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Alabama Power
the southern electric system

10CFR50.55a(g)

Docket No. 50-364

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555

Gentlemen:

Relief Request for Temporary
Non-Code Repair of Service Water Piping
Joseph M. Farley Nuclear Plant - Unit 2

During work to discover the source of an underground pipe leak at the Joseph M. Farley Nuclear Plant, it was determined that a through-wall flaw existed in the Unit 2 Train B service water discharge line from the diesel generators. The leak was in a section of ASME Class 3 piping which could not be isolated for repair in accordance with the ASME Code without removing the Unit 2 Train B service water system from service. This would have required that the unit be shut down. Therefore, following appropriate evaluations, a temporary repair was effected to stop the leakage.

Using the guidance of Generic Letter 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," the flaw and pipe condition were evaluated to determine the acceptability of a temporary non-Code repair. This evaluation determined that the flaw originated at the exterior surface of the pipe at a location where the protective pipe coating had become damaged. This evaluation further indicated that the flawed piping satisfied the "Through-Wall Flaw" stability criteria of Generic Letter 90-05. Enclosure 1 to this letter provides the details of the technical evalu on which was performed to justify the use of a temporary repair.

Since the flaw meets the stability criteria of Generic Letter 90-05 and permanent repairs in accordance with the ASME Code are impractical without shutting down the unit, Alabama Power Company requests granting of relief permitting temporary non-Code repair of the affected service water piping as an alternative to the requirements of the ASME Boiler and Pressure Vessel Code, Section XI. The detailed Code relief request is provided as

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Enclosure 2 to this letter. This relief, if granted, will remain in effect until the next scheduled outage of 30 days or greater, or until the next Unit 2 refueling outage which is currently scheduled to begin in March, 1992.

If you have any questions, please advise.

Respectfully submitted,

ALABAMA POWER COMPANY

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JDW/DEMc:maf29.55

Enclosures

cc: Mr. S. D. Ebneter
Mr. S. T. Hoffman
Mr. G. F. Maxwell

ENCLOSURE 1

Technical Justification for Performance of a Temporary Repair in Accordance with Generic Letter 90-05

1.0 Flaw Detection

Due to a surface water indication of an underground leak in the vicinity of the Primary Access Point (PAP) structure, excavation of the area to determine the source of the leakage was performed. An excavation approximately 40 feet long, extending approximately 25 feet underneath the PAP structure between the Unit 1 Turbine Building and the Auxiliary Building, was required to locate the leak. On February 24, 1991, it was determined that the source of the leakage was a through-wall flaw in the Unit 2 Train B service water return line from the diesel generators. The leakage rate from the flaw was estimated to be approximately 15 gallons per minute. It should be noted that the Unit 2 Train B service water system was capable of performing its design functions at all times, even with the existence of the leak.

2.0 Impracticality of Repair at Power

The specific location of the flaw is line 12-HBC-204 downstream of Unit 2 Train B Diesel Building discharge valves Q2P16V536 and Q2P16V564 in a section of piping which connects the Diesel Generator Building discharge to a common header with the Train B discharge from the Turbine Building, the Auxiliary Building and Containment Building (refer to Figure 1). This common header directs the Unit 2 Train B service water discharge to the river during normal plant operation or to the Service Water Ultimate Heat Sink Pond during emergency recirculation operation. The section of piping containing the flaw is an ASME Section III, Class 3 and Seismic Category I line with a design rating of 150 psig at 200°F.

Due to its location, isolation of the leak using available isolation valves would have required that the Unit 2 Train B service water flow through the Diesel Building, Turbine Building and Containment and Auxiliary Buildings be stopped. This is not possible without shutting down the unit.

The feasibility of conducting a Code repair utilizing a freeze seal on the downstream side of the flaw to allow the Turbine Building, Auxiliary Building and Containment Building Train B discharge lines to remain in service was evaluated. However, estimates of the required time to effect a Code repair under these conditions indicated that an acceptable repair could not be achieved within the 72 hour Limiting Condition for Operation (LCO) of Technical Specification 3.7.4. The Code required hydrostatic test to verify the adequacy of the repair could not have been performed without removing additional portions of the system from service which, in turn, would require the unit to be shut down.

Therefore, Alabama Power Company elected to evaluate the flaw and pipe condition using the guidance of Generic Letter 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping." Based on the results of that evaluation, a temporary repair to stop the leak was utilized and relief from the ASME Code, using Generic Letter 90-05 for guidance, is being requested to allow continued use of the temporary repair until the next scheduled outage exceeding 30 days but no longer than the next Unit 2 refueling outage which is currently scheduled to begin in March, 1992.

3.0 Flaw Characterization and Root Cause Determination

The through-wall flaw is in a 12" ASME Section III, Class 3, carbon steel line (SA106 Grade B with a nominal wall thickness of 3/8"). Based on the 12.5% manufacturer's tolerance, the piping was procured with a specified wall thickness of no less than 0.328". The flaw is located near the top of the pipe at approximately the 11 o'clock position facing north. It is in a straight, horizontal run of piping and is not near a weld or in the heat affected zone of a weld.

The flaw was characterized using visual examination, radiography and ultrasonic thickness measurements. Based on the visual examination, the flaw is located in an area approximately 2" in diameter where the protective pipe coating is missing and the base metal is exposed. The perforation is roughly circular in shape, approximately 3/8" diameter at the inside pipe wall and 3/4" diameter at the outside pipe wall. The area directly adjacent to and encompassing the flaw revealed some evidence of pitting or corrosion.

Radiography of the section of pipe containing the flaw was performed to locate any wall thinning, blockage or indications of microbially induced corrosion (MIC). Results from the radiography are not conclusive as 12" piping approaches the maximum line size where radiography can be used to examine the condition of a water-filled line. Nevertheless, the radiography indicates the flaw is localized and no other flaws are visible on the film adjacent to the known flaw or on the opposite wall of the pipe.

Ultrasonic thickness measurements were made with a Krautkramer-Branson USK-7S instrument and a dual element 4 MHz transducer calibrated on a 0.10" to 0.50" calibration standard in 0.10" increments. Based on the ultrasonic thickness measurements, the wall thickness within a 5" radius of the perforation varies from 0.34" to 0.36". This indicates that the flaw is limited to the perforation and there is no further localized wall thinning.

Based on the visual examination, evaluation of the radiographs and the ultrasonic thickness measurements, it is postulated that the through-wall flaw was initiated by damage to the protective coating and pipe wall on the exterior of the pipe. After the protective coating was breached, the growth of the flaw continued from the exterior of the pipe due to localized corrosion at the flaw. When the remaining wall could no longer withstand the pipe pressure, the local area failed. The through-wall flaw then continued to grow due to flow assisted erosion.

The flaw contains no linear indications (cracks) that would indicate it was caused by stresses in the pipe. As discussed in Section 5.0 below, the flaw was temporarily repaired by installation of a repair enclosure over the flawed section of the pipe. Flaw growth due to erosion is stopped by the installation of the repair enclosure as it prevents flow through the flaw. Therefore, as (1) the flaw was not caused by stresses in the pipe, and (2) any further flaw growth due to corrosion and erosion should be minimal, the probability of uncontrolled propagation of the flaw is very small.

4.0 Flaw Evaluation

The structural integrity of the flawed piping was evaluated using the "Through-Wall Flaw" approach outlined in Generic Letter 90-05. This approach requires that the calculated stress intensity factor "K" be less than 35 $ksi(in)^{0.5}$. Applying the equations as presented in the Generic Letter, a "K" value of 7.2 $ksi(in)^{0.5}$ was calculated for the flawed piping location. Therefore, the flawed piping satisfies the flaw stability criteria of this approach and Generic Letter 90-05 supports a temporary non-Code repair of the ASME Section III, Class 3 line. Additional details on the calculation are provided in Appendix A.

5.0 Description of Temporary Repair

The leak in the service water line has been temporarily repaired by enclosing the leaking section of the pipe in a pipe repair enclosure that is specifically designed for in-service, non-destructive repair of leaks in straight runs of pipe. The pipe repair enclosure does not affect the structural integrity of the flawed pipe and is reversible in that the flawed piping can be returned to the as-found flawed condition. The specific enclosure used was a "PRI SelfSeal Line Repair Enclosure" manufactured by TEAM, Inc. This device includes two longitudinally flanged pipe sleeve halves which are bolted in place around the leaking section of the pipe. The flanged pipe sleeves are manufactured from SA216 WCC cast carbon steel and the bolting is SA193 Grade B7. A sealing element provides the pressure boundary between the repair enclosure and the surface of the pipe. This sealing element used both compression and the pressure of the leaking fluid in stopping the leak. No liquid sealing compounds were used. The 12" nominal size repair enclosure as required for this temporary repair weighs 223 lbs. It has an overall length of 11" and a sealing length of approximately 8".

The maximum recommended working pressure for the PRI SelfSeal Line Repair Enclosure is 1,000 psig at 650°F. The design conditions for this service water line are 150 psig at 200°F. However, (1) based on the maximum service water discharge temperature for the diesel generators, the service water temperature will not exceed 150°F at the location in the line where the repair enclosure is installed, and (2) based on the backpressure maintained on the service water system due to the elevation change in the recirculation to pond line or the standpipe in the return to river line, maximum service water pressure is not expected to exceed 25 psig at the location in the line where the repair enclosure is installed. Therefore, the pressure and temperature rating of the PRI SelfSeal Line Repair Enclosure significantly exceeds the conditions the repair enclosure will see in this service.

6.0 Augmented Inspection Program

Based upon the flaw characterization and root cause determination, it was determined that the most susceptible locations for similar degradation were the coated, underground portions of the service water system piping. During the excavation to identify the source of leakage, a total of approximately 60 feet of buried service water piping was partially or completely unearthed. Since the flaw had developed at a location where the exterior protective coating had been damaged, all portions of the normally buried service water piping which had been unearthed (accessible) were visually examined. This VT-3 examination identified three additional areas where the protective pipe coating was damaged. The pipe wall thickness was measured at these locations by ultrasonic testing (UT) and was found to be in excess of the minimum allowable pipe wall thickness and there was no evidence of external corrosion. All VT and UT exams were performed by certified examiners using qualified procedures. It is believed that these additional areas of pipe coating damage were created during performance of the excavation to locate the flaw. This is based upon the absence of external corrosion at these locations which would have been expected if the damage had been pre-existent.

Additional augmented inspection as recommended by Generic Letter 90-05 would not be productive in assessing the overall condition of the underground service water piping for the following reasons:

1. The root cause of the flaw is essentially random in nature. Therefore, there is no reason to suspect overall degradation of the protective coating on the underground service water piping based upon discovery of this one flaw.

2. The augmented inspection is performed at "accessible locations." The service water pipe susceptible to the corrosion identified is all buried. The act of excavating additional sites for inspection could, in itself, cause damage to the protective pipe coating at the chosen locations. This is evident by the discovery of three additional areas of coating damage in the piping which was examined which appear to have been caused by the excavation work performed to find the leak. Therefore, even if damage to the pipe coating at the chosen locations was discovered, that would not necessarily be indicative of overall degradation of the protective coating of the underground service water piping.

7.0 System Interactions

7.1 Loss of Service Water System Flow

The leak rate from the through-wall flaw was estimated to be approximately 15 gpm. As the leak is on a return header from the Diesel Generator Building, it would tend to cause a very small increase in the flow rate to the diesel generators. As the leak rate is very small in comparison to the normal flow of approximately 1,500 gpm through the 12" return header, the increased flow to the diesel generators would cause negligible changes in service water flows to other components.

The service water pond serves as the Ultimate Heat Sink for Farley Nuclear Plant. Exit flow from the service water system is normally returned to the Chattahoochee River. Should the service water system be in the recirculation to the service water pond mode, coincident with a loss of the river water system, a service water system leak will result in a loss of water inventory from the Ultimate Heat Sink. However, a loss of approximately 15 gpm is very small in comparison to existing losses of 1,145 gpm considered in the evaluation of the Ultimate Heat Sink due to other plant losses.

Therefore, a postulated failure of the temporary repair will have negligible effect on the performance of the service water system or the performance of the Ultimate Heat Sink.

7.2 Pipe Stress Analysis

A portion of the line has been left unearthed to facilitate weekly walkdown of the temporary repair. A piping stress analysis has been completed to demonstrate that the unearthed portion of the service water line retains its Seismic Category I qualification in its unearthed configuration. The unearthed portion of the line was modeled with the repair enclosure installed for a combination of pressure, deadweight and seismic (SSE) stresses. Thermal expansion stresses were not considered as the maximum service water temperature in this line is 150°F.

The analysis indicates that the maximum stress at the location of the leak is 3,956 psi as compared to the 18,000 psi allowed by Equation 9 of ASME Section III. Calculated pipe stresses in the remainder of the unearthed portion of the line are also well below code allowables.

7.3 Seismic II/I Interactions

Interaction with adjacent systems/structures due to Seismic II/I considerations was not a concern in the original design. The service water piping was buried in accordance with acceptable design criteria to prevent such interaction between the non-seismic structure located above it as well as other piping systems buried in this area. Since a portion of the service water piping must remain excavated to facilitate the weekly inspection program described in Section 8.0, as well as the permanent Code repair, Seismic II/I interaction has been considered.

The bracing, shoring and access manway have all been analyzed in accordance with Seismic II/I criteria and the results demonstrate that they are capable of performing their intended function of ensuring that the integrity of the service water system will be maintained during and following a seismic event. Also, the PAP slab above the piping has been shown to be adequate to ensure its integrity during a seismic event. Therefore, Seismic II/I interactions have been appropriately considered and found acceptable.

7.4 Missile Protection

The original design had sufficient backfill to preclude the effects of site and tornado generated missiles. Since a portion of the excavation will not be backfilled until the permanent repair is completed, missile protection must be provided. Turbine missiles are not postulated as part of the Farley Nuclear Plant design basis as stated in Section 10.2.3 of the Farley Nuclear Plant FSAR. Tornado generated missiles as described in FSAR Section 3.3.2 are bounding for this analysis.

The analysis indicates that the PAP's concrete slab, which is located above the pipe, is a sufficient missile barrier to resist postulated tornado missiles. In addition, the manway for access to the excavation was designed to withstand the impact of postulated tornado generated missiles. Therefore, the unearthed portion of the service water line is adequately protected from postulated missiles.

7.5 Flooding and Spray

Flooding of the excavated area below the PAP slab could occur if the temporary pipe repair fails. There are no safety-related components in the excavated area other than the service water piping in question. No safety-related system would be affected by spray that may result from a failure of the repair enclosure.

In the unlikely event of a failure of the repair enclosure the flow of water would not erode the excavation due to the construction of the shoring system. The lagging used on the side walls is held very tightly in place by sandbags and would not allow a spray directly against the soil. Also it would not allow soil to travel through the joints in the lagging if the excavation were to fill with water. The soil under the vertical supports is protected from erosion by lateral steel braces across the floor of the excavation and by plywood over the support footing.

This system of braces on the floor of the excavation would prevent any velocity of water flow capable of erosion. No significant soil erosion was observed between the time the leak was uncovered and the temporary repair was completed. Routine surveillance will be performed to ensure the continued integrity of the excavation and bracing system.

If the flow of water from the leak were to fill the excavation and begin to exit the area, the water would drain to the yard drainage system. No safety-related system would be affected by the water flowing to the yard drainage system. The amount of flow is small and was pumped to the yard drainage sytem during excavation with no adverse affects on the system.

7.6 Freeze Protection

The approximately 30 ft. long section of piping in the excavation underneath the PAP and access manway may be exposed to outside ambient temperatures until permanent repairs are made. However, it is our engineering judgment that specific measures to prevent freezing of this line are not required for the following reasons:

- o The unearthed portion of the line is a relatively short section
- o The unearthed portion of the line is below grade and in a tunnel under a heated building
- o A continuous flow of water is maintained through the line as long as Train B of Unit 2 is in service
- o The line is relatively large diameter
- o The climate in south Alabama is mild

7.7 Security

Security concerns resulting from leaving a portion of the service water system piping unearthed beneath the PAP have been evaluated and appropriate actions have been taken.

8.0 Integrity of Temporary Repair

The structural integrity and leak tightness of the temporary repair will be qualitatively assessed by performance of a weekly walkdown of the section of piping which will remain unearthed beneath the PAP structure. In addition, the continued structural integrity of the supports for the excavation will be assessed as a part of this weekly walkdown.

Due to the nature of this flaw, periodic radiographic (RT) or ultrasonic (UT) examination are not considered feasible to assess the integrity of the temporary non-code repair. Factors leading to this conclusion are:

1. The flaw originated at the exterior surface of the pipe at a location where the carbon steel pipe was in contact with soil due to damage to the protective pipe coating. The temporary repair enclosure will not be buried during the period between its application and the completion of a permanent Code repair. Therefore, the temporary repair enclosure will not be in contact with soil which contributed to the through-wall flaw in the original pipe. In any case, the initiation of exterior corrosion of the temporary repair enclosure can be detected more effectively by periodic visual examination than by the application of RT or UT examination methods.

2. The temporary repair enclosure and pipe configuration does not lend itself to effective volumetric examination (RT or UT) or meaningful examination results from these methods. The enclosure relies upon both external compression and the internal pressure from the leak to establish a leak tight seal. Integrity of this seal is best verified by periodic visual examinations.

3. Installation of the enclosure and maintenance of its leak tight integrity have eliminated flow through the hole. Thus, further flow assisted corrosion due to through-wall leakage is not expected. Therefore, actions taken ensure that the flaw will not continue to propagate.

Appendices:

Appendix A, Flaw Evaluation

Figures:

Figure 1, Simplified Schematic - Unit 2 Service Water System

Alabama Power Company - Farley Nuclear Plant

Service Water System - Unit 2 Train B

Diesel Generator Building Return Header

Appendix A: Flaw Evaluation - "Through-Wall Flaw" Approach

Pipe Data:

Pipe size - NPS 12 with 0.375 in. nominal wall thickness

Minimum wall - 0.28 in. as measured at 3 locations remote from the flaw. These 3 locations are in the areas where the protective pipe coating was removed to allow installation of the PRI SelfSeal Line Repair Enclosure.

Material - SA106 Gr. B

Stress Allowable - $S_c = S_h = 15{,}000$ psi

Max. Temperature - 150°F

Design Pressure - 150 psig

Minimum Wall Calculation:

$$t_{min} = \frac{PDo}{2(SE+Py)} + A$$

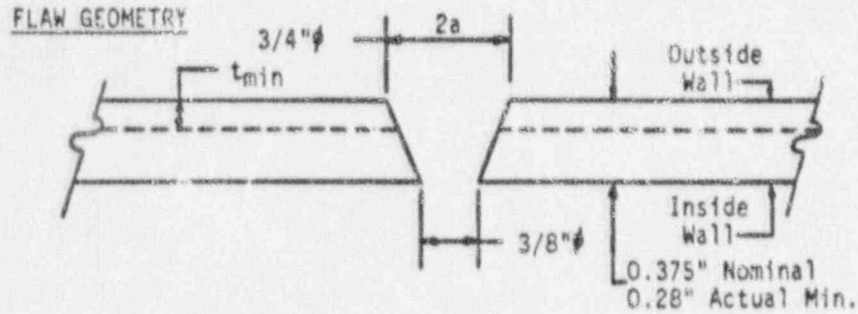
$$= \frac{150\ (12.75)}{2[15{,}000 + (150)(0.4)]} + 0.065$$

$$t_{min} = 0.128 \text{ in.}$$

Therefore, the three areas with a measured wall thickness of 0.28 in. do not violate minimum wall thickness requirements. The 0.128 in. wall thickness will be used as the minimum wall thickness.

Flaw Configuration:

Figure 1:



Circumference = C = 3.1416(d) = 3.1416(12.75) = 40.06 in.

Through-wall flaw length = 2a = 0.75 in.

As (2a = 0.75 in.) < 3 in.,
and as (2a = 0.75 in.) < [15% x (40.06 in.)] $\leq$ 6 in.,
the flaw is acceptable for the "Through-Wall Flaw" Approach

Generic Letter 90-05 Flaw Evaluation - "Through-Wall Flaw" Approach:

Stress intensity factor = $K = 1.4\ sF\ (3.1416a)^{0.5}$

From pipe stress analysis, s = 3,956 psi

Geometry factor = $F = 1 + A(c)^{1.5} + B(c)^{2.5} + C(c)^{3.5}$

$$c = \frac{a}{3.1416(R)}$$, where R = mean radius = 6.1875 in.

$$= \frac{0.375 \text{ in.}}{3.1416(6.1875 \text{ in.})}$$

$$= .01929$$

Coefficients:

$$r = \frac{R}{t_{min}} = \frac{6.1875}{0.128} = 48.34$$

$$A = -3.26543 + 1.52784(r) - 0.072698(r^2) + 0.0016011(r^3)$$
$$= 81.57118$$

$$B = 11.36322 - 3.91412(r) + 0.18619(r^2) - 0.004099(r^3)$$
$$= -205.78382$$

$$C = -3.18609 + 3.84763(r) - 0.18304(r^2) + 0.00403(r^3)$$
$$= 210.31242$$

$$F = 1 + 81.57118(0.019)^{1.5} - 205.78382(0.019)^{2.5} + 210.31242(0.019)^{3.5}$$
$$= 1.2036$$

$$K = 1.4(3{,}956)(1.2036)[3.1416(0.375)]^{0.5}$$
$$= 7{,}235 \text{ psi(in)}^{0.5}$$

Therefore, as the stress intensity factor "K" is less than 35,000 psi(in)$^{0.5}$ (consistent with the lower-bound fracture toughness property in ASME Code Case N-463), Generic Letter 90-05 allows a temporary non-Code repair to be proposed.

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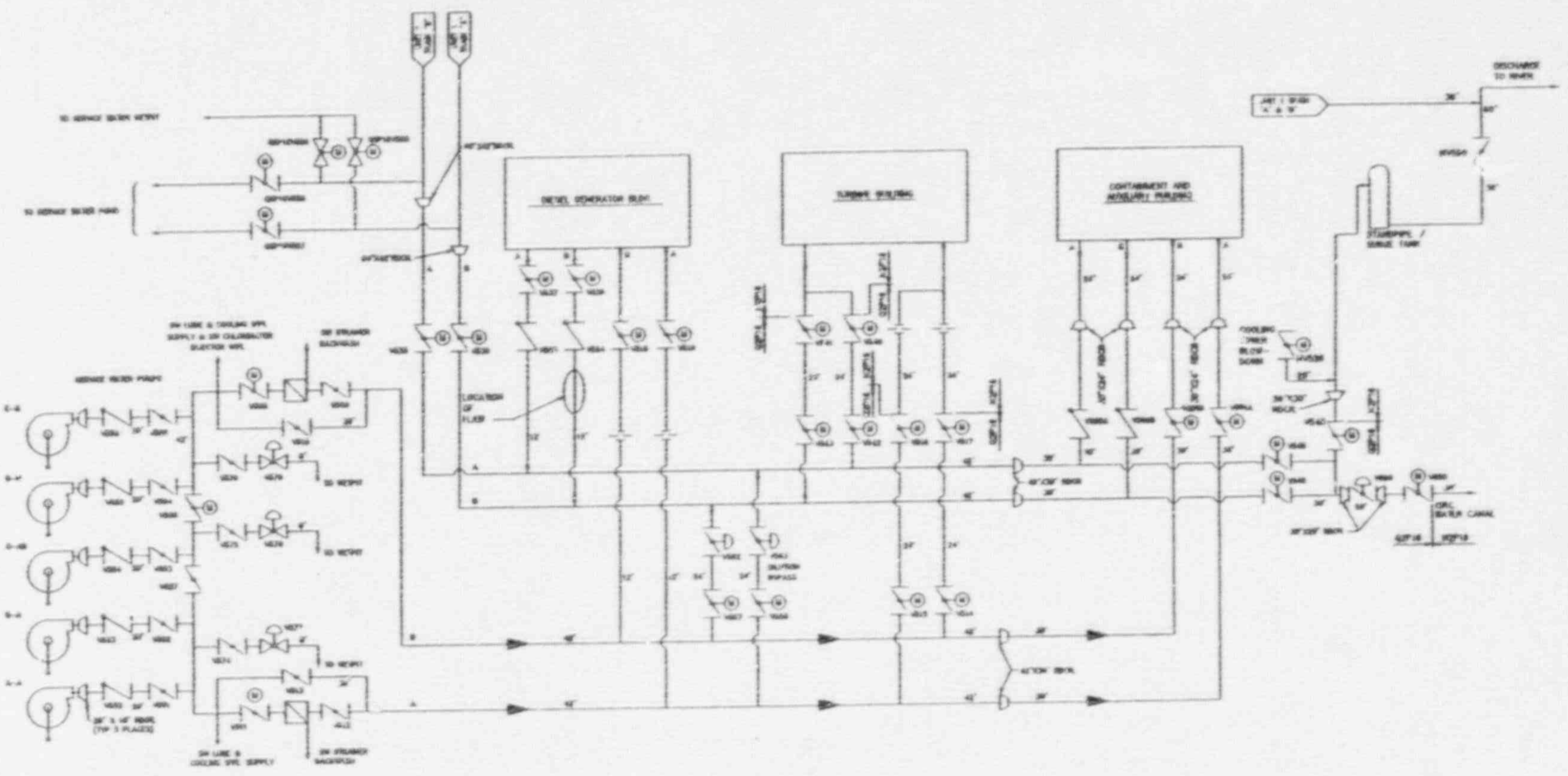

FIGURE 1
SIMPLIFIED SCHEMATIC-
UNIT 2 SERVICE WATER SYSTEM

ENCLOSURE 2

SERVICE WATER TEMPORARY NON-CODE REPAIR
RELIEF REQUEST

System:	Service Water
Component:	12" carbon steel pipe (Unit 2 service water train B discharge from diesel generators, line 12-HBC-204)
Class:	ASME Class 3
Function:	This line is the train B service water return line from the Unit 2 diesel generators to the header which directs service water discharge flow to the river during normal operation or to the service water pond during recirculation operation.
Requirement:	ASME Section XI, 1983 Edition through Summer 1983 Addenda, Articles IWA-4000 and IWD-4000, require repairs of the pressure retaining boundary of Class 3 components to be performed in accordance with the Owner's Design Specification and Construction Code of the component or system. The Construction Code for Farley Nuclear Plant nuclear piping is ASME Section III, 1971 Edition through Summer 1971 Addenda.
Relief Requested:	A through-wall flaw was detected on the train B service water return line from the diesel generators during plant operation. A Pipe Repairs, Inc. (PRI) SelfSeal Line Repair Enclosure was installed as a temporary leakage-limiting measure. Relief is requested from the ASME Code requirements to allow this temporary leakage-limiting device to remain as a non-Code temporary repair until the next scheduled outage exceeding 30 days, or until the next Unit 2 refueling outage.
Basis for Relief:	Generic Letter 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," was used for guidance in performing a temporary repair to limit leakage since the flaw was detected in a section of piping that cannot be isolated during plant operation for performance of a Code repair within the 72 hour limiting condition for operation of Technical Specification 3.7.4. Following the Generic Letter guidance allowed the leak to be stopped without a plant shutdown and provided reasonable assurance of the structural integrity of the line.

The flaw was characterized using visual (VT), ultrasonic (UT) and radiographic (RT) examination techniques and was determined to be a rounded through-wall flaw measuring approximately 3/8" at the ID surface and 3/4" at the OD surface of the pipe. The structural integrity of the pipe was evaluated using the "Through-Wall Flaw" approach of G.L. 90-05 and it was determined that the flawed piping satisfied the flaw stability criteria for this approach. The PRI SelfSeal Line Repair Enclosure installed is a non-welded leakage-limiting repair device rated for design working pressures of 1,000 psig at 650°F, which is well above the design pressure and temperature of 150 psig at 200°F for moderate energy line 12-HBC-204.

Augmented Inspection:

Based on the flaw root cause determination, further visual examination of the unearthed (accessible) portions of the service water return lines was performed and three locations were identified where the protective coating was damaged. The pipe wall thickness was measured at these three locations by UT and found to be within manufacturing tolerances for the nominal pipe wall thickness with no evidence of external corrosion.

Specific Considerations:

The structural integrity and leak tightness of the temporary non code repair as well as the structural integrity of the supports for the excavation will be assessed by performance of a weekly walkdown of the section of piping which will remain unearthed beneath the Primary Access Point structure.