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105 K-WEST ISOLATION BARRIER LEAK RECOVERY PLAN

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Isolation Barrier Leakage Recovery Plan

Introduction:

Leak testing is being performed in 105 KW to verify the performance of the isolation barriers which have been recently installed. When an 11 inch differential head is established between the main basin and the discharge chute, a leak-rate of approximately 30 - 35 gpm is observed. The leak-rate would be achieved by a 1.65" - 2" diameter hole (or equivalent). Analyses suggest that the flow is turbulent/laminar transitional (dominantly turbulent), which would be indicative of a single point leak, typical of a pipe or large opening. However, local vortex rotation is observed in the entry to the West transfer chute while no observable motion was seen in the East transfer chute: this may be an indication of seal leakage in the East isolation barrier.

The potential for leakage had been considered during the design and field work planning stages. Review of potential leak detection technologies had been made; at the planning stage it was determined that location specific leak detection could be established relatively quickly, applying existing K Basins technology (dye or ultrasonics). The decision was made not to pre-stage leak detection since the equipment development is highly dependent on the nature and location of the leak, and the characteristics of the leak rate provides data which guides leak characterization technology. The expense could be deferred and potentially avoided without risk to critical path activity.

Consistent with the above, a systematic recovery plan has been developed utilizing phased activities to provide for management discipline combined with timely diagnosis and correction. Because this activity is not critical path at this time, activities will be coordinated with other plant activity to optimize overall plant work. Particular care will be exercised in assuring that information gained from this recovery can be utilized in the more critical work in 105 KE.

Phased Recovery:

A phased recovery plan will be utilized. Elements of the phased approach to recovery from barrier door leak(s) follow:

PHASE I - Locate and verify sources(s) of leakage

PHASE II - Repair phase

Develop repair strategies

Qualify repair method

Mockup test repair method as required

Implement repair

PHASE III - Verify that flow has ceased (within initial acceptance criteria) utilizing the isolation barrier acceptance test.

Detailed Discussion of activities to be performed in Phase I:

Location and verification of the sources(s) of leakage will follow the following sequence:

1. Develop a listing of probable mechanisms of failure that would create the leak. Include a review of drawings and verification of possible imbedded piping systems that may provide communication between zones.
2. Define diagnostic tools and approaches to determine leak locations, sizes and possible mechanisms.
3. Perform systematic selection of leak detection methods.
4. Identify non-intrusive methods of determining leak locations and magnitudes.
5. Perform underwater video inspections of barrier wall installation and discharge pit zone for potential leak areas.
6. Develop written procedures to perform non intrusive leak location and magnitude determination.

Work will be performed with normal discipline for isolation barrier activities. A technical oversight group has been established to provide technical support and counsel. General work control and administrative considerations include:

1. Detailed work procedures entered in work packages that govern and control field work will follow normal practices (i.e., have the potential for change of the plant configuration) and will be USQ screened.
2. Review non-intrusive written procedures for technical merit and assure retrievable documentation to support final decisions.

3. Determine the leak location methods and the order in which methods are performed using technical oversight group counsel.
4. All information developed or obtained during the leak testing will be documented for the permanent record in the summary report.
5. State approval will be obtained for diagnostic activities (e.g., discharge chute level reductions) which exceed the state approved Notice of Compliance as amended.

Potential Leak Locations:

A systematic review of potential leak locations was performed. Potential locations identified include:

1. Penetrations through structure (See Figure 1)
 - a. Unisolated piping systems connecting basin and discharge chute
 - b. Floor cracks which run under sill or under island
 - c. Cracks through center island or stub wall
 - d. Leak from reservoir of water on reactor side
 - e. Pump syphon
 - f. Makeup
2. Barrier related (See Figure 2)
 - a. EPDM rubber J-seal to stainless sealing surface interface
 - i. J-seal Damaged
 - ii. Failure to seat J-seal (not drawn up fully)
 - iii. Failure to seat J-seal (material caught in seal)
 - b. Rubber J-seal to barrier interface
 - c. Structure of barrier
 - d. Stainless steel sealing surface to basin angle iron epoxy bonded interface.
 - e. Leakage behind the basin angle iron

These were ranked in order from most likely to least likely based on existing data (magnitude of leak, configuration of the pump, overall behavior of the main basin and discharge chute levels, knowledge of risks during installation and behavior of leak [laminar versus turbulent]).

1. Unisolated piping systems connecting basin and discharge chute
2. Rubber J-seal to stainless sealing surface interface
 - i. J-seal Damaged
 - ii. Failure to seat J-seal (not drawn up fully)
 - iii. Failure to seat J-seal (material caught in seal)
3. Leakage behind the basin angle iron

4. Stainless steel sealing surface to basin angle iron epoxy bonded interface.
5. Floor cracks which run under sill or under island
6. Cracks through center island or stub wall
7. Leak from reservoir of water on reactor side
8. Rubber J-seal to barrier interface
9. Structure of barrier
10. Pump syphon (ruled out by decoupling pump)
11. Inadvertent makeup (ruled out by data behavior)

Technologies for Leak Detection and problem localization:

Leakage had been considered during the design and field work planning stages. Review of potential leak detection technologies had been made; at the planning stage it was determined that leak detection could be established relatively quickly, applying existing K Basins technology (dye or ultrasonics). The decision was made not to pre-stage leak detection since the equipment development is dependent on the nature and location of the leak. The expense could be deferred and potentially avoided without risk to critical path activity.

As discussed above, leak detections needs were identified by characterizing potential leak locations. Following this, a systematic approach to leak location was developed.

Techniques for general inspections include:

- visual inspection for indicators (debris movement, local turbulence, inspection for penetrations, etc.)
- underwater basin inspection by camera to review known locations of plugs and to identify potential penetrations such as pipes

The basic technologies considered for leak detection and localization are:

- use visual volometers ["tell-tale" flags] to detect and localize flow
- use dye tracing to quantify flow
- use sonar detection
- drain discharge chute totally, and look for flow
- use laser volometer

Seal configuration and performance can also be evaluated by:

- Develop mirrors to inspect bottom of seal
- Check barrier torquing
- Reverify seal compression with "go- no go" test
- procure and use small diameter underwater videocamera capable of entering spaces 2" in diameter or smaller

The basic strategy will be to apply simple technologies first and to rely on developmental technologies only as necessary.

Instrument development priorities have been established based on the ranked probable leak locations, projected effectiveness of the instrumentation, availability, and the relative expense. Instruments under development include:

- Visual volometer has been developed and tested in prototype. They will be used in a number of potential leak locations for gross determination of the leak location.
- Mirrors based on Idaho National Engineering Laboratory (INEL) Naval Reactors fuel storage basin technology have been designed and are being fabricated. The polished stainless steel mirror surface on an approximately 24' pole is supplemented by a 5" magnifying glass which allows detailed remote examination. The mirror will be used for seal inspection in the currently inaccessible space at the bottom of the door.
- Compatible dyes have been identified. Equipment for metering dye into locations up to 16' below the pool surface have been prototyped. The dye can be used in small quantities to characterize a small leak through the seals or in the areas of the seals. Larger quantities can be metered into piping to determine the interconnection points with the main basin, if flow is identified through the piping inlet.
- A small diameter bubble injection system has been developed in prototype, and provides an alternative non-intrusive method of tracing leaks. The bubbles would be used in a fashion similar to the dye, would be introduced on one side of the suspected leak location and would be tracked as they are swept through the leak.

Repair Planning:

A specific repair plan will be developed, based on the nature of the leak, as characterized by the diagnostic program.

Functional Verification:

Following repair, the leak test will be performed to verify discharge chute integrity.

Conclusion:

A systematic approach will be followed in resolution of the leakage identified by the leak test.

FIGURE 1 - LOCATIONS OF POTENTIAL LEAKS; FIGURE IDENTIFIES WHERE LEAK PROBES WILL BE LOCATED FOR THE INITIAL DIAGNOSTIC TESTING.

- M: MULTIPLE FLAG VOLOMETER
- S: SINGLE FLAG VOLOMETER
- : PIPE
- (○): DRAIN SUMP WITH SEDIMENT BLOWN CLEAR

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FIGURE 2 - POTENTIAL LEAK PATH:

- 1- RUBBER J-SEAL TO STAINLESS SEALING SURFACE INTERFACE
 - A. J-SEAL DAMAGED
 - B. FAILURE TO SEAT J-SEAL
 - C. FAILURE TO SEAT J-SEAL (MATERIAL CAUGHT IN SEAL)
- 2- RUBBER J-SEAL TO BARRIER INTERFACE
- 3- STRUCTURAL BARRIER ITSELF
- 4- STAINLESS STEEL SEALING SURFACE TO ANGLE (EPOXY BONDED INTERFACE)
- 5- LEAKAGE BEHIND THE BASIN ANGLE IRON

TOP VIEW