Nuclear Operating Company

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

March 12, 2012
NOC-AE-12002807
File No.: G25
10CFR50.55a

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Unit 2
Docket No. STN 50-499
Request for Relief from ASME Boiler and Pressure Vessel Code,
Section XI Requirements for the Essential Cooling Water System
(Relief Request RR-ENG-3-08)

In accordance with the provisions of 10 CFR 50.55a(a)(3)(ii), the South Texas Project requests relief from IWA-5250 of Section XI of the ASME Boiler and Pressure Vessel Code. Approval will allow deferral of code repair of flaws found in the Unit 2 Essential Cooling Water (ECW) Class 3 piping until after Unit 2 is returned to service, which is currently scheduled for mid-April 2012. A code repair of the affected valves at this time is not possible because the necessary parts will not be available until after the scheduled restart date. The work will be performed following receipt of the replacement parts. Compliance with the requirements of 10 CFR 50.55a would result in a hardship without a compensating increase in the level of quality and safety.

Two indications were found of through-wall dealloying located on the body of cast aluminum-bronze ECW valve 2-EW-FV-6936 on July 28, 2011. An additional three dealloying indications on the same valve body were found November 30, 2011. A similar valve, 2-EW-FV-6937, has also been found to show indications of dealloying. Evaluation of the affected components determined that the structural integrity of the ECW piping is not adversely affected by the dealloying.

The attached relief request addresses the present condition of the valves, and implementation of compensatory and corrective actions. The affected valves are considered to be operable but degraded. Operability and functionality of the system have been maintained. Deferring code repair of the flawed components will not adversely affect the health and safety of the public.

A list of commitments in the request is attached.

STPNOC asks for NRC approval of this relief request by April 7, 2012, to support restart of Unit 2 from the current unit outage.

If there are any questions, please contact either Mr. P. L. Walker at (361) 972-8392 or me at (361) 972-7867.

D. W. Rencurrel
Senior Vice President,
Technical Support & Oversight

PLW

Attachments: 1) Request for Relief from ASME Boiler and Pressure Vessel Code, Section XI Requirements for the Essential Cooling Water System (RR-ENG-3-08)

2) List of Commitments

A047
NRR

STI No. 33369231

cc:

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SOUTH TEXAS PROJECT
UNIT 2
REQUEST FOR RELIEF FROM ASME BOILER AND PRESSURE VESSEL CODE, SECTION XI REQUIREMENTS FOR THE ESSENTIAL COOLING WATER SYSTEM
(RR-ENG-3-08)

1. Component for Which Relief is Requested

(a) Description:

Aluminum-bronze Essential Cooling Water (ECW) blowdown isolation valves 2-EW-FV-6936 and 2-EW-FV-6937 are 4-inch 150-lb. air-operated valves manufactured by W-K-M (RF 70-28-2 DRT Nuc 3 Control Valve). The valves are designed to meet the requirements specified in ASME Section III, 1974 Edition through 1975 Winter Addenda with Code Case 1761-1.

Figure 1 describes the valve location, and a schematic of the valve is provided as Figure 2.

(b) Function:

The ECW System is designed to supply cooling water to various safety-related systems for normal plant operation, normal shutdown, and during and after postulated design-basis accidents. Valves 2-EW-FV-6936 and 2-EW-FV-6937 have a safety-related function to stop ECW blowdown on a safety injection signal. The valves fail closed on loss of power. The valves are normally closed and opened only when blowdown is needed.

(c) Class:

ASME Code Class 3

(d) Description of the flaws:

Two indications of through-wall dealloying were identified on the inlet flange of cast aluminum-bronze ECW valve 2-EW-FV-6936 on July 28, 2011. The valve minimum wall thickness in the affected area is ¼ - inch. Residue deposits indicating dealloying were found at the 10 o'clock (Figure 3) and 2 o'clock (Figure 4) positions (looking upstream from the valve inlet). Prior to cleaning, each indication was less than 1/2-inch in diameter. Cleaning reduced each indication to less than 1/8-inch in diameter. Subsequent inspection on November 30, 2011, found additional residue at the 2 o'clock position with little apparent change at the 10 o'clock position. Visual examination found no cracks, and there is no measurable leakage.

The November 30, 2011, inspection identified an additional three dealloying indications on the same valve body. The indications are on the inlet flange of 2-EW-FV-6936 between the 11 o'clock and 1 o'clock positions (between the first two indications). See Figure 5. Prior to cleaning, the indications were approximately 1/8 - inch in diameter. Visual examination found no cracks, and there is no measurable leakage.

A dealloying indication on valve 2-EW-FV-6937 was found on January 9, 2012. The valve minimum wall thickness in the affected area is ¼ - inch. Dealloying at the 2 o'clock position was identified as a spot less than 1/8 - inch in diameter surrounded by multiple pinpoints of secondary indications. See Figure 6. This may be indicative of a dealloyed volume of piping material with a surface area 1 - inch by 1-1/2 inch. Visual examination found no cracks, and there is no measurable leakage.

2. Applicable Code Edition and Addenda:

ASME Boiler and Pressure Vessel Code, Section XI, 2004 Edition

3. Applicable Code Requirement:

ASME Section XI, IWA-5250(a)(3) requires that the source of leakage be evaluated for repair or replacement in accordance with IWA-4000 or IWA-7000. Relief from the requirements of IWA-5250(a)(3) is requested so that code repair of the through-wall flaw at these locations may be deferred until the parts required for replacing the valves can be obtained.

4. Reason for Request

The flaws in valve 2-EW-FV-6936 were first found on July 28, 2011, during six-month visual examination of ECW large bore piping. Unit 2 was in Mode 1 at 100% power. Note that refueling outage 2RE15 began October 29, 2011. Through an oversight, the need for a relief request was not identified at the time of discovery, and repairs were not completed during 2RE15 prior to Unit 2 restart and breaker closure on November 22, 2011. Subsequent to restart of Unit 2, an unrelated and unplanned shutdown occurred on November 29, 2011. Unit 2 remains shutdown in Mode 5 with restart planned for mid-April 2012.

The second set of dealloying flaws was found in valve 2-EW-FV-6936 on November 30, 2011, during a follow-up visual examination. Unit 2 was in Mode 5 at 0% power.

A dealloying flaw was visually identified in valve 2-EW-FV-6937 on January 9, 2012, during the periodic examination of ECW large bore piping. Unit 2 was in Mode 5 at 0% power.

These flaws are to be repaired by replacing the degraded valve bodies. Replacement of the affected valves at this time is not possible because the necessary parts are not available. Valve replacement will follow receipt of the replacement parts. Approval of this relief request will allow deferral of code repair of flaws until after Unit 2 is returned to service, currently scheduled for mid-April 2012. Time required to obtain the parts precludes resolution of the flaws prior to the planned Unit 2 startup date. Delaying unit restart until completion of repairs would constitute a hardship without a compensating increase in the level of quality and safety.

5. Proposed Alternative

ASME Section XI, IWA-5250, requires that leakage be evaluated for corrective action and implies that any component with through-wall leakage must be repaired or replaced regardless of the leakage rate. The expectation of ASME Section XI is that through-wall leaks are repaired at the time of discovery. Replacement of the affected valves is to be deferred until parts are available. The work can be performed when the unit is in Mode 1. More frequent monitoring has been implemented to detect changes in the condition of the flaws and initiate compensatory actions as needed until a repair can be implemented.

6. Basis for Use

6.1 Scope

Two indications of through-wall dealloying were identified on the inlet flange of cast aluminum-bronze ECW valve 2-EW-FV-6936. These indications only affect the ECW train B blowdown valve to the sump.

An additional three indications of dealloying were found on the same valve body. These indications only affect the ECW train B blowdown valve to the sump.

An indication of dealloying was found on valve 2-EF-FV-6937. This indication only affects the ECW train C blowdown valve to the sump.

No indications of dealloying have been found on ECW train A blowdown valve to the sump.

6.2 Specific Considerations

The ECW system is a low-pressure system with normal operating pressure of approximately 50 psig and a design pressure of 120 psig. Normal system temperature is 47 to 100 degrees F. Temperature following a design-basis accident is not expected to exceed 120 degrees F.

Three independent ECW loops are required to be operable in Modes 1, 2, 3, and 4. If only two of the essential cooling water loops are operable, all three are to be operable within seven days. If only one loop remains in service, one loop is to be returned to service within one hour. If these requirements are not met, the affected unit is to be in Hot Standby within the next six hours and in Cold Shutdown within the next 30 hours. The requirements of the Configuration Risk Management Program can be applied to extend the return-to-service time. However, engineering review determined that, although degraded by the flaws, these ECW valves remain operable.

Consequences of potential system interactions, including flooding, spray on equipment, and loss of flow to the system, are addressed in Appendix 9A of the South Texas Project Updated Final Safety Analysis Report, "Assessment of the Potential Effects of Through-Wall Cracks in ECWS Piping". The assessment assumes the effects of spray from a moderate energy line (10-inch diameter). Safety-related equipment is either designed to operate in a spray environment, or protected if sensitive to spray. Flooding in a given area due to the ECW system is enveloped by worst case flow from an opening in a local pipe due to a "critical crack" with an area equivalent to a rectangle of length one-half the pipe diameter and a width equal to one-half the pipe wall thickness. This assessment bounds the condition under consideration.

Flooding assessment gives a potential flooding rate of approximately eight gallons per minute through a postulated crack in the ECW pipe. However, the flood volume over a seven-day period is enveloped by the licensing-basis flooding analysis with a maximum flood rate of approximately 5750 gallons per minute for 30 minutes.

Leakage from ECW piping in this location flows to the Mechanical Auxiliary Building (MAB) sumps. Sump level alarms are available to warn operators if leakage exceeds the sump pump capacity. The MAB sumps have two sump pumps, each rated at 390 gpm for 110-ft of head. The MAB sump room is neither safety-related nor required for safe cold shutdown.

The ECW pumps and the cooling reservoir have adequate design margin and make-up capability to account for postulated leakage and are therefore fully capable of fulfilling the design-basis functions and mission times during a design-basis accident.

The flawed components are located downstream of components cooled by the ECW system. Each ECW blowdown valve can be isolated by means of a normally open, manually operated isolation valve immediately upstream. The isolation valves provide the ability to isolate the blowdown valves while maintenance is being performed.

Structural integrity is monitored by the following methods:

- Perform monthly walkdowns of the affected valves to detect changes in size of the discolored area or leakage until a code repair is performed. Structural integrity and the monitoring frequency are re-evaluated if significant changes in the condition of the dealloyed area are found during this monitoring. (See commitment in Attachment 2.) There is no measurable leakage at this time.
- Continuation of large bore ECW piping periodic walkdowns. VT-2 examinations of all ECW train piping are performed at six–month intervals to identify areas of dealloying. These examinations have proven to be an effective means of identifying flaws in ECW components prior to deterioration of structural integrity margins below ASME Section XI requirements. The dealloying process proceeds very slowly. Despite the increased frequency of inspection following identification of a flaw, changes observed in flaw conditions over a period of months have been inconsequential or non-existent. Dealloying flaws are only detectable by visual examination once they have reached the piping surface. Dealloying flaws are addressed under the station condition reporting program.

6.3 Root Cause Determination

The root cause of dealloying is a combination of corrosion and stress. The dealloying process normally initiates from a crevice such as the area behind a backing ring, a fabrication-induced flaw, or a casting flaw. Dealloying in this case is believed to be similar to dealloying seen in other susceptible aluminum-bronze components. The process by which dealloying of aluminum-bronze occurs is described in previous communications with the NRC (Reference 8.1).

6.4 Flaw Evaluation

The critical length of a crack without affecting the structural integrity of the valve body is 3.0 inches, determined using the actual piping end loads from the stress calculation and comparing with the critical bending stress from summary of fracture results for 4-inch nominal pipe size, and critical bending stress for through-wall casting with cracks.

Design ultimate tensile strength of aluminum-bronze is 75 ksi. The allowable stress is determined using average ultimate tensile strength (30 ksi) of 100-percent dealloyed aluminum-bronze. In accordance with ASME Section III Appendix III, the base material allowable stress at maximum temperature (S_h) is one quarter of the ultimate tensile strength, or 7.5 ksi.

From ASME III Section NC 3600, the allowable stresses are:

- EQ. 8 (ND-3652) (Pressure and weight) = 1.0 * S_h = 7500 psi
- EQ. 9B (NCA-2142) (Pressure, weight, OBE) = 1.2 * S_h = 9000 psi
- EQ. 9D (NCA-2142) (Pressure, weight, SSE) = 2.4 * S_h = 18000 psi
- EQ. 10 (NC-3653.2(a)) (Thermal) = 1.5 * S_h = 11250 psi
- EQ. 11 (NC-3652.2(c)) (Pressure, weight, thermal) = 2.5 * S_h = 18750 psi

Expansion Stress

Allowable stress range for expansion stress:

S_A = 1.25 S_c + 0.25 S_h (ND-3600)

Where S_c = allowable stress at minimum temperature

S_h = allowable stress at design temperature.

In this case, $S_c = S_h$, so that for 100 percent dealloyed material:

S_A = 1.25 *(7.5) + 0.25*(7.5)

S_A = 11.25 ksi

End Loading Stress

The following table summarizes loads transferred from the pipe to the valve body (pipe end loads), pipe break stresses, and the corresponding safety margins.

Loading Condition	Moment M_b (ft-lb)	Moment M_c (ft-lb)	$(M_b^2 + M_c^2)^{\frac{1}{2}}$ (ft-lb)	Allowable Moment (ft-lb)	Safety Margin
Normal	125	258	287	1533	5.34
Upset	153	398	426	3067	7.20
Faulted	170	461	491	5428	11.05

Upset = Operating-Basis Earthquake

Faulted = Safe-Shutdown Earthquake

Where: M_b = resultant moment loading due to sustained and occasional loads

M_c = range of resultant moments due to thermal expansion

Postulated Pipe Break Stress

	EQ. 9 Pressure and Weight (psi)	EQ. 10 Thermal (psi)	EQ. 9+10 (psi)	Allowable (psi)	Safety Margin
STRESS	1656	457	2113	19440	9.20

Pressure Stress

Pressure stress for the location is calculated at 120 psi, which is small relative to the minimum allowable value of 7500 psi for dealloyed material. Combining the primary membrane stresses results in the following:

Pressure stress = 481 psi

Membrane stress = 908 psi (due to bending loads)

Combined stress = 1389 psi

The combined stress remains below the 7500 psi allowed for dealloyed aluminum bronze.

The following are the predicted stresses from current stress analyses, versus the allowable stresses, with the attendant safety margins:

STRESSES	PRESSURE + DEAD WEIGHT	FAULTED	THERMAL
PREDICTED STRESS (psi)	1389	1813	457
ALLOWABLE STRESS (psi)	7500	18000	11250
SAFETY MARGIN	5.3	9.9	24.6

The maximum ratio of ultimate tensile strength for material before dealloying versus 100 percent dealloyed material is 75 ksi/30 ksi, or 2.5. This compares to a safety margin of 5.3 applied in the original stress analysis. Therefore, the material continues to have significant margin against failure for the design-load conditions.

Based on significant margin available compared to the fracture analysis calculation and also with allowable stresses based on ultimate tensile strength of 100 percent dealloyed material, dealloying does not compromise structural integrity of the valve body.

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

6.5 Augmented Inspection

Normally, walkdowns of ECW piping are performed at intervals of six months. In the event a flawed area is discovered, augmented monthly inspections are performed to monitor the flaw to detect changes in the size of the discolored area or leakage rate. A flaw caused by dealloying is not detectable by either ultrasonic testing or radiography.

Inspectors look for: 1) change from residue buildup to active dripping; 2) new indication at a different area on the component; or 3) a substantial change (about 2x or more) in the area of the original indication. Periodic monitoring and inspection by STPNOC provide confidence in the ability to detect changes in the leakage rate before leakage becomes a safety issue. Structural integrity and the monitoring frequency are re-evaluated if monitoring identifies significant changes in the condition of the flawed area.

The dealloyed areas have not shown sufficient change from the time of discovery to warrant accelerated implementation of corrective measures.

The experience at the South Texas Project is that the dealloying process progresses very slowly. Changes observed in flaw conditions over a period of months have been inconsequential or non-existent. Any changes in flaw parameters would be identified well before operability of the affected ECW train is challenged. Consequently, monthly inspections are appropriate.

6.7 <u>Conclusion</u>

The South Texas Project has analyzed previously identified through-wall flaws in ECW piping and found that degradation progresses slowly. Dealloying produces detectable leakage before flaws reach a limiting size that would affect the operability of the Essential Cooling Water System. Rapid or catastrophic failure due to dealloying is not a concern. Flaws are monitored and inspected to ensure detection of leakage. Increased inspection frequency provides assurance that changes in the condition of the flaws will be identified and assessed for further action as needed. Evaluation of the flaw using fracture mechanics methodology concludes that the structural integrity of the ECW piping is not adversely affected. The de-alloying indications in either ECW control valve assembly do not prevent ECW flow control valves 6936 or 6937 from performing their safety functions. Operability and functionality of the system are maintained, and deferring repair of the valves will not affect the health and safety of the public.

7. <u>Duration of Proposed Alternative</u>

Replacement of the flawed valves will be deferred until the required parts are available to complete the repair, provided the condition continues to meet the acceptance criteria. The work will not be dependent on the unit's operational mode, and so may be performed prior to the next refueling outage.

8. <u>References</u>

8.1 Letter, Status of Corrective Actions in the ECW System, M. A. McBurnett to Document Control Desk, dated November 1, 1988 (ST-HL-AE-2748)

8.2 Letter, Relief from ASME Boiler and Pressure Vessel Code Section XI Requirements (Dealloying) (Relief Request RR-ENG-35) (Supplement 2), T. J. Jordan to Document Control Desk, dated August 10, 2000 (NOC-AE-00000816) (ML003742174)

FIGURE 1: PIPING DIAGRAM FOR ESSENTIAL COOLING WATER SYSTEM

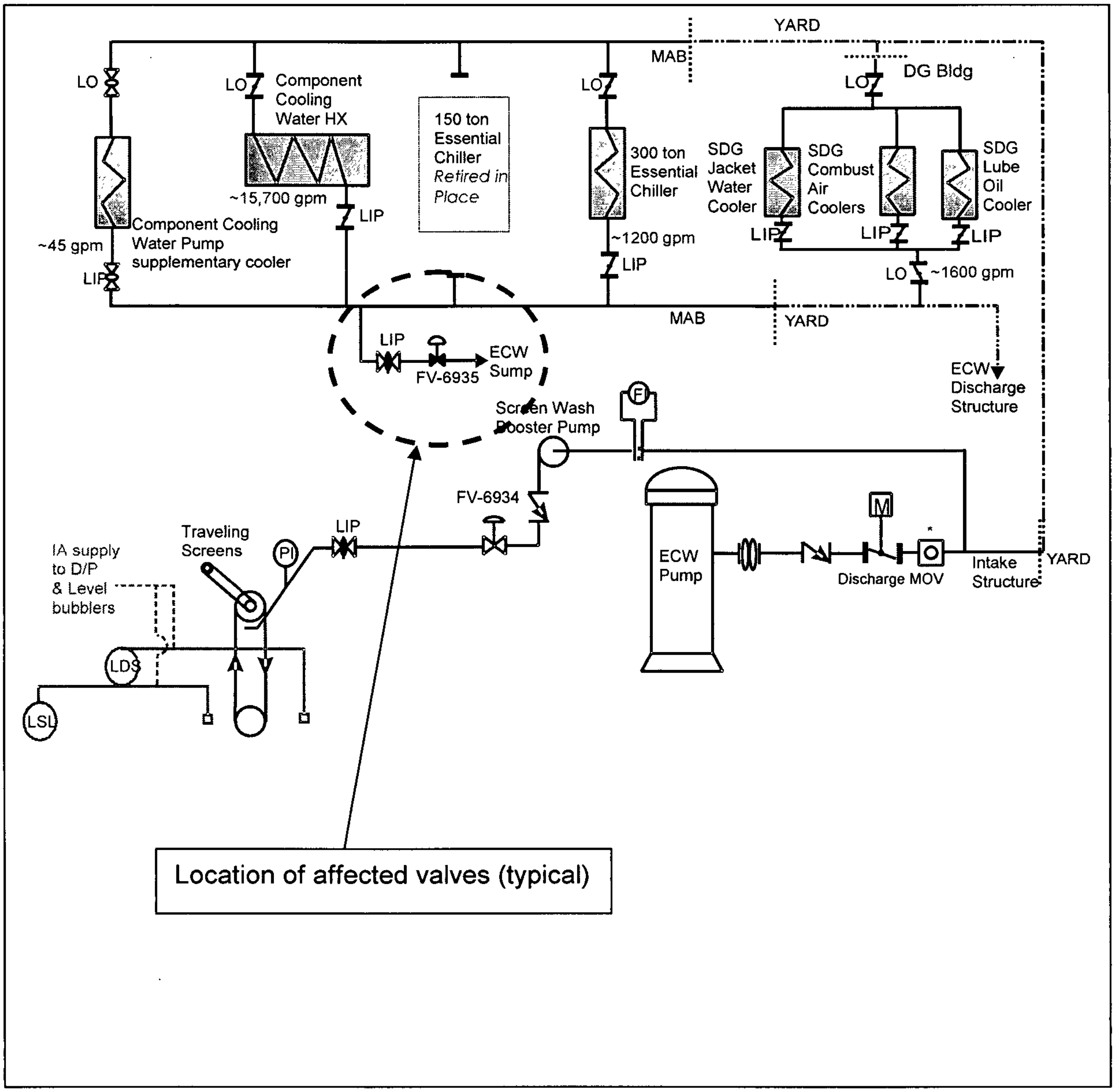


FIGURE 2: SCHEMATIC OF AFFECTED ECW VALVE

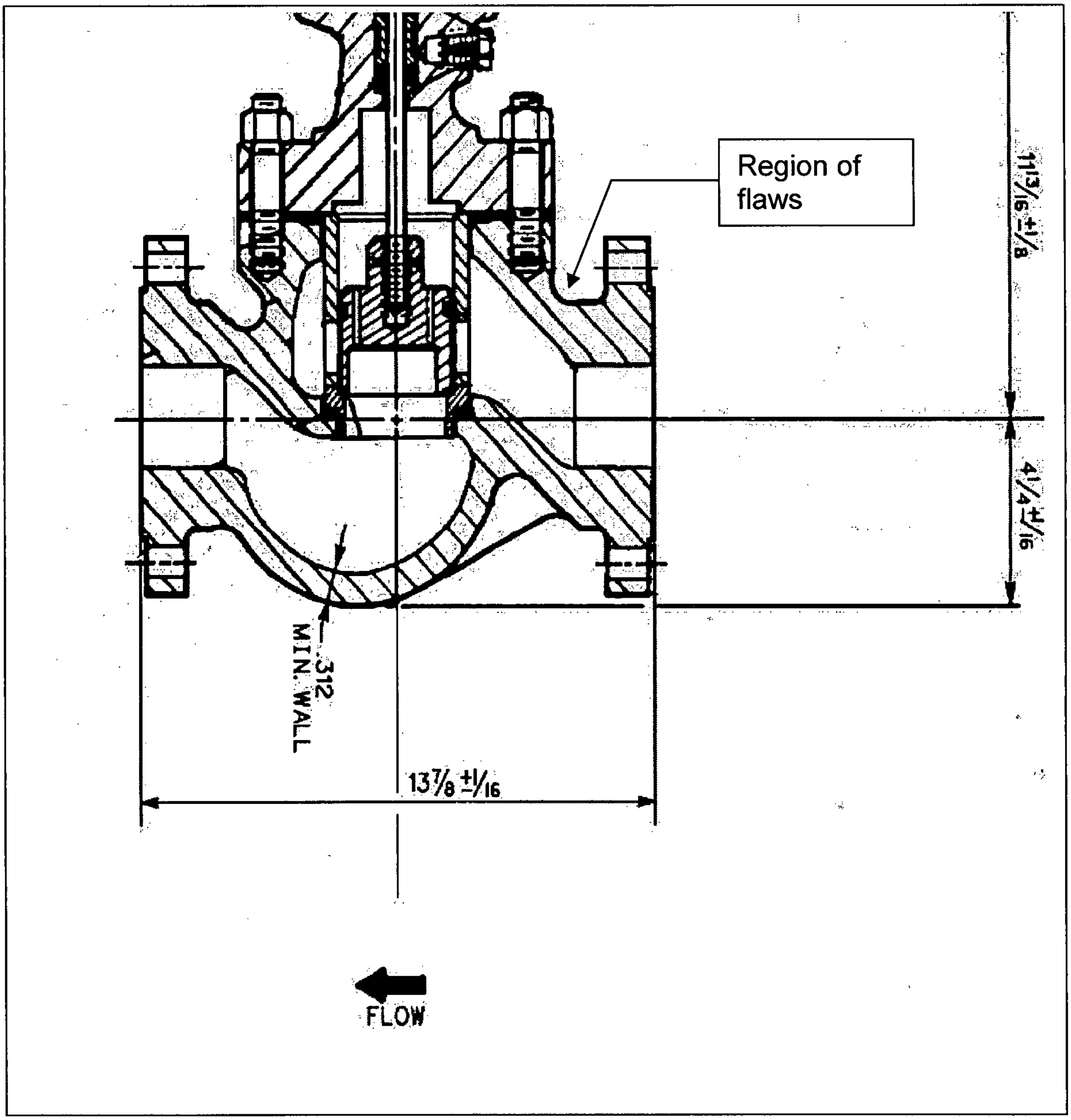
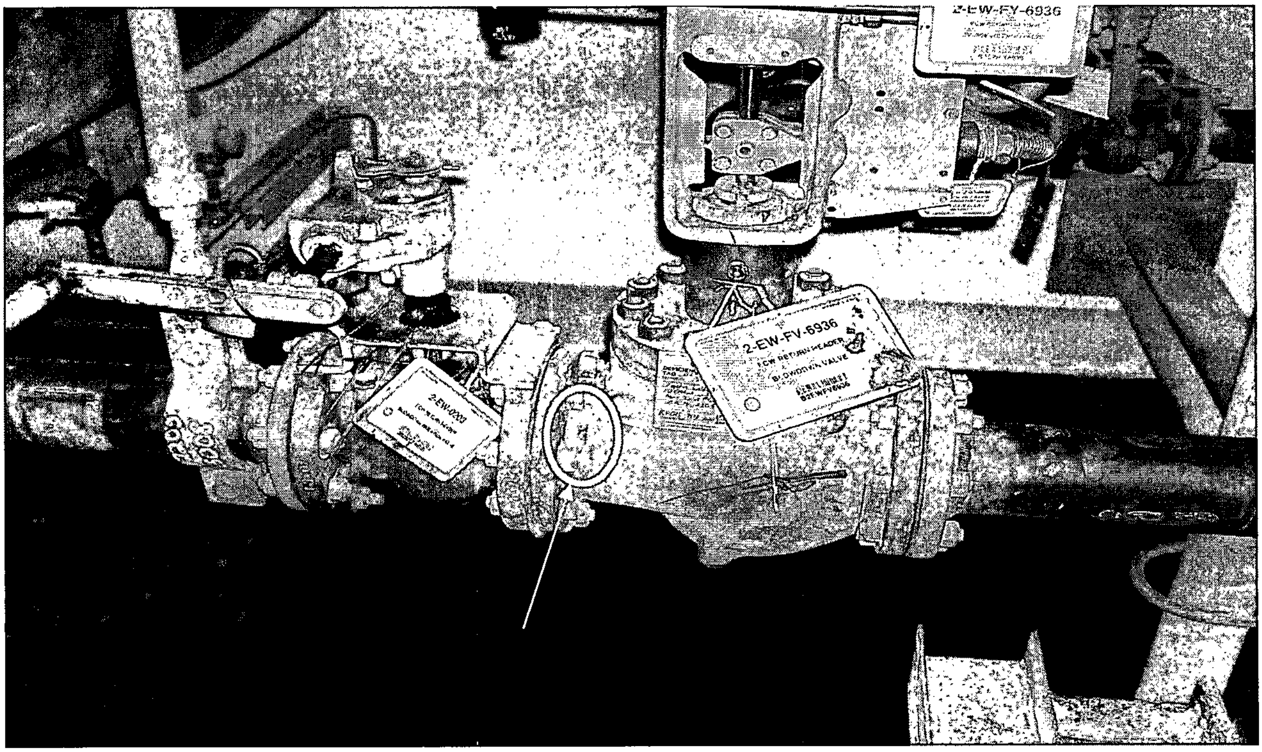


FIGURE 3: DEALLOYED AREA AT 10 0'CLOCK POSITION (2-EW-FV-6936)



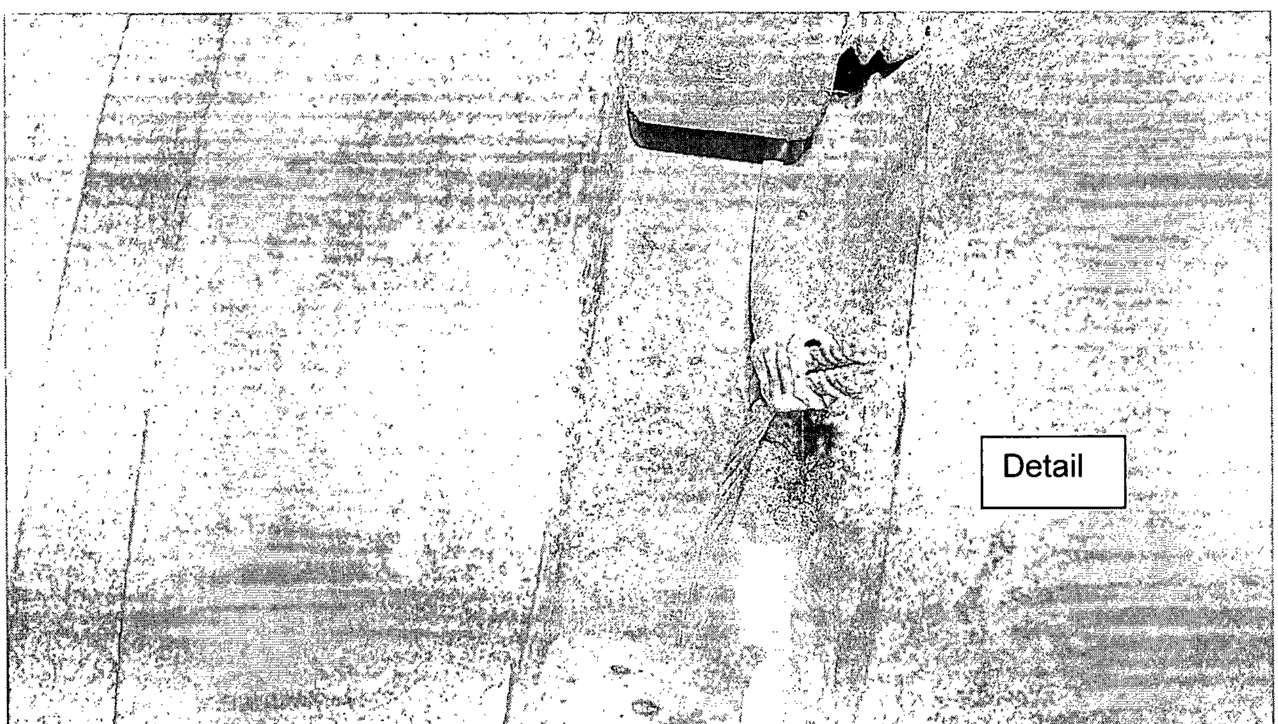
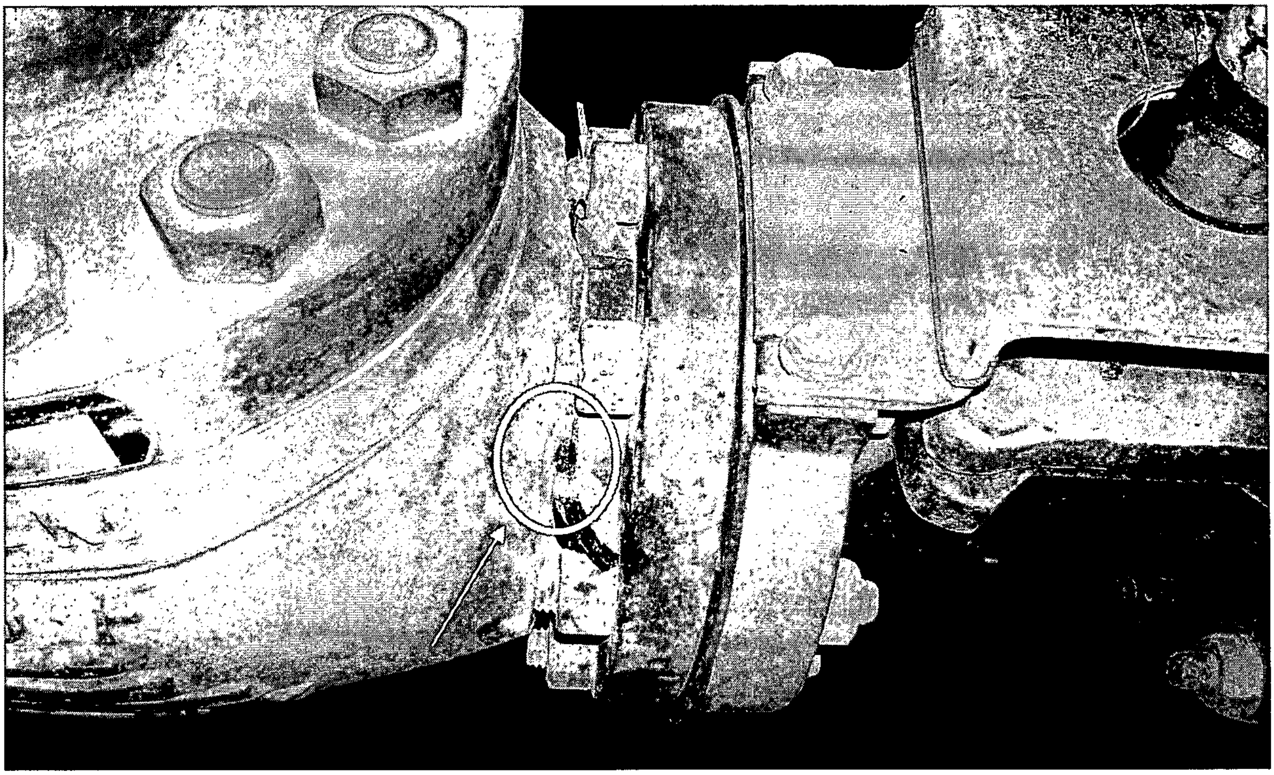


FIGURE 4: DEALLOYED AREA AT 2 O'CLOCK POSITION (2-EW-FV-6936)



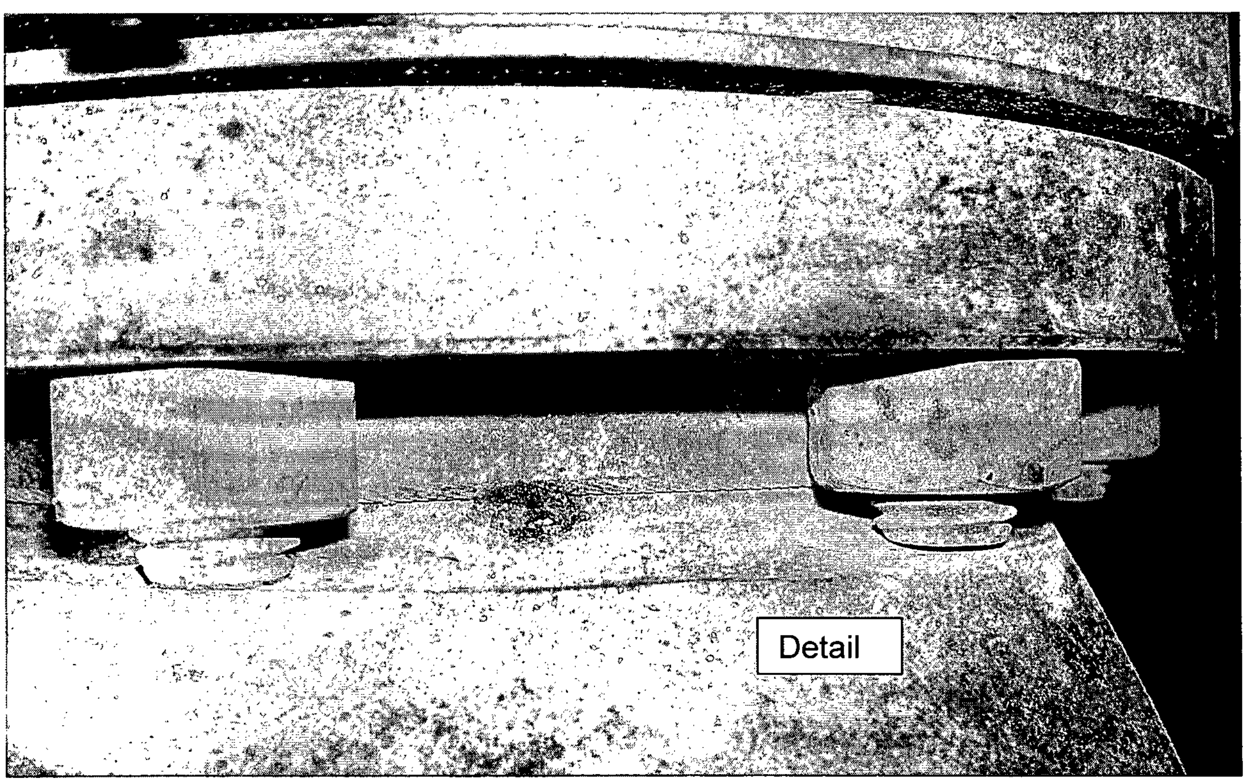
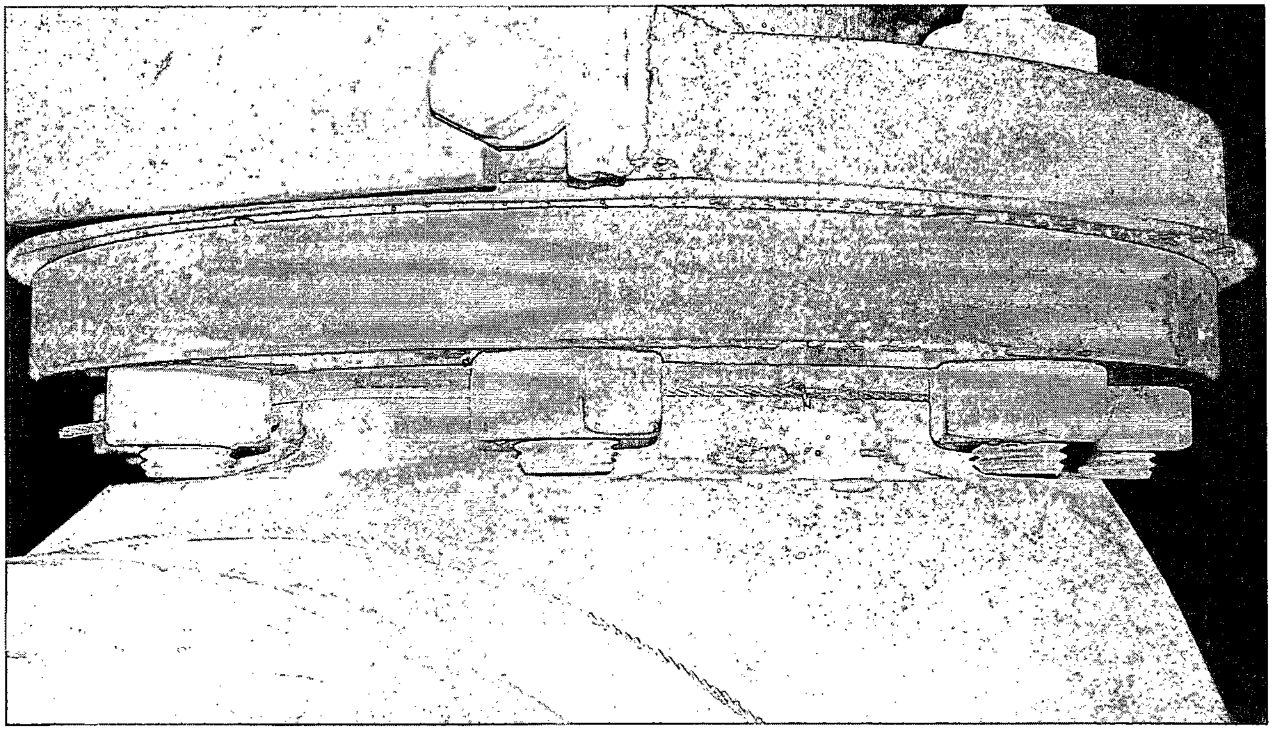


FIGURE 5: ADDITIONAL AREAS OF DEALLOYING (2-EW-FV-6936)



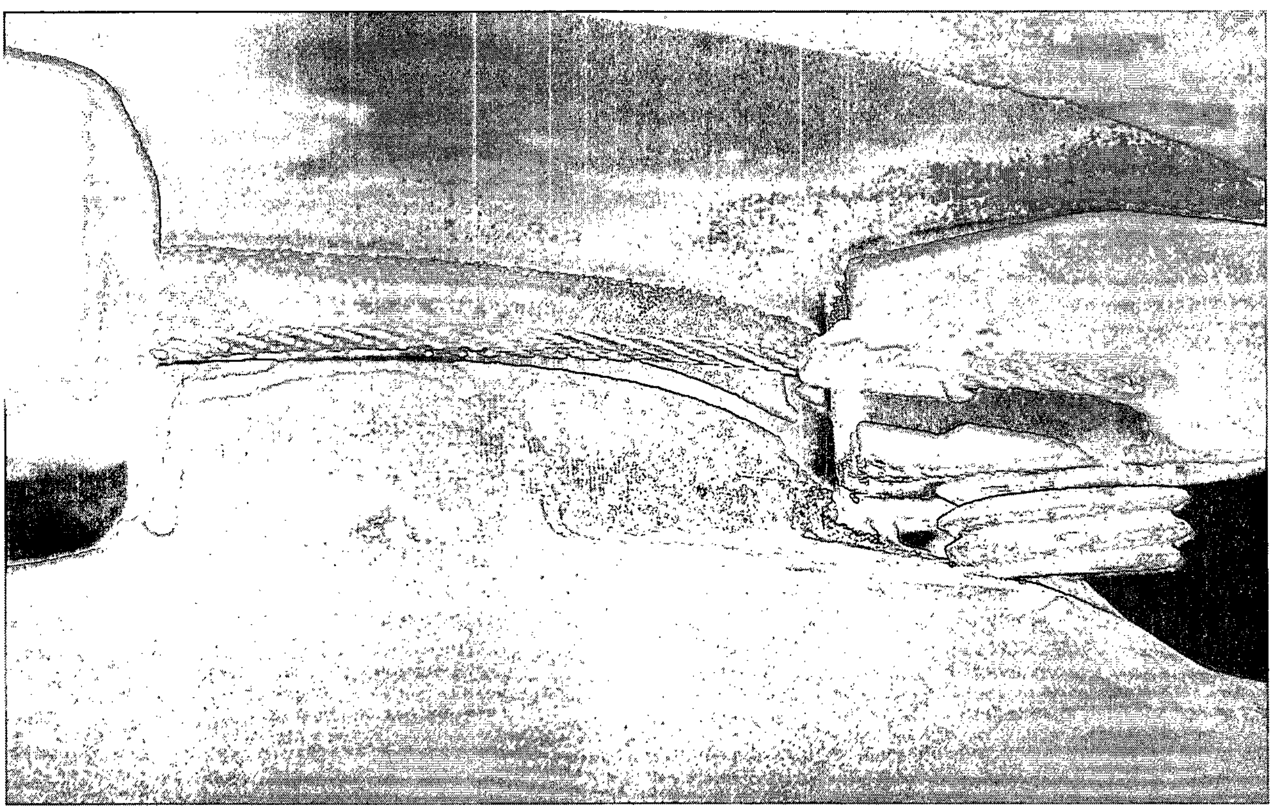
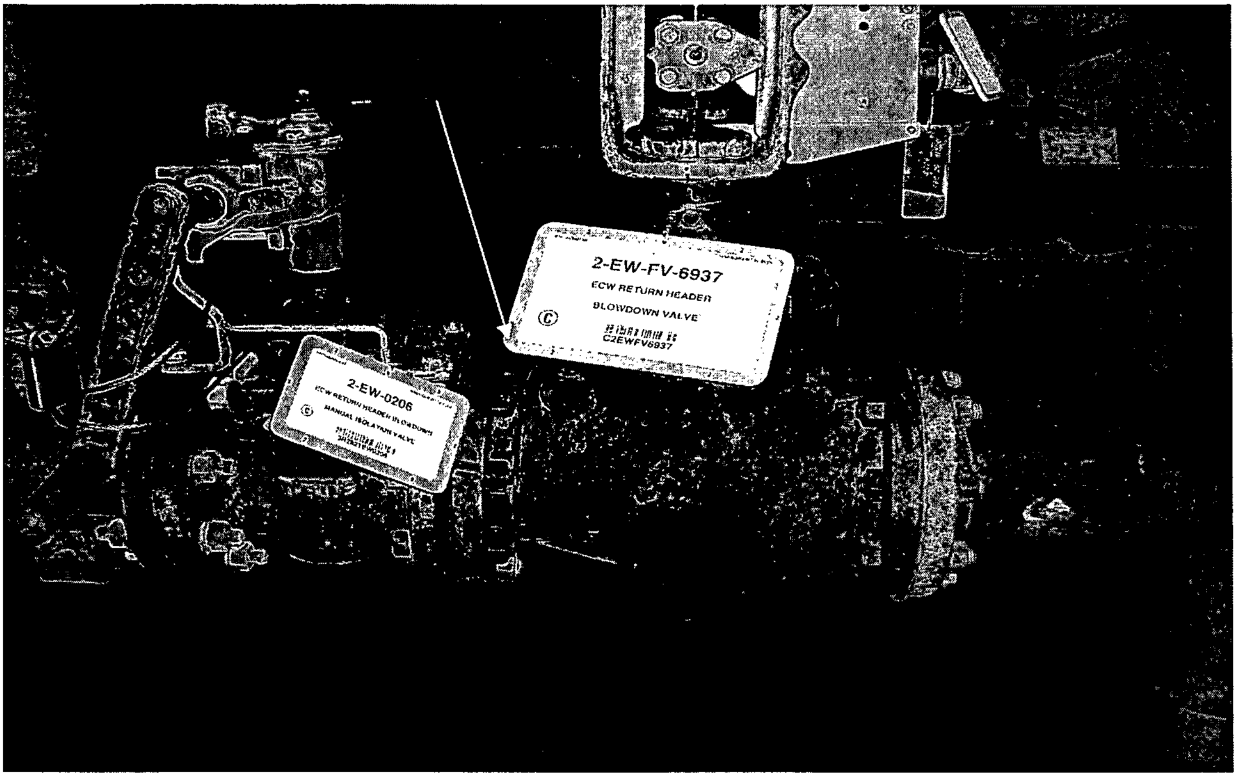
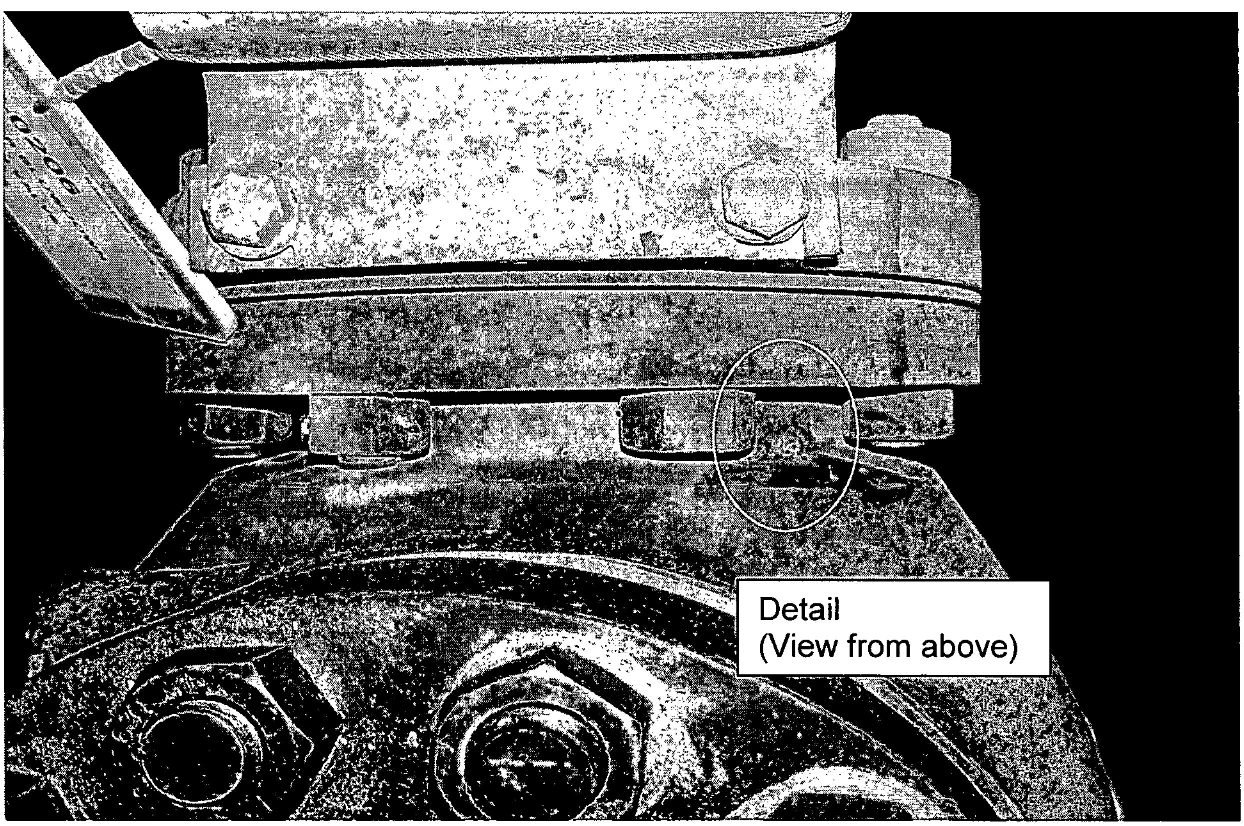


FIGURE 6: DEALLOYED AREA AT 2 O'CLOCK POSITION (2-EW-FV-6937)





LIST OF COMMITMENTS

The following table identifies the actions in this document to which the STP Nuclear Operating Company has committed. Statements in this submittal with the exception of those in the table below are provided for information purposes and are not considered commitments. Please direct questions regarding these commitments to Philip Walker at (361) 972-8392.

Commitment	Expected Completion Date	CR Action No.
2-EW-FV-6936: Perform monthly walkdowns of the affected valves to detect changes in size of the discolored area or leakage until a code repair is performed. Re-evaluate structural integrity and the monitoring frequency if significant changes in the condition of the dealloyed area are found.	12/12/2012	11-12309-04
2-EW-FV-6937: Perform monthly walkdowns of the affected valves to detect changes in size of the discolored area or leakage until a code repair is performed. Re-evaluate structural integrity and the monitoring frequency if significant changes in the condition of the dealloyed area are found.	05/01/2013	12-1044-03