with a maximum of 25 welds will be performed every 10 years thereafter.

The Selective Leaching of Aluminum Bronze program directs that 20 percent with a maximum of 25 welds of the above ground weld population with backing rings are examined volumetrically to manage cracking prior to the period of extended operation and every 10 years thereafter.

Discovery of a weld indication that does not meet the acceptance criteria requires expansion of the volumetric examination sample population. Each weld found with a weld indication not meeting the acceptance criteria requires five additional volumetric examinations to be performed until no additional weld indication not meeting the acceptance criteria is found.

The Selective Leaching of Aluminum Bronze program directs that prior to the period of extended operation 20 percent with a maximum of 25 welds of the above ground weld population with no backing rings and 20 percent with a maximum of 25 welds of the above ground weld population with backing rings be examined one-time destructively to detect loss of material due to selective leaching and verify microstructure phase distribution.

If selective leaching or microstructure phase distribution that does not meet the acceptance criteria are found the following will be performed.

1. Five Time-of-Flight Diffraction (TOFD) UT examinations within 60 days for each weld not meeting acceptance criteria until no additional weld not meeting the acceptance criteria is found. Welds for examination will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) consider variability of construction, size distributions, structural integrity margins, and consequence of failure.
2. Periodic TOFD UT monitoring will be performed every 5 years on any welds not removed and previously found to not meet acceptance criterion but met structural integrity capability. These welds shall be monitored until 3 consecutive examinations identify no additional propagation of the selective leaching.
3. Periodic TOFD UT examinations of an additional 10% sample of the remaining above ground weld types (with or without backing ring) every 5 years. The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring), considering variability of construction, size distributions, structural integrity margins, and consequence of failure.

~~periodic destructive examinations of 20 percent with a maximum of 25 welds of the above ground weld population with no backing rings and 20 percent with a maximum of 25 welds of the above ground weld population with backing rings will be performed every 10 years thereafter.~~

~~Discovery of unacceptable selective leaching or continuous microstructure phase distribution requires five additional destructive examinations to be performed until no unacceptable selective leaching or non-continuous microstructure phase distribution are found.~~

Yard walkdowns are performed in the areas above the buried piping with aluminum bronze welds to look for changes in ground conditions that would indicate leakage. If a leak from a buried pipe weld is discovered by surface water monitoring or during a buried ECW piping inspection, a section of each leaking piping weld will be removed for destructive examination. Visual inspections are performed every six months of the external surfaces of the above ground welds for evidence of through wall leakage.

The Buried and Underground Piping and Tank program, B2.1.18, includes the visual inspection of the buried aluminum bronze exterior pipe coatings for visible breaks, gaps, and discontinuities which could indicate cracking of the welds.

The acceptance criterion for volumetric examination of aluminum bronze welds is no detected planar indication that is surface connected (exposed to the ECW environment) unless the depth of the indication is contained within the 80% of the weld root pass region. An indication not connected to the surface (not exposed to the ECW environment) is acceptable.

The acceptance criterion for visual inspection of the aluminum bronze welds and adjacent copper alloy piping during the walkdowns is no through wall leakage.

The acceptance criteria for destructive examinations are:

1. No loss of material due to selective leaching penetrating 80% of the root-pass region.
2. Found selective leaching is and non-propagating (surrounded by a ~~non-continuous~~ resistant phase distribution).
3. The microstructure of the weld root region shall exhibit a ~~non-continuous-resistant~~ phase distribution consistent with the metallurgical technical basis report.

The acceptance criterion for TOFD UT examination is no loss of material due to selective leaching resulting in not meeting ASME Section XI Code required margins imposed by ASME Section XI structural factors for normal/upset and emergency/faulted conditions.

The acceptance criterion for buried aluminum bronze exterior pipe coating is defined in the Buried Piping and Tanks Inspection Aging Management Program B2.1.18. An external surface examination capable of detecting selective leaching will be performed on the buried ECW piping welds in the vicinity of degraded coatings to detect loss of material due to selective leaching. The acceptance criterion for extent of loss of material on the external surface is that upon removal of the selective leaching the minimum wall thickness is maintained. Corrective action, such as surface conditioning, is performed until no selective leaching is detected. If unacceptable wall thickness is found following surface conditioning, the buried ECW piping is repaired or replaced.

An aluminum bronze weld found to have an indication that does not meet the acceptance criteria or has through wall leakage is removed and destructively examined to determine extent of cracks, extent of selective leaching, and the microstructure phase distribution. The condition is documented in the corrective action program and a structural integrity analysis is performed to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.

An unacceptable structural integrity evaluation requires:

- A determination of operability.
- An extent of condition evaluation to determine the cause of the structural integrity evaluation failure and identify other locations requiring examination.
- Monthly aboveground walkdowns of the aluminum bronze welds.
- Monthly yard walkdowns to verify no through-wall leakage is occurring.

- Volumetric examination of an additional 25 above ground welds within the next six months to look for cracking. Perform TOFD UT examination on the remaining above ground weld population using a sample with a 95/95 confidence until no additional weld indication not meeting the acceptance criteria and within structural integrity is found. The weld population used to determine the 95/95 confidence sample will be based on the above ground weld types (with or without backing rings) and locations that would not meet code allowable margins when evaluated against the failed components degraded load carrying capability.

The TOFD UT examinations are prioritized by examining the weld locations with the least structural integrity margin and with the highest consequence of failure first. Planning and preparations for performing TOFD UT extent of condition examinations following one weld not meeting structural integrity will commence upon discovery of the condition. The examinations will commence at the next ECW train outage and will sequence through all the ECW trains during each ECW train outage. The examinations will be completed within 90 days. This allows for timely planning and execution of sequenced train by train examinations during first available train work windows.

If a second weld is found that does not meet structural integrity:

- Develop examination plan, schedule and bases for the examination of the remaining above ground welds. Inform the NRC of the examination plan, schedule, and bases.
- Perform TOFD UT examinations on 100 percent of the remaining above ground welds to determine extent of condition.
- Perform an evaluation of the below ground weld margins to identify locations requiring inspection. The evaluation will focus on below ground locations where structural integrity could be challenged based on the relative stress margins and the inspection results obtained on the above ground structurally unacceptable weld(s). Inform the NRC of the examination plan, schedule, and bases for below ground weld inspections.
- Perform periodic 95/95 confidence sample TOFD UT examinations every 5 years on the remaining welds which have not been TOFD UT examined. The population used to determine the 95/95 confidence sample will be based on the above ground weld types (with or without backing rings). The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring), considering construction, size distributions, structural integrity margins, and consequence of failure. Five additional volumetric examinations for each weld found with a weld indication not meeting the acceptance criteria until no additional weld indication not meeting the acceptance criteria is found.
- Perform A repair or replacement program of the susceptible weld(s).

## **Aging Management Program Elements**

An evaluation of each element of the Aging Management Program against the 10 elements described in Appendix A of NUREG-1800, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants*, is provided below.

### *Scope of Program (Element 1)*

The Selective Leaching of Aluminum Bronze program manages loss of material and cracking due to selective leaching for aluminum bronze (copper alloy with greater than 8 percent aluminum) components and welds exposed to raw water within the scope of license renewal.

Prior to the period of extended operation, all aluminum bronze castings susceptible to loss of material due to selective leaching, including attachment welds related to the castings and aluminum bronze root valves with adapter socket welds, will be replaced with material that is not susceptible to selective leaching.

Extruded piping tees with aluminum bronze weld repairs are characterized using the following techniques:

1. The vendor Record of Nonconformance is evaluated; or
2. Where insufficient information is available, then past radiography film is used to determine the limiting size of the weld repair by measuring the size of the area of interest on the film; or
3. Where past radiography film is not available, radiography will be performed to characterize the weld repair. Extrapolation during sizing of the weld repair is not performed. Where the repair size is such that failure of the repair would affect the structural integrity of the component, the component will be replaced prior to the period of extended operation.

STP uses copper alloy piping with less than 8 percent aluminum, which is not susceptible to selective leaching. However, welds in which the filler metal is copper alloy with greater than 8 percent aluminum may be susceptible to loss of material and cracking due to selective leaching. The final composition of welds and process used to fabricate the welds results in a reduction in the susceptibility of the root pass filler material to selective leaching.

The following weld material is used.

- ERCuAl-A2 with no backing ring,
- ERCuNiAl with no backing ring,
- ERCuAl-A2 with backing ring, and
- ERCuAl-A2 non-cast component weld repairs.

### *Preventive Actions (Element 2)*

The Selective Leaching of Aluminum Bronze program does not prevent degradation due to aging effects but provides for component replacement and inspections to detect aging degradation prior to the loss of intended functions.

External surfaces of the buried aluminum bronze piping are coated to prevent selective leaching of the exterior surface of the aluminum bronze welds. The above ground piping is not coated.

*Parameters Monitored or Inspected (Element 3)*

The susceptibility of aluminum bronze welds is related to the integrity of the weld, the weld material composition, and the welding temperature controls.

Loss of material due to selective leaching is monitored through system walkdowns and destructive examinations.

Cracking associated with selective leaching is monitored through volumetric examination and destructive examination.

Phase distribution to verify the potential for continuous selective leaching is monitored through destructive examination.

Welds without backing rings are either original ERCuAl-A2 material or replacement ERCuNiAl material. The original ERCuAl-A2 welds without backing rings were radiographed at time of installation to detect the presence of weld flaws. The replacement ERCuNiAl welds without backing rings were examined visually and by liquid penetrant method at time of installation. The ERCuNiAl weld material is less susceptible to selective leaching than the ERCuAl-A2 weld material due to the addition of nickel.

Welds with backing rings are original ERCuAl-A2 material. The original ERCuAl-A2 welds with backing rings were examined visually and by use of liquid penetrant method at time of installation.

The aging management program will manage cracking of the above ground weld population with no backing rings by performing a one-time volumetric examination on 20 percent with a maximum of 25 welds prior to the period of extended operation. If a weld indication that does not meet the acceptance criteria is found during the one-time inspection of welds with no backing rings, periodic volumetric examinations of 20 percent with a maximum of 25 welds will be performed every 10 years thereafter.

The aging management program will manage cracking of the above ground weld population with backing rings by performing periodic volumetric examinations on 20 percent with a maximum of 25 welds prior to the period of extended operation and every 10 years thereafter.

Since the population of welds use similar material and are exposed to the same environment, the samples for volumetric examination will be randomly selected from the total population of welds, considering construction and size distributions. The above ground welds are used as the bounding condition to represent both the above and below ground welds when performing the volumetric examination.

The aging management program will manage loss of material due to selective leaching and verify microstructure phase distribution of the above ground weld population with and without backing rings by performing a one-time destructive examination on 20 percent with a maximum of 25 welds with backing rings and 20 percent with a maximum of 25 welds without backing rings prior to the period of extended operation. The samples for the destructive examination sample population will be selected from the total population of welds with and without backing rings, considering construction and size distributions.

If selective leaching or microstructure phase distribution that does not meet the acceptance criteria are found the following will be performed.

1. Five Time-of-Flight Diffraction (TOFD) UT examinations within 60 days for each weld not meeting acceptance criteria until no additional weld not meeting the acceptance criteria is found. Welds for examination will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) consider variability of construction, size distributions, structural integrity margins, and consequence of failure.
2. Periodic TOFD UT monitoring every 5 years on any welds not removed and previously found to not meet acceptance criterion but met structural integrity capability. These welds shall be monitored until 3 consecutive examinations identify no additional propagation of the selective leaching.
3. Periodic TOFD UT examinations of an additional 10% sample of the remaining above ground weld types (with or without backing ring) every 5 years. The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring), considering variability of construction, size distributions, structural integrity margins, and consequence of failure.

~~, periodic destructive examinations of 20 percent with a maximum of 25 welds will be performed every 10 years thereafter.~~

~~Since destructive examinations are used to verify the susceptibility of the weld to selective leaching, the samples for the sample population will be randomly selected from the total population of welds with and without backing rings, considering construction and size distributions.~~

Periodic walkdowns of the above ground piping, components and welds is performed to verify no through wall leakage.

Periodic walkdowns of the yard areas over the buried ECW piping and welds is performed to verify no evidence of through wall leakage.

An aluminum bronze weld found to have an indication that does not meet the acceptance criteria or has through wall leakage is removed and destructively examined to determine extent of cracks, extent of selective leaching, and the microstructure phase distribution. The condition is documented in the corrective action program and a structural integrity analysis is performed to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.

The Buried and Underground Piping and Tank program, B2.1.18, includes the visual inspection of the buried aluminum bronze exterior pipe coatings for visible breaks, gaps, and discontinuities which could indicate possible cracking of the welds. An external surface examination capable of detecting selective leaching will be performed on the buried ECW piping welds in the vicinity of degraded coatings to detect loss of material due to selective leaching.

#### *Detection of Aging Effects (Element 4)*

The Selective Leaching of Aluminum Bronze program includes one-time and periodic volumetric and destructive examinations of aluminum bronze welds to determine if loss of material and cracking due to selective leaching is occurring.



The Selective Leaching of Aluminum Bronze program includes visual inspections every six months of the external surfaces of the above ground components and welds for evidence of through wall leakage.

Every six months, a walkdown is performed in the areas above the buried ECW piping containing copper alloy welds with aluminum content greater than 8 percent. During the walkdown, the ground is observed for conditions that would indicate leakage. If a leak from a below-grade piping weld is discovered by surface water monitoring, a section of each leaking piping weld will be removed for destructive examination.

The Buried and Underground Piping and Tank program, B2.1.18, specifies that whenever aluminum bronze materials are exposed during inspection of the buried ECW piping, the exterior pipe coating is inspected for degradation. If degradation is identified near a weld a volumetric examination will be performed to determine if cracking of the weld is occurring. An external surface examination capable of detecting selective leaching will be performed on the buried ECW piping welds in the vicinity of degraded coatings to detect loss of material due to selective leaching.

If leaking below-grade welds are discovered during a buried ECW piping inspection, a section of each leaking weld will be removed for destructive examination.

An aluminum bronze weld found to have an indication that does not meet the acceptance criteria or has through wall leakage is removed and destructively examined to determine extent of loss of material, extent of cracking due to selective leaching, and the microstructure phase distribution.

#### *Monitoring and Trending (Element 5)*

This is an inspection program to determine if selective leaching is occurring and the degree of the selective leaching.

STP will maintain the history of the volumetric and destructive examinations results. Following completion of the volumetric and destructive examinations scope, a review is performed to identify potential adverse trends or other indications requiring action.

#### *Acceptance Criteria (Element 6)*

The acceptance criterion for volumetric examination of aluminum bronze welds is no detected planar indication that is surface connected (exposed to the ECW environment) unless the depth of the indication is contained within the 80% of the weld root pass region. An indication not connected to the surface (not exposed to the ECW environment) is acceptable.

The acceptance criterion for visual inspection of the aluminum bronze welds and adjacent copper alloy piping during the walkdowns is no through wall leakage.

The acceptance criteria for destructive examinations are:

1. No loss of material due to selective leaching penetrating 80% of the root-pass region.
2. Found selective leaching is non-propagating (surrounded by a ~~non-continuous~~ resistant phase distribution).

3. The microstructure of the weld root region shall exhibit a ~~non-continuous-resistant~~ phase distribution consistent with the metallurgical technical basis report.

The acceptance criterion for TOFD UT examination is no loss of material due to selective leaching resulting in not meeting ASME Section XI Code required margins imposed by ASME Section XI structural factors for normal/upset and emergency/faulted conditions.

The acceptance criterion for buried aluminum bronze exterior pipe coating is defined in the Buried Piping and Tanks Inspection Aging Management Program B2.1.18. The acceptance criterion for extent of loss of material on the external surface of buried aluminum bronze piping with coating degradation is that upon removal of the selective leaching the minimum wall thickness is maintained.

If an acceptance criterion is not met, the condition is documented in the corrective action program.

#### *Corrective Actions (Element 7)*

The following corrective actions are performed when acceptance criteria are not met:

A through wall leak of the above or below ground weld.

- Remove weld and destructively examined to determine the extent of cracks, extent of selective leaching, and the microstructure phase distribution.
- Perform five additional volumetric inspections to assess extent of condition and cause.
- Perform a structural integrity evaluation to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.
- Replace leaking weld
- Perform an AMP effectiveness evaluation to determine program changes required to manage the aging.

An aluminum bronze weld found to have an indication that does not meet the acceptance ~~criteria~~criterion.

- Remove weld and destructively examined to determine the extent of cracks, extent of selective leaching, and the microstructure phase distribution.
- Perform five additional volumetric examinations until no additional weld indication not meeting the acceptance ~~criteria~~criterion is found to assess extent of condition and cause.
- Perform a structural integrity evaluation to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.
- Perform an AMP effectiveness evaluation to determine program changes required to manage the aging.
- Replace weld

Assess extent of condition and cause of a weld destructive examination does not meeting acceptance criteria but the welds meets structural integrity.

- Perform five additional ~~TOFD UT examinations within 60 days destructive examinations for each weld not meeting acceptance criteria until no additional weld~~

- not meeting the acceptance criteria is found. unacceptable selective leaching or non-continuous microstructure phase distribution are found to assess extent of condition and cause. The TOFD UT examinations to be completed within 60 days of identifying acceptance criteria not met. Welds for examination will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) consider variability of construction, size distributions, structural integrity margins, and consequence of failure.
- Perform periodic TOFD UT monitoring every 5 years of any welds not removed and previously found to not meet acceptance criterion but met structural integrity capability. These welds shall be monitored until 3 consecutive examinations identify no additional propagation of the selective leaching.
  - Perform periodic TOFD examination of an additional 10% sample of the remaining above ground weld types every 5 years. The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) not meeting acceptance criteria, considering construction, size distributions, structural integrity margins, and consequence of failure.
  - Perform a structural integrity evaluation on any weld not meeting acceptance criteria to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.
  - Perform an AMP effectiveness evaluation to determine program changes required to manage the aging.

Assess extent of condition and cause of an unacceptable If structural integrity evaluation is determined to be unacceptable:

- Perform a determination of operability.
- Perform extent of condition evaluation to determine the cause of the structural integrity evaluation failure and identify other locations requiring examination. These additional examinations will focus on stress margin locations less than or equal to that of the structurally unacceptable weld.
- Perform TOFD UT examination on the remaining above ground weld population using a sample with a 95/95 confidence until no additional weld indication not meeting the acceptance criteria and within structural integrity is found. The weld population used to determine the 95/95 confidence sample will be based on the above ground weld types (with or without backing rings) and locations that would not meet code allowable margins when evaluated against the failed components degraded load carrying capability.
- The TOFD UT examinations are prioritized by examining the weld locations with the least structural integrity margin and with the highest consequence of failure first. Planning and preparations for performing TOFD UT extent of condition examinations following one weld not meeting structural integrity will commence upon discovery of the condition. The examinations will commence at the next ECW train outage and will sequence through all the ECW trains during each ECW train outage. The examinations will be completed within 90 days. This allows for timely planning and execution of sequenced train by train examinations during first available train work windows.
- If a second weld is found that does not meet structural integrity:

- Develop examination plan, schedule and bases for the examination of the remaining above ground welds. Inform the NRC of the examination plan, schedule, and bases.
- Perform TOFD UT examinations on 100 percent of the remaining above ground welds to determine extent of condition.
- Perform an evaluation of the below ground weld margins to identify locations requiring inspection. The evaluation will focus on below ground locations where structural integrity could be challenged based on the relative stress margins and the inspection results obtained on the above ground structurally unacceptable weld(s). Inform the NRC of the examination plan, schedule, and bases for below ground weld inspections.
- Perform periodic 95/95 confidence sample TOFD UT examinations every 5 years on the remaining welds which have not been TOFD UT examined. The population used to determine the 95/95 confidence sample will be based on the above ground weld types (with or without backing rings). The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring), considering variability of construction, size distributions, structural integrity margins, and consequence of failure.
- Perform monthly aboveground walkdowns of the aluminum bronze welds to verify no through-wall leakage is occurring.
- Perform monthly yard walkdowns to verify no through wall leakage is occurring.
- ~~Perform volumetric examination of an additional 25 above ground welds within the next six months to look for cracking.~~
- ~~Perform five additional volumetric examinations for each weld found with a weld indication not meeting the acceptance criteria until no additional weld indication not meeting the acceptance criteria is found.~~
- Determine a repair or replacement program of the susceptible weld(s) based on the cause of the structural integrity evaluation failure, results of the additional TOFD UT volumetric examinations and the extent of condition.

The Buried Piping and Tanks Inspection Aging Management Program B2.1.18, outlines corrective actions resulting from the identification of degraded buried aluminum bronze exterior pipe coating. Corrective action for selective leaching found under degraded ECW buried piping coatings such as surface conditioning is performed until no selective leaching is detected. If unacceptable wall thickness is found following surface conditioning, the buried ECW piping is repaired or replaced.

STP QA procedures, review and approval process, and administrative controls are implemented in accordance with the requirements of 10 CFR 50 Appendix B and are acceptable in addressing corrective actions. The QA program includes elements of corrective action, and is applicable to the safety-related and nonsafety-related systems, structures, and components that are subject to aging management review.

#### *Confirmation Process (Element 8)*

STP QA procedures, review and approval process, and administrative controls are implemented in accordance with the requirements of 10 CFR 50 Appendix B and are acceptable in addressing confirmation processes and administrative controls. The QA program includes

elements of corrective action, and is applicable to the safety-related and nonsafety-related systems, structures, and components that are subject to aging management review.

*Administrative Controls (Element 9)*

See Element 8.

*Operating Experience (Element 10)*

STP identified through-wall cracks in the ECW system piping which were initiated by pre-existing weld defects and propagated by a selective leaching phenomenon. The pre-existing weld defects identified appeared in welds with backing rings. The weld population consists of shop and field welds without backing rings, field welds with backing rings, weld repairs to extruded piping tees, and valves with adapter socket welds. Welds that have shown through-wall cracks have been welds with backing rings, weld repairs to extruded piping tees, and valves with adapter socket welds. Laboratory failure analysis data has indicated that in the cases with leaks, a preexisting crack penetrating into the central core of the weld was present. Poor fit-up may have contributed to such root pass cracking. Crack growth appears to have occurred by a process of the crack tip selective leaching locally and the crack propagating through the selectively leached zone. The affected welds were repaired.

Selective leaching has occurred in susceptible aluminum bronze components. STP will replace all susceptible aluminum bronze components prior to the period of extended operation.

**Enhancements**

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

*Scope of Program (Element 1) and Preventive Actions (Element 2)*

Procedure will be enhanced to:

- Replace all aluminum bronze castings susceptible to selective leaching, including attachment welds with material that is not susceptible to selective leaching, prior to the period of extended operation.
- Replace aluminum bronze root valve adapter socket welds with material that is not susceptible to selective leaching prior to the period of extended operation.
- Replace extruded piping tees with aluminum bronze weld repairs where the repair size is such that failure of the repair would affect the structural integrity of the component prior to the period of extended operation.

*Parameters Monitored or Inspected (Element 3)*

Procedure will be enhanced to:

- Specify, loss of material due to selective leaching is monitored through system walkdowns and destructive examinations.
- Specify, cracking associated with selective leaching is monitored through volumetric

examination and destructive examination.

- Specify, phase distribution to verify the potential for continuous selective leaching is determined through destructive examination.
- Verify, the management of cracking of the above ground weld population with no backing rings by performing a one-time volumetric examination on 20 percent with a maximum of 25 welds prior to the period of extended operation.
- Specify, if a weld indication that does not meet the acceptance criteria is found during the one-time inspection of weld with no backing rings, periodic volumetric examinations of 20 percent with a maximum of 25 welds will be performed every 10 years thereafter.
- Verify, the management of cracking of the above ground weld population with backing rings by performing periodic volumetric examinations on 20 percent with a maximum of 25 welds prior to the period of extended operation and every 10 years thereafter.
- Specify, the samples for volumetric examination be randomly selected from the total population of above ground welds, considering construction and size distributions.
- Verify, the management of selective leaching and microstructure phase distribution of the above ground weld population with and without backing rings by performing a one-time destructive examination on 20 percent with a maximum of 25 welds with backing rings and 20 percent with a maximum of 25 welds without backing rings prior to the period of extended operation.
- ~~Specify, if selective leaching or microstructure phase distribution do not meet the acceptance criteria during the one-time destructive examinations, periodic destructive examinations of 20 percent with a maximum of 25 welds will be performed every 10 years thereafter.~~
- Require the sample population for destructive examinations be randomly selected from the total population of welds with and without backing rings, considering construction and size distributions.
- If selective leaching or microstructure phase distribution that does not meet the acceptance criteria is found require the following be performed.
  - Five TOFD UT examinations within 60 days for each weld not meeting acceptance criteria until no additional weld not meeting the acceptance criteria is found. Welds for examination will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) consider variability of construction, size distributions, structural integrity margins, and consequence of failure.
  - Periodic TOFD UT monitoring every 5 years on any welds not removed and previously found to not meet acceptance criterion but met structural integrity capability. These welds shall be monitored until 3 consecutive examinations identify no additional propagation of the selective leaching.

- Periodic TOFD UT examinations of the remaining 10 percent of the above ground weld types (with or without backing ring) will be performed every 5 years thereafter. The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring), considering variability of construction, size distributions, structural integrity margins, and consequence of failure.
- Require a weld which does not meet the acceptance criteria or has through wall leakage, be removed and destructively examined to determine the extent of cracks, extent of selective leaching, and the microstructure phase distribution.
- Require a welds which does not meet the acceptance criteria or has through wall leakage be documented in the corrective action program and a structural integrity analysis be performed to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.
- Require an external surface examination capable of detecting selective leaching will be performed on the buried ECW piping welds in the vicinity of degraded coatings to detect loss of material due to selective leaching.

#### *Detection of Aging Effects (Element 4)*

Procedure will be enhanced to:

- Require one-time and periodic volumetric examination of above ground aluminum bronze welds to determine if cracking is occurring.
- Require one-time and periodic destructive examination of above ground aluminum bronze welds to determine if selective leaching is occurring and verify phase distribution.
- Require a weld which does not meet the acceptance criteria or has through wall leakage be removed and destructively examined to determine extent of cracks, extent of selective leaching, and the microstructure phase distribution.
- Require whenever aluminum bronze materials are exposed during inspection of the buried ECW piping, the exterior aluminum bronze pipe coating is inspected for degradation. If degradation is identified near a weld, a volumetric examination will be performed to determine if cracking due to selective leaching is occurring. An external surface examination capable of detecting selective leaching will be performed on the buried ECW piping welds in the vicinity of degraded coatings to detect loss of material due to selective leaching.

#### *Monitoring and Trending (Element 5)*

Procedure will be enhanced to:

- Require that the history of the volumetric, TOFD UT, and destructive examinations results be maintained and a review be performed to identify potential adverse trends or other indications requiring action.

#### *Acceptance Criteria (Element 6)*

Procedure will be enhanced to:

- Specify, the acceptance criterion for volumetric examination of aluminum bronze welds is no detected planar indication that is surface connected (exposed to the ECW environment) unless the depth of the indication is contained within the 80% of the weld root pass region. An indication not connected to the surface (not exposed to the ECW environment) is acceptable.
- Specify, the acceptance criterion for visual inspection of the aluminum bronze welds and adjacent copper alloy piping during the walkdowns is no through wall leakage.
- Specify, the acceptance criteria for destructive examinations are:
  1. No loss of material due to selective leaching penetrating 80% of the root-pass region.
  2. Found selective leaching is and non-propagating (surrounded by a ~~non-continuous~~ resistant phase distribution).
  3. The microstructure of the weld root region shall exhibits a ~~non-continuous~~ resistant phase distribution consistent with the metallurgical technical basis report.
- Specify, the acceptance criterion for TOFD UT examination is no loss of material due to selective leaching resulting in not meeting ASME Section XI Code required margins imposed by ASME Section XI structural factors for normal/upset and emergency/faulted conditions.
- Require, if an acceptance criterion is not met, the unacceptable condition be documented in the corrective action program and a structural integrity analysis be performed to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.
- The acceptance criterion for extent of loss of material on the external surface of buried aluminum bronze piping with coating degradation is that upon removal of the selective leaching the minimum wall thickness is maintained.

#### *Corrective Actions (Element 7)*

Procedure will be enhanced to:

- Require, upon discovery of a weld which does not meet the acceptance criteria or has through wall leakage, the weld is removed and destructively examined to determine extent of cracking, extent of selective leaching, and the microstructure phase distribution.
- Specify, when a weld is found that does not meet the acceptance criteria a structural integrity analysis shall be performed to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.
- Specify, discovery of a weld indication that does not meet the acceptance criteria requires expansion of the volumetric examination sample population. Each weld found



with a weld indication not meeting the acceptance criteria requires five additional volumetric examinations to be performed until no additional weld indication not meeting the acceptance criteria is found.

- Specify, discovery of selective leaching or continuous microstructure phase distribution that do not meet the acceptance criteria but the welds meets structural integrity requires performing the following: ~~expansion of the destructive examinations sample population. Each destructive examination not meeting the acceptance criteria requires five additional destructive examinations to be performed until no unacceptable selective leaching or non-continuous microstructure phase distribution are found.~~
  - Five TOFD UT examinations within 60 days for each weld not meeting acceptance criteria until no additional weld not meeting the acceptance criteria is found to. Welds for examination will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) consider variability of construction, size distributions, structural integrity margins, and consequence of failure.
  - Periodic TOFD UT monitoring every 5 years of any welds not removed and previously found to not meet acceptance criterion but met structural integrity capability. These welds shall be monitored until 3 consecutive examinations identify no additional propagation of the selective leaching.
  - Periodic TOFD examinations of an additional 10% sample of the remaining above ground weld types every 5 years. The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) not meeting acceptance criteria, considering construction, size distributions, structural integrity margins, and consequence of failure.
  - A structural integrity evaluation on a weld not meeting acceptance criteria to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.
  - An AMP effectiveness evaluation to determine program changes required to manage the aging.
- Specify discovery of an unacceptable structural integrity evaluation requires performing the following:
  - A determination of operability.
  - An extent of condition evaluation to determine the cause of the structural integrity evaluation failure and identify other locations requiring examination. These additional examinations will focus on stress margin locations less than or equal to that of the structurally unacceptable weld.
  - Monthly walkdowns of aboveground aluminum bronze welds.
  - Monthly yard walkdowns to verify no through-wall leakage is occurring.
  - Perform TOFD UT examination on the remaining above ground weld population using a sample with a 95/95 confidence until no additional weld indication not meeting the acceptance criteria and within structural integrity is found. The weld population used to determine the 95/95 confidence sample will be based on the above ground weld types (with or without backing rings) and locations that would not meet code allowable margins when evaluated against the failed components degraded load carrying capability.
  - The TOFD UT examinations are prioritized by examining the weld locations with

the least structural integrity margin and with the highest consequence of failure first. Planning and preparations for performing TOFD UT extent of condition examinations following one weld not meeting structural integrity will commence upon discovery of the condition. The examinations will commence at the next ECW train outage and will sequence through all the ECW trains during each ECW train outage. The examinations will be completed within 90 days. This allows for timely planning and execution of sequenced train by train examinations during first available train work windows.

- If a second weld is found that does not meet structural integrity:
  - Develop examination plan, schedule and bases for the examination of the remaining above ground welds. Inform the NRC of the examination plan, schedule, and bases.
  - Perform TOFD UT examinations on 100 percent of the remaining above ground welds to determine extent of condition.
  - Perform an evaluation of the below ground weld margins to identify locations requiring inspection. The evaluation will focus on below ground locations where structural integrity could be challenged based on the relative stress margins and the inspection results obtained on the above ground structurally unacceptable weld(s). Inform the NRC of the examination plan, schedule, and bases for below ground weld inspections.
- Periodic 95/95 confidence sample TOFD UT examinations every 5 years on the remaining welds which have not been TOFD UT examined. The population used to determine the 95/95 confidence sample will be based on the above ground weld types (with or without backing rings). The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring), considering variability of construction, size distributions, structural integrity margins, and consequence of failure.
- ~~Volumetric examination of an additional 25 above ground welds within the next six months to look for cracking.~~
- ~~Five additional volumetric examinations for each weld found with a weld indication not meeting the acceptance criteria until no additional weld indication not meeting the acceptance criteria is found.~~
- Determine a repair or replacement program of the susceptible weld(s) based on the cause of the structural integrity evaluation failure, results of the additional volumetric examinations and the extent of condition.
- ~~Specify, if acceptance criteria are not met a determination of operability and an assessment of the extent of condition is performed. Additionally, perform an AMP effectiveness evaluation to determine program changes required to manage the aging.~~
- Specify, corrective action for selective leaching found under degraded ECW buried piping coatings such as surface conditioning is performed until no selective leaching is detected. If unacceptable wall thickness is found following surface conditioning, the buried ECW piping is repaired or replaced.

## **Conclusion**

The continued implementation of the Selective Leaching of Aluminum Bronze program provides reasonable assurance that aging effects will be managed such that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

**Enclosure 3**

**STPNOC Regulatory Commitment Changes**

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
44	<p>The Selective Leaching of Aluminum Bronze program will:</p> <ul style="list-style-type: none"> <li>• Replace all aluminum bronze castings susceptible to selective leaching, including attachment welds related to the castings with material that is not susceptible to selective leaching.</li> <li>• Replace aluminum bronze root valve adapter socket welds with material that is not susceptible to selective leaching.</li> <li>• Replace extruded piping tees with aluminum bronze weld repairs where the repair size is such that failure of the repair would affect the structural integrity of the component.</li> </ul> <p>Enhance the Selective Leaching of Aluminum Bronze procedure to:</p> <ul style="list-style-type: none"> <li>• Specify loss of material due to selective leaching is monitored through system walkdowns and destructive examinations.</li> <li>• Specify cracking associated with selective leaching is monitored through volumetric examination and destructive examination.</li> <li>• Specify phase distribution to verify the potential for continuous selective leaching is monitored through destructive examination.</li> <li>• Verify the management of cracking of the above ground weld population with no backing rings by performing a one-time volumetric examination on 20 percent with a maximum of 25 welds prior to the period of extended operation.</li> <li>• Specify, if a weld indication that does not meet the acceptance criteria is found during the one-time inspection of welds with no backing rings, periodic volumetric examinations of 20 percent with a maximum of 25 welds will be performed every 10 years thereafter.</li> <li>• Verify, the management of cracking of the above ground weld population with backing rings by performing periodic volumetric examinations on 20 percent with a maximum of 25 welds prior to the period of extended operation and</li> </ul>	B2.1.37	<p>Replacements and inspections to be complete no later than six months prior to the PEO or the end of the last refueling outage prior to the PEO, whichever occurs later.</p> <p>Procedure changes no later than the date the renewed operating licenses are issued.</p> <p>CR 12-22150</p>

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	<p>every 10 years thereafter.</p> <ul style="list-style-type: none"> <li>Specify, the samples for volumetric examination be randomly-selected from the total population of above ground welds, considering construction and size distributions.</li> <li>Verify, the management of loss of material due to selective leaching or microstructure phase distribution of the above ground weld population with and without backing rings by performing a one-time destructive examination on 20 percent with a maximum of 25 welds with backing rings and 20 percent with a maximum of 25 welds without backing rings prior to the period of extended operation.</li> <li><del>Specify, if loss of material due to selective leaching or microstructure phase distribution do not meet the acceptance criteria during the one-time destructive examinations, periodic destructive examinations of 20 percent with a maximum of 25 welds will be performed every 10 years thereafter.</del></li> <li>Require the sample population for destructive examinations be randomly selected from the total population of welds with and without backing rings, construction and size distributions.</li> <li>Require a weld which does not meet the acceptance criteria or has through wall leakage, be removed and destructively examined to determine extent of cracking, extent of selective leaching and the microstructure phase distribution.</li> <li>Require a weld which does not meet the acceptance criteria or has through wall leakage, be documented in the corrective action program, and a structural integrity analysis be performed to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.</li> <li>Require an external surface examination capable of detecting selective leaching will be performed on the buried ECW piping welds in the vicinity of</li> </ul>		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	<p>degraded coatings to detect loss of material due to selective leaching.</p> <ul style="list-style-type: none"> <li>Require that the history of the volumetric, TOFD UT, and destructive examinations results be maintained and a review be performed to identify potential adverse trends or other indications requiring action.</li> <li>Specify, the acceptance criterion for volumetric examination of aluminum bronze welds is no detected planar indication that is surface connected (exposed to the ECW environment) unless the depth of the indication is contained within the 80% of the weld root pass region. An indication not connected to the surface (not exposed to the ECW environment) is acceptable.</li> <li>Specify, the acceptance criterion for visual inspection of the aluminum bronze welds and adjacent copper alloy piping during the walkdowns is no through wall leakage.</li> <li>Specify, the acceptance criterion for destructive examinations is; <ul style="list-style-type: none"> <li>No loss of material due to selective leaching penetrating 80% of the root-pass region.</li> <li>Found selective leaching is non-propagating (surrounded by a <del>non-</del><u>continuous-resistant</u> phase distribution).</li> <li>The microstructure of the weld root region shall exhibits a <del>non-</del><u>continuous-resistant</u> phase distribution consistent with the metallurgical technical basis report.</li> </ul> </li> <li><u>Specify, the acceptance criterion for TOFD UT examination is no loss of material due to selective leaching resulting in not meeting ASME Section XI Code required margins imposed by ASME Section XI structural factors for normal/upset and emergency/faulted conditions.</u></li> <li>Specify, discovery of a weld indication that does not meet the acceptance criteria requires expansion of the volumetric examination sample population. Each weld found with a weld indication not meeting the acceptance criteria</li> </ul>		



Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	<p>requires five additional volumetric examinations to be performed until no additional weld indication not meeting the acceptance criteria is found.</p> <ul style="list-style-type: none"> <li>• Specify, discovery of selective leaching or continuous microstructure phase distribution that do not meet the acceptance criteria <u>but the welds meets structural integrity requires performing the following: expansion of the destructive examinations sample population. Each destructive examination that does not meet the acceptance criteria requires five additional destructive examination examinations to be performed until no unacceptable selective leaching or non-continuous microstructure phase distribution are found.</u> <ul style="list-style-type: none"> <li>○ <u>Five TOFD UT examinations within 60 days for each weld not meeting acceptance criteria until no additional weld not meeting the acceptance criteria is found to. Welds for examination will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) consider variability of construction, size distributions, structural integrity margins, and consequence of failure.</u></li> <li>○ <u>Periodic TOFD UT monitoring every 5 years of any welds not removed and previously found to not meet acceptance criterion but met structural integrity capability. These welds shall be monitored until 3 consecutive examinations identify no additional propagation of the selective leaching.</u></li> <li>○ <u>Periodic TOFD examinations of an additional 10% sample of the remaining above ground weld types every 5 years. The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring) not meeting acceptance criteria, considering construction, size distributions, structural integrity margins, and consequence of failure.</u></li> <li>○ <u>A structural integrity evaluation on a weld not meeting acceptance criteria to confirm that the load carrying capacity of the installed welds remain adequate to support the intended function of the ECW system through the period of extended operation.</u></li> </ul> </li> </ul>		



Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	<ul style="list-style-type: none"> <li>○ <u>An AMP effectiveness evaluation to determine program changes required to manage the aging.</u></li> <li>• Specify, discovery of an unacceptable structural integrity evaluation requires performing the following. <ul style="list-style-type: none"> <li>○ A determination of operability.</li> <li>○ An extent of condition evaluation to determine the cause of the structural integrity evaluation failure and identify other locations requiring examination. These additional examinations will focus on stress margin locations less than or equal to that of the structurally unacceptable weld.</li> <li>○ Monthly walkdowns of aboveground aluminum bronze welds.</li> <li>○ Monthly yard walkdowns to verify no through-wall leakage is occurring.</li> <li>○ <u>Perform TOFD UT examination on the remaining above ground weld population using a sample with a 95/95 confidence until no additional weld indication not meeting the acceptance criteria and within structural integrity is found. The weld population used to determine the 95/95 confidence sample will be based on the above ground weld types (with or without backing rings) and locations that would not meet code allowable margins when evaluated against the failed components degraded load carrying capability.</u></li> <li>○ <u>The TOFD UT examinations are prioritized by examining the weld locations with the least structural integrity margin and with the highest consequence of failure first. Planning and preparations for performing TOFD UT extent of condition examinations following one weld not meeting structural integrity will commence upon discovery of the condition. The examinations will commence at the next ECW train outage and will sequence through all the ECW trains during each ECW</u></li> </ul> </li> </ul>		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	<p><u>train outage. The examinations will be completed within 90 days. This allows for timely planning and execution of sequenced train by train examinations during first available train work windows.</u></p> <ul style="list-style-type: none"> <li>○ <u>If a second weld is found that does not meet structural integrity:</u> <ul style="list-style-type: none"> <li>• <u>Develop examination plan, schedule and bases for the examination of the remaining above ground welds. Inform the NRC of the examination plan, schedule, and bases.</u></li> <li>• <u>Perform TOFD UT examinations on 100 percent of the remaining above ground welds to determine extent of condition.</u></li> <li>• <u>Perform an evaluation of the below ground weld margins to identify locations requiring inspection. The evaluation will focus on below ground locations where structural integrity could be challenged based on the relative stress margins and the inspection results obtained on the above ground structurally unacceptable weld(s). Inform the NRC of the examination plan, schedule, and bases for below ground weld inspections.</u></li> </ul> </li> <li>○ <u>Periodic 95/95 confidence sample TOFD UT examinations every 5 years on the remaining welds which have not been TOFD UT examined. The population used to determine the 95/95 confidence sample will be based on the above ground weld types (with or without backing rings). The sample will be selected from the total population of above ground welds associated with the weld type (with or without backing ring), considering variability of construction, size distributions, structural integrity margins, and consequence of failure.</u></li> </ul>		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	<ul style="list-style-type: none"> <li><del>○ Volumetric examination of an additional 25 above ground welds within the next six months to look for cracking.</del></li> <li><del>○ Five additional volumetric examinations for each weld found with a weld indication not meeting the acceptance criteria until no additional weld indication not meeting the acceptance criteria is found and.</del></li> <li><del>○ Determine a repair or replacement program of the susceptible welds within the STP Technical Specification requirements based on the cause of the structural integrity evaluation failure, results of the additional volumetric examinations and the extent of condition.</del></li> <li>● Specify, when acceptance criteria are not met a determination of operability and an assessment of the extent of condition is performed. Additionally, perform an AMP effectiveness evaluation to determine program changes required to manage the aging.</li> <li>● Specify, the acceptance criterion for extent of loss of material on the external surface of buried aluminum bronze piping with coating degradation is that upon removal of the selective leaching the minimum wall thickness is maintained.</li> <li>● Specify, corrective action for selective leaching found under depredated ECW buried piping coatings such as surface conditioning is performed until no selective leaching is detected. If unacceptable wall thickness following surface conditioning is found, the buried ECW piping is repaired or replaced.</li> </ul>		