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Nuclear L.L.C.

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

Salem Generating Station, Units 1 and 2
Facility Operating License Nos. DPR-70 and DPR-75
NRC Docket Nos. 50-272 and 50-311

Subject: Draft Responses to Requests for Additional Information, Generic Letter 2004-02

The attached draft information was provided to the NRC staff in preparation for the forthcoming meeting with PSEG Nuclear LLC (PSEG) regarding the response to Generic Letter 2004-02 for Salem Generating Station, Unit Nos. 1 and 2.

There are no regulatory commitments contained in this letter.

If you have any questions or require additional information, please contact Mr. Paul Duke at 856-339-1466.

Sincerely,

Jeffrie J. Keenan
Manager - Licensing

Attachment
1. Draft RAI Responses

Enclosure
1. Compact Disc (CD) labeled, "Generic Vortex Tests, January 2008"

A116
NRR

cc: S. Collins, Administrator, Region I, NRC (w/o enclosure)
R. Ennis, Project Manager - USNRC (w/o enclosure)
NRC Senior Resident Inspector, Salem (w/o enclosure)
P. Mulligan, Manager IV, NJBNE (w/o enclosure)
H. Berrick - Commitment Tracking Coordinator - Salem (w/o enclosure)
L. Marabella - Corporate Commitment Tracking Coordinator (w/o enclosure)

Draft For Discussion

RAI 13
Previous RAI 14
RAI 14a
RAI 14b
RAI 15

RAI 13

The Salem Unit 1 chemical effects head loss test was conducted utilizing the full debris load. However, the Unit 1 thin bed test had a significantly higher head loss (78 mbar) than the non-chemical full load head loss (30 mbar). Please provide information that justifies that the chemical effects testing conducted with the full debris load bounds the head loss that could occur on a chemically laden thin bed. Alternately, a thin bed test can be conducted with chemicals to ensure that the head loss included in the evaluation is bounding for potential plant conditions.

Response to RAI 13

The Unit 1 thin bed test used a debris load and flow rate that were greater than those used for the Unit 1 full load test. Furthermore, the Unit 1 thin bed test utilized room temperature water, while the Unit 1 full load test utilized a heated test loop. The Unit 1 thin bed test was Test 3-repeat and the Unit 1 full load test was Test 5 in the 2-Sided MFTL Head Loss Tests.

The total debris loads for the Unit 1 thin bed (TB) and full load (FL) tests are provided in Tables 3f.4.1.5.6-2/3/6/7 of the March 2009 Supplemental Response. These are the debris loads at which the maximum head loss values cited in the RAI were recorded. The main differences are shown below. The % difference is based on the full load test.

Debris Type	Thin Bed Test Volume ft^3	Full Load Test Volume ft^3	% Difference %
Nukon	310	236	31%
Kaowool	39	33	18%
Qualified Coatings	12.6	11.5	9.6%

The Unit 1 thin bed test included more debris than the final design debris load which was used for the full load test. This is acceptable, though, since the thin bed test was used to demonstrate a trend (i.e. that the thin bed effect was not experienced on a complex strainer).

A more appropriate comparison of head losses is the Unit 1 full load head loss to the head loss after the addition of Portion 12 in the Unit 1 thin bed test (see Figure 3f.4.2.3.3-1 of the March 2009 Supplemental Response) since the theoretical fiber bed thickness after the addition of Portion 12 in the thin bed test is approximately equal to the theoretical bed thickness in the full load test. The thin bed head loss after the addition of Portion 12 was ~58 mbar (see Figure 3f.4.2.3.3-1 of the March 2009 Supplemental Response). The thin bed head loss after the addition of Portion 14 (the last portion) was 78.5 mbar.

Based on the head loss after the addition of Portion 12 in the Unit 1 thin bed head loss test, as well as scaling due to the differences in test temperature and flow rate, it can be shown that the head losses measured for the Unit 1 thin bed and full load tests were very comparable. Based on the equivalence of the thin bed and full load head losses, along with CCI's experience of their strainer not exhibiting the thin bed effect, the Unit 1 full load test was the appropriate test to use as the basis for the chemical effects test. Therefore, the chemical effects head loss test was performed using the full load test for Unit 1.

Previous RAI 14

In its March 31, 2009, submittal, the licensee provided a calculation of void fraction due to vortexing and degasification of the fluid as it passes through the debris bed. Staff evaluation of the response is split into two sections. Further information is required for both the vortex formation and degasification areas.

Previous RAI 14 - Vortex Formation
The supplemental response stated that there is a potential for intermittent vortex formations during two pump operation at the minimum submergence level with little or no debris on the strainer. The March 31, 2009, submittal stated that video analysis of the test showed that the maximum air ingestion rate during the test was 0.05% by volume. The response further calculated that the total air entrainment would be 0.00356% if the entire strainer train was included in the calculation. The staff needs more information regarding the video analysis and the calculation to determine whether the methodology used to derive the estimate is realistic. It is not clear how video could be used to estimate the amount of entrained air.

Previous RAI 14 Response - Vortexing

The vortex analysis is based on the following video which has been provided. The video was taken during the CCI Generic Vortex Tests conducted in January 2008.

CCI_vort_test_45mm_45m3h.MOV

The video was used to determine the size of potential vortices which could occur for the clean screen condition. The size of the vortex relative to the pocket was estimated based on the image below. Figure 1 below is an image that was taken from a video of a clean screen vortex test whose Froude number and submergence bound the worst case Froude number and submergence at modules nearest the sump pit at Salem.

The CCI Generic Vortex Tests were used to develop Figure 3f.3.1.1-2 in the March 2009 Supplemental Response, repeated as Figure 2 below. Figure 2 shows strainer operating regions with respect to vortex formation based on strainer submergence level and Froude number. The data point selected for the vortex analysis (explained below) is marked as a black 'X' on the red "Limit_C" line used to delineate the unsafe operating region from the operating region with limited air intake. Salem operates in the safe region with limited air intake, as shown by the U1_2pump, U2_1pump, and U2_2pump data points in Figure 2. Vortices such as the one shown occurred less than 20% of the time, but are conservatively assumed to occur 100% of the time in the vortex analysis.

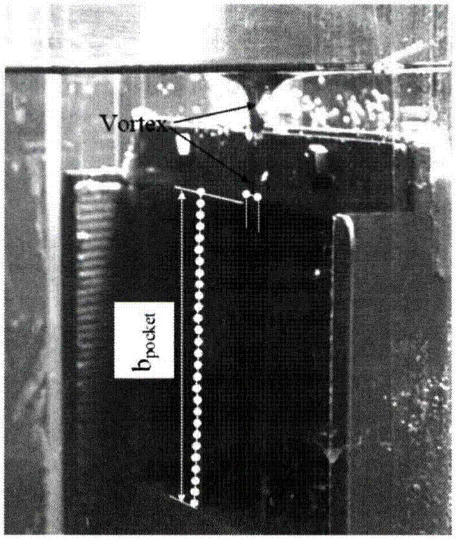


Figure 1: Screen Shot from Vortex Test Video

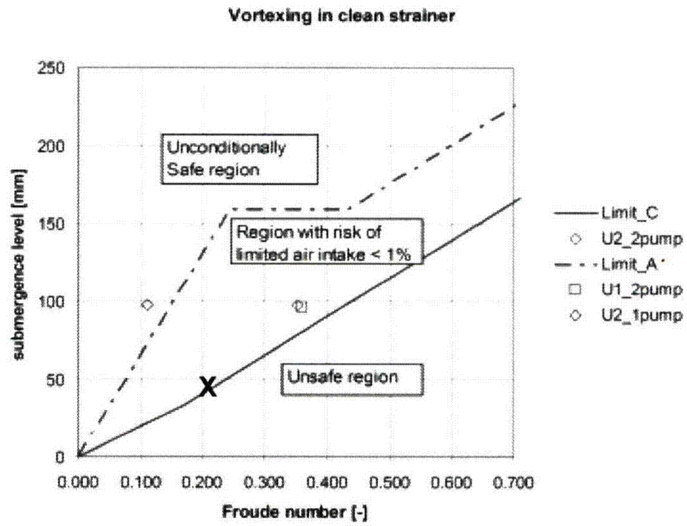


Figure 2: Clean Strainer Vortex Test Results

Based on scaling of the screen shot in Figure 1, the vortex diameter is approximately 1/27th of the height of the pocket. Since the pocket opening is 120 mm tall, the diameter of the vortex is 4.44 mm [=120 mm/27], and the cross sectional area of the vortex is 1.55×10^{-5} m^2 [$=\pi d^2/4$].

The air from the vortex is modeled as reaching the velocity of water once it is inside the pocket. Thus, the proportion of air ingested (α_p) is the ratio of the cross section of the vortex to the cross section of the 4 pockets which were used during the tests. The inside of the pocket is 70 mm wide and 109 mm tall. Thus, the 0.05% [$=1.55 \times 10^{-5}$ m^2 / (4*0.070 m*0.109 m)] air ingestion by volume is computed.

In addition, water will flow through all rows of the strainer, not just the top row (only the top row of pockets of the test strainer was open during the vortex tests). At Salem, each strainer module is 7 rows tall. Thus, the effective air ingestion over the entire height of the strainer is 0.00726% [=0.05%/7].

At Salem, a train of strainer modules is connected to the sump pit. For the clean strainer scenario at Salem, 49% of the water to the sump flows through the nearest 1/3 of the strainer module nearest the sump pit (e.g. through the first ~3 columns of pockets nearest the sump pit). The remaining water (51%) flows through the furthest 2/3 of the module nearest the sump pit and two modules further from the sump pit. The flow split is determined using the methodology provided in §3f.9 of the March 2009 Supplemental Response. Thus, the potential volumetric fraction of air entering the sump pit is 0.00356% [=0.00726%*0.49].

Previous RAI 14 - Degasification
The licensee determined that degasification of the fluid could occur as it passes through the debris bed. The licensee postulated that any evolved gasses would be reabsorbed by the liquid prior to reaching the pump suction due to the static head of water above the pump. It was not clear to the staff that any gasses that evolved from the sump fluid would be reabsorbed into the fluid prior to flowing into the pump suction. It was not clear that the dynamics of reabsorption were fully addressed or that all possibilities for evolved gasses were considered. For example, could the gasses collect within the strainer and be entrained in the flow as larger bubbles later in the event? This issue could be mitigated if it were shown that higher submergence would result for the large break LOCA such that degasification were reduced or eliminated and that the head loss across the strainer for a small break LOCA would be significantly lower. Please provide justification for the conclusion in the submittal that all gasses would be reabsorbed prior to the fluid entering the pump, or provide an alternative evaluation of degasification and its effects on the pump.

Previous RAI 14 Response - Degasification

The response to this RAI consists of two parts. First, an assessment is performed to determine the quantity of air evolved as well as its impact on NPSH. Second, an assessment is performed to determine the ability of the evolved air to form air bubbles at the top of the suction box.

Air Evolution
In order to assess the impact of degasification, an alternate analysis was performed in lieu of demonstrating that evolved air bubbles would dissolve back into solution. The alternate analysis determined the quantity of air which would come out of solution as the water passed through the debris bed and then determined the void fraction at the pump inlet. The quantity of air which is dissolved in solution and which evolves from solution is computed using Henry's Law. The methodology used is consistent with that employed in the NUREG/CR-6224 Correlation and Deaeration Software Package issued in 2005 (ADAMS Accession No. ML051590366). This approach conservatively neglects the "salting-out" effect which states that the solubility of gases in water with electrolytes (e.g. boric acid) is less than in fresh water.

The analysis was performed using both the DEPS Minimum Safeguards and the DEPS Maximum Safeguards post-LOCA pressure/temperature profiles in order to determine the worst case void fraction. The sump pool is assumed to be saturated with air. The relative humidity above the sump pool (which impacts the amount of air in solution) was modeled as 100% as would be expected in a post-accident environment at switchover. A transient water level was used wherein the minimum strainer submergence was modeled at the time of switchover, and the water level increased thereafter (as determined in the minimum flood level analysis). In addition, the amount of air evolved was computed separately for each row of pockets (7 rows total) since less air comes out of solution in the lower pockets due to the greater air solubility at higher pressures. The air evolved was tracked separately for each pocket row up to the pump inlet. At the pump inlet, the total void fraction was computed as the average of the void fraction computed based on the air evolved in each individual row. Averaging the individual void fractions is appropriate since the flow from the individual rows will be mixed in the suction piping. For sump temperatures less than 160°F (at which chemical precipitates could be present), the void fraction was conservatively computed based on the top row only due to the potential presence of bore holes.

The analysis conservatively ignored any re-dissolution of the air en route to the pump inlet. However, compression was credited for the evolved air bubbles at the pump inlet due to the greater pressure at the pump inlet relative to the pressure immediately downstream of the strainer. The compression is modeled as isothermal since it is gradual, the evolved air bubbles are relatively small (see Section below for size of bubbles), and the surrounding water is at a constant temperature as the fluid flows from the strainer to the pump inlet.

The void fraction (α_p) at the pump inlet was then used to compute a β multiplier for the NPSH required in accordance with Appendix A of Regulatory Guide 1.82, Revision 3 (e.g. $NPSH_{required}$ for α_p<2% = $NPSH_{required}$ x β where $\beta = 1+0.50*\alpha_p$).

This approach is used to demonstrate that sufficient NPSH available exists for the RHR pumps even when considering the impact of any potential air evolution as the sump fluid passes through the debris bed/strainer.

Air Accumulation in Suction Box

The ability of air bubbles to accumulate at the top of the suction box is addressed using streamlines produced as part of the CFD analysis of the suction box created for the strainer head loss computation. Based on the streamlines shown in Figure A-25 below, there is a clear movement of water entering the sump pit from the diffuser of the z-shaped duct to the ECCS pump suction pipes, with velocities in the top region of the pit of 1 m/s or more. The streamline plots show the primary flow of water from the diffuser moving towards the rear wall of the pit and then down towards the pump suction pipes.

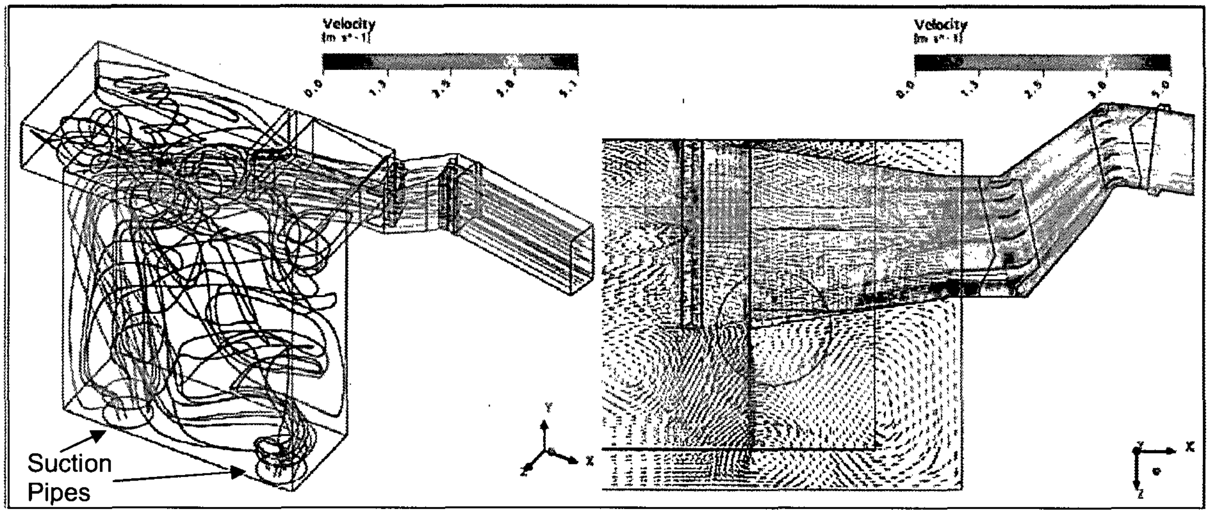


Figure A- 25 Streamlines and vector plot (9000 gpm transient)

The CFD analyses also determined that the average velocity across both a horizontal plane near the top of the sump (not in the suction box) and a horizontal plane near the bottom of the sump (near the outlet pipes) is ~0.3 m/s for a 5110 gpm flow and ~0.5 m/s for a 9000 gpm flow. These velocities are much greater than the maximum upward velocity for air bubbles evolved in the debris bed.

The maximum upward air bubble velocity is the terminal velocity. The terminal velocity is computed by performing a force balance on a spherical bubble where the buoyancy force is offset by the gravity force and drag force (which is velocity dependent). For air bubbles from 10-100 μm in diameter, the maximum terminal velocities in the post-LOCA sump are very small and therefore, the air bubbles would remain entrained in the downward flow. The bubble size is based on the maximum expected size of the interstitial spaces in a debris bed. Based on Figures 3 and 4 below, the interstitial spaces between fibers in a debris bed are expected to be 10-100 μm.

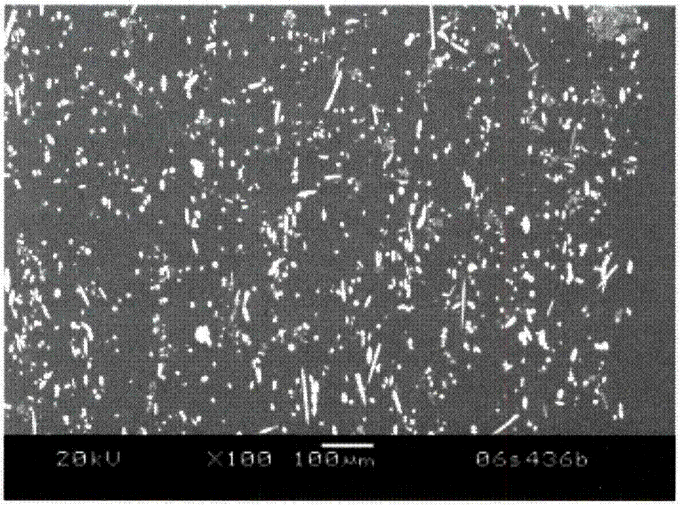


Figure 3: SEM of Nukon Fiber Region in a Debris Bed

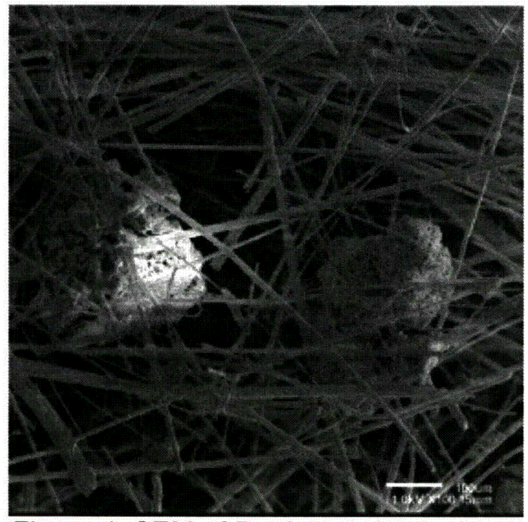


Figure 4: SEM of Particulate Embedded in Fibrous Debris Bed

Figure 3 is Figure 6.30 of NUREG/CR-6917 and Figure 4 is Figure VIII-1 of Appendix VIII to the NRC SE for NEI 04-07. Figure 3 is based on a debris bed which contained 1015 g/m^2 (0.21 lbm/ft^2) of Nukon fiber and a total debris loading of 1522 g/m^2 (0.31 lbm/ft^2) per Section 6.4 of NUREG/CR-6917. Figure 4 is based on the tests documented in NUREG/CR-6874; however, multiple debris loadings were tested and it is not clear which test the picture is based on. Per Table 2.1 of NUREG/CR-6874, Nukon fiber loadings of 0.023 and 0.046 ft^3/ft^2 were tested. Thus, the debris bed shown in Figure 4 is either for 0.05 or 0.11 lbm/ft^2 of Nukon (based on an as-fabricated density of 2.4 lbm/ft^3).

The total debris loading (Nukon, Kaowool, Fiberglas, Coatings, and Latent) on the Salem strainers is greater than the debris loadings in the tests upon which Figures 3 and 4 are based. Therefore, the interstitial spaces in the Salem debris beds will most likely be smaller than 10-100 μm, which provides support for the evolved air bubbles being on the order of 10-100 μm.

It is recognized that bore holes (e.g. bed collapse) may occur at low sump temperatures (<160°F) at which chemicals are present. Fewer interstitial spaces will exist in a bore hole than in the debris bed. However, bore holes will not result in completely clean strainer area as is evidenced in Figure 3f.4.2.3.4-4 of the March 2009 Supplemental Response, shown below.

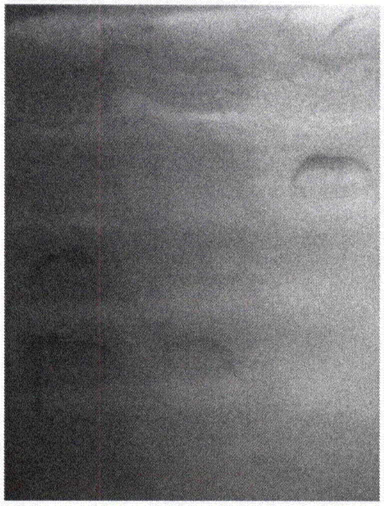


Figure 5: Unit 1 Full Load Test Debris Bed After Chemical Addition

Therefore, air bubbles evolved in flow through bore holes would have a size similar to those evolved in the debris bed. These air bubbles would remain entrained in the downward flow in the suction box. Thus, air bubbles would not accumulate at the top of the suction box.

NRC RAI #14a
Please discuss whether the operation of the residual heat removal pumps has been evaluated with respect to vortex formation at the RWST suction intake with the water level at the low-low-level setpoint to ensure adequate pump performance.

NRC RAI #14b
Please also discuss whether the minimum water level for Case 1 credits the injection of the accumulators. If credit is taken, please provide a basis to demonstrate that their injection would be expected and a basis for considering the Case 1 to be a limiting water level that bounds small-break LOCA cases for which the accumulators may not inject or may not fully inject. If a more limiting water level is possible for small-break LOCA conditions without accumulator injection, please identify this water level.

NRC RAI #15
Page 2 of Attachment 1 to the licensee's submittal of March 31, 2009, indicates that level switches used for indication of containment flood levels "alert the control room operator when sufficient sump level has been achieved to support initiation of cold leg recirculation". This statement suggests that two conditions must now be satisfied before recirculation switchover is initiated: RWST low water level AND containment sump level. Please describe what action the operator would take if both of these conditions are not met; in particular, a case where the RWST is exhausted, but indicated containment water level is too low to have activated the level switches.

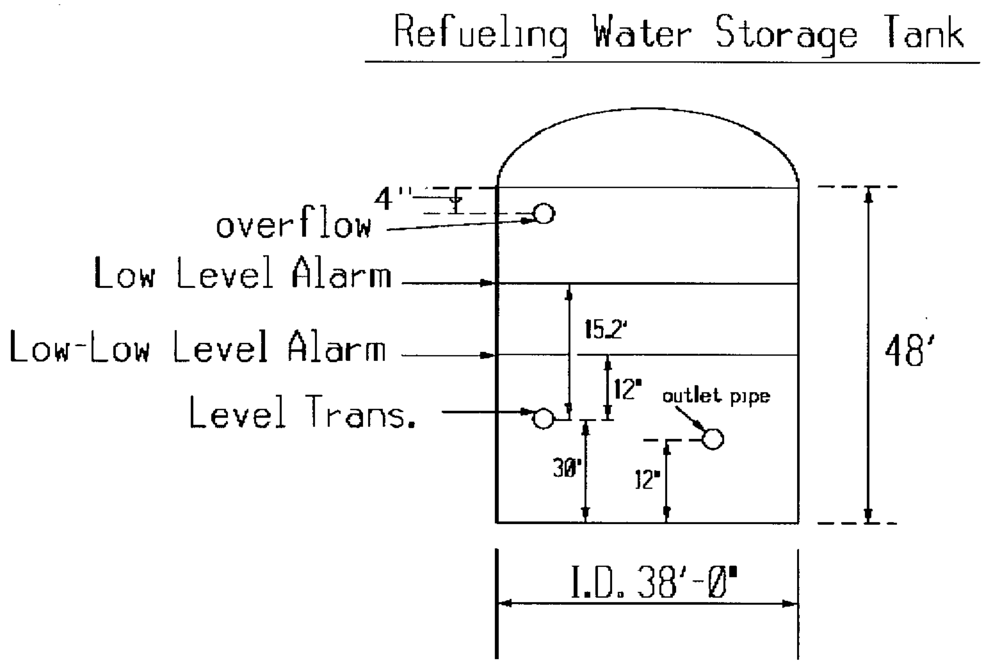
Response Background

RWST Description
Refueling Water Storage Tank (RWST) provides borated water which is injected into the Reactor Coolant System (RCS) through the Emergency Core Cooling System (ECCS) pumps or sprayed into containment for containment heat removal and pressure control during the injection phase of Loss of Coolant Accident (LOCA).

The RWST level is monitored by two separate level transmitters. Additionally, the alarm is provided for "RWST High", "RWST low", and "RWST Low-Low" water level. The low-low setpoint is indication that the tank has reached the low-low level. The low level alarm setpoint is set high enough to ensure a sufficient volume is available to allow operators the time to switch from injection to recirculation phase before level decreases to the low-low level setpoint. The setpoints are established such that they account for instrument uncertainty.

Design Information

- Total Capacity = 400,000 gallons
- Technical Specification minimum volume = 364,500 gallons
- Level tap located 2.5 ft above the bottom for zero reference
- Total span of 48 ft
- Internal Diameter = 38 feet
- ECCS Outlet nozzle = 12 inches from bottom
- Low-Low level alarm = 1 foot above the level tap
- Low level alarm = 15.2 feet above the level tap



System Response

When a LOCA occurs, an automatic Safety Injection (SI) signal is initiated via the Engineered Safety Features (ESF) System on Containment High Pressure (4 psig) or Low-Low Pressurizer Pressure (1765 psig), or manually via key switches in the control room.

The SI signal starts the Centrifugal Charging pumps, the Safety Injection Pumps, and the Residual Heat Removal (RHR) Pumps. These pumps inject to the RCS cold legs, taking suction from the RWST. The initial injection of borated water from the RWST to the RCS is referred to as the ECCS injection phase. The Containment Spray (CS) pumps start automatically when containment pressure reaches the initiation setpoint of 15 psig. The CS pumps also take suction from the RWST, through a separate line (different from the ECCS suction) and discharge to the containment ring header.

When RWST level reaches its low-level alarm at 15.2 feet, procedural guidance directs operators to initiate switchover to the recirculation phase. One of the first steps the operator needs to verify is that the adequate sump level exists (80' 11") for transfer to recirculation operation. Switchover to recirculation operation is initiated only if adequate water level exists.

Due to design differences between Salem Unit 1 and Salem Unit 2 there is a slightly different strategy for system swap over to recirculation operation.

For Unit 1, once adequate sump inventory has been verified for the swap over to the recirculation phase, the following actions are taken: The operators will stop the RHR pumps and manually reconfigure the pump suctions from the RWST to the recirculation sump. After the manual realignment of the pump suction is completed, the RHR pumps are restarted in accordance with the EOPs and recirculate the containment sump water to the RCS cold legs and provide suction to the Charging and SI pumps. One RHR pump also provides recirculation containment spray flow to one ring header. This alignment is referred to as cold leg recirculation.

The Unit 2 procedure is similar to Unit 1. Once RWST low level alarm is reached and the required containment flood level is verified, operators arm a semi-automatic swap over system. This semi-automatic swap over system realigns the RHR pump suctions from the RWST to the recirculation sump. The remainder of the transition process is similar to that of Salem Unit 1 and controlled by emergency operating procedures.

In case the RWST reaches the low level (15.2 feet level above the level tap) and the required containment flood level is not reached, then the operator continues to drawdown from the RWST until either required containment flood level (80' 11") is reached or RWST low-low water level alarm is reached. During this period, the control room operator uses various combinations of ECCS pumps in accordance with EOPs. However, all the operating ECCS and CS pumps are stopped when the RWST reaches low-low alarm level. Further details are provided below.

<u>Emergency Operating Procedures</u>

Salem Units 1 & 2 use Emergency Operating Procedures (EOPs) during various phase of LOCA.

- Per EOP-LOCA-1 (Reference 2) the injection phase continues until the RWST low level alarm is reached which corresponds to RWST level of 15.2 feet.
- When the RWST low level alarm is reached, EOP-LOCA-3 (Reference 3) is entered. One of the first steps in this EOP is to verify that the adequate sump level exists (80' 11") for transfer to recirculation operation. If adequate water level exists then switchover to recirculation operation is initiated.
- If inadequate water level exists for recirculation operation, then EOP-LOCA-5 (Reference 4) is entered. Under this EOP the ECCS injection from the RWST continues until either required containment flood level (80' 11") is reached or RWST low-low water level alarm is reached.
- Under EOP-LOCA-5, if the RWST level reaches low-low level alarm setpoint and the required containment flood level is not reached, then all the operating ECCS and CS pumps that take suction from RWST are stopped.
- EOP-LOCA-5 provides various steps that would add makeup to the RWST to extend its time available as a viable suction source.
- EOP-LOCA-5 also provides steps if the RWST is depleted.

Response to RAI 14a

As stated above, the RHR pumps stop taking suction from the RWST once the RWST level is at 15.2 feet and the required containment level is reached. Anti-vortex suppression devices are installed in the RWST suction lines. Therefore, there is more than adequate submergence available to preclude vortex in the RHR pumps.

It should be noted that RHR pump operation at the RWST low-low level setpoint is a very unlikely scenario. During a LOCA, water from the RWST will be directed into the RCS through the ECCS pumps to provide core cooling or sprayed into containment for containment heat removal and pressure control. The water pumped from the RWST will collect on the containment floor and mix with that discharged from the postulated large break in the RCS piping raising the containment flood level.

The only way the RWST reaches the low-low alarm level and the containment sump level does not exceed the alarm set point level is, if a RWST pipe break occurs outside the Reactor Containment or containment flood level indication malfunctions.

The first possibility requires a break in the RCS pressure boundary and another break in the RWST piping outside the Reactor Containment during the injection phase. This is not a credible accident; assuming two breaks is outside the Salem design and licensing basis. As noted in UFSAR Section 6.3.1.4, the Salem ECCS is designed to tolerate a single active failure during the short-term immediately following an accident, or to tolerate a single active or passive failure during the long-term following an accident.

There are two redundant level switches installed inside the Reactor Containment. The possibility of both malfunctioning is extremely remote. Also, in addition to the level switches there are two separate level transmitters that provide the containment flood level.

In case the RWST reaches the low level alarm and the required containment flood level is not reached, the EOP-LOCA-5 provides guidance for operation of the ECCS pumps. It directs the operator to immediately initiate RWST makeup and to stop the operating ECCS and CS pumps. All the operating ECCS and CS pumps are stopped (if they are not already stopped) at low-low level alarm if the required containment flood level is not reached.

Based on the above information it is concluded that there is no concern associated with vortex formation for the RHR pumps.

Response to RAI 14b

Reference 1 was created to determine the minimum flood level inside the Reactor Containment following a design basis LOCA. During the recirculation phase of LOCA, the containment sump strainers need to be fully submerged to ensure the operability of the RHR pumps. The strainers have a minimum submergence of 3 inches during recirculation based on the minimum flood level and the height of the installed strainers.

The ECCS pumps take suction from the RWST during the injection phase of LOCA. When the RWST level reaches the low level set point, a control room alarm is generated indicating that the operator should begin to initiate the switchover to the recirculation phase. Also, the level switches installed inside the Reactor Containment provide an alarm to the control room when the containment flood level has reached 80' 11", the minimum flood level for the operator to initiate recirculation.

Reference 1 determined the most limiting case for minimum containment flood level. In this case a break on the Reactor Coolant Piping (RCS) is large enough to allow RCS blow down but not large enough to allow the total ECCS flow to drain from the break (i.e., the ECCS pumps are able to keep the entire RCS full).

The case with the minimum water level from Reference 1 will be used to provide a response to the RAI. This case assumed a break in the RCS piping that would cause the system pressure to drop low enough to actuate injection from the ECCS Accumulators. It will be modified such that injection from the ECCS Accumulators will not be credited.

The following evaluation determines the containment flood level without crediting the accumulators. This evaluation is for Salem Unit 1. Since the differences between the two Units are very small, this evaluation will also be applicable to Salem Unit 2. The information provided below is from Reference 1 unless otherwise noted.

RWST volume needed to reach Containment flood level of 80' 11" = 264,380 gallons
Volume in each accumulator = 6500 gallons (Reference 7)
Water in four accumulators = 26,000 gallons

Based on the minimum flood level calculation, containment volume at RWST low level alarm (with accumulator injection) = 207,800 gallons

Containment flood volume at RWST low level alarm (without accumulator injection) = 207,800 - 26,000 = 181,800 gallons

Additional water volume below RWST low level alarm to reach 80' 11" = 264,380 – 181,800 = 82,580 gallons

RWST low level alarm from the RWST level tap = 15.2 feet
RWST volume per level = 8483.2 gallons/feet
RWST low-low level alarm above level tap = 1 foot

Calculated water level in feet below low level alarm = 82,580/8483.2 = 9.8 feet
RWST level above level tap = 15.2 – 9.8 = 5.4 feet

Based on the above evaluation, the minimum containment flood level will be reached prior to reaching the RWST low-low level alarm with a margin of 4.4 feet of RWST level. Therefore, there is no concern with adequate submergence even if the accumulators are not credited.

Response to RAI 15

As discussed above, the EOPs are entered during a design basis LOCA. These EOPs provide adequate guidance.

When the RWST low level alarm is reached, EOP-LOCA-3 (Reference 3) is entered. One of the first steps in this EOP is to verify that the adequate sump level exists (80' 11") for transfer to recirculation operation. If adequate water level exists then switchover to recirculation operation is initiated.

If inadequate water level exists for recirculation operation, then EOP-LOCA-5 (Reference 4) is entered. Under this EOP, the ECCS injection from the RWST continues until either required containment flood level (80' 11") is reached or RWST low-low water level alarm is reached.

EOP-LOCA-5, requires all the ECCS pumps taking suction from RWST be stopped if the RWST low-low level alarm is reached and the containment flood level alarm setpoint is not reached. It also provides various steps that would add makeup to the RWST to extend its time available as a viable suction source and to minimize the RWST outflow, thereby extending the time core cooling can be provided by the RWST. One of the alternate suction sources would be providing borated water from the Reactor Makeup Water Control System by taking suction from the Boric Acid Storage Tank mixed with the water from Primary water Storage Tank and using the centrifugal charging pumps and normal charging lines to inject water into the RCS.

Based on the above information, the Salem EOPs provide adequate information to take necessary actions when the conditions to switchover to recirculation phase are not satisfied (RWST low water level and containment sump level).

References

1 S-C-CAN-MDC-2061 Minimum Containment Flood Level
2. 1(2)-EOP-LOCA-1 Loss of Reactor Coolant
3 1(2)-EOP-LOCA-3 Transfer to Cold Leg Recirculation
4. 1(2)-EOP-LOCA-5 Loss of Emergency Recirculation
5. S-C-RHR-MDC-1711 Available NPSH at RHR Pumps in Recirculation Mode
6 S-C-VAR-MDC-1429 Minimum Usable Volume for Various Safety Related and Important to Safety Tanks
7. S-C-A900-MDC-0082 Containment Volume Verses Flood Level Analysis
8. VTD 323585 RWST Draindown & Cold Leg Recirculation Engineering Report