Report on the Seabrook Station
Refueling Water Storage Tank
Design Deficiency

Prepared by: Yankee Atomic Electric Company

for Public Service Company of New Hampshire

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Introduction

On September 28, 1978 Mr. Seth Folsom of the Region 1 office of the NRC was informed by Mr. John Haseltine of Yankee Atomic Electric Company, Seabrook Station Project Manager, of a design deficiency associated with the refueling water storage tanks (RWST) at Seabrook Station. The deficiency was reported under 10CFR50.55a(e) and was reported within 24 hours of confirmation of the deficiency. The deficiency was reported to Mr. Folsom as an undersizing of the RWST.

The undersizing was discovered in a routine design review of the Net Positive Suction Head (NPSH) for the containment spray and residual heat removal pumps. The design review verified proper NPSH but it also showed that there did not appear to be sufficient water inthe RWST to complete the transfer of pump suctions from the tank to the containment sump before it was emptied.

This report serves as a written report under the 30 day requirements in 10CFR50.55a(e)(3) and is arranged to provide the information requested in the regulation.

Description of Deficiency

The water storage capacity of the RWST serves dual purposes in the station design. One is to flood the cavity and canal area above the reactor prior to refuelings and the other is to supply borated water to the containment spray and injection pumps during a loss of coolant accident. As reported to the IE Inspector on September 28, the deficiency concerns the undersizing of the RWST's useable volume for a loss of coolant accident. The tank was adequately sized for the flooding of the reactor cavity and canal.

The tank capacity is dependent upon a number of parameters. The major parameter is the flooding of the containment during a loss of coolant accident to a height which will provide sufficient NPSH for the containment spray and residual heat removal pumps and proper containment sump screen submergence. The 375,000 gallon design submitted in the Preliminary Safety Analysis Report (PSAR) met this requirement. Approximately 350,000 gallons of the tank was assumed to be injected and this volume did allow sufficient flooding of the containment to meet pump NPSH requirements and screen coverage. The deficiency arose in the ability of the remaining 25,000 gallons in the tank to meet the other design parameters.

The other design parameters are instrument error, a working allowance, transfer allowance, single failure, and unuseable volume. The following is an explanation of what these parameters are and how they were satisfied or not satisfied in the original design of the RWST.

1. Instrument error - Increased volume is necessary to account for the accuracy of the instrumentation reading the RWST level. Initially a nominal 1% full scale instrument accuracy error was assumed which translates into 3500 gallons. This error has to be taken twice - once

to assure that the tank does initially contain 350,000 gallons and a second time to assure that 350,000 gallons has been injected. Thus, 7,000 gallons of capacity was necessary for instrument error.

Recently we were informed by Westinghouse, who is responsible for the RWST level instrumentation, that they prefer a 3% full scale instrument error which causes an increase in the allowance for instrument error to 21,000 gallons.

2. Working allowance - Some allowance above the required capacity of 350,000 gallons is necessary to prevent alarms with only minor water losses from the tank. It would not be practical to maintain a level at the exact setpoint and thus, a nominal 3,000 gallons over and above the design capacity is desired for this margin.

3. Transfer allowance - Additional RWST capacity must be provided to accommodate a reasonable delay time associated with the transfer of certain pump suctions from the RWST to the containment sump. As stated in RESAR-3, when the proper quantity of water has been transferred to the containment, the containment sump valves open. This automatically shifts RHR and containment spray pump suctions to the containment sump. However, the safety injection and charging pumps continue to draw from the RWST.If you assumed a 10 minute realignment time, the allowance would be 24,000 gallons since the flow rate of the pumps remaining on the RWST is 2,400 gallons per minute (gpm).

4. Single failure - Because of the automatic transfer of RHR and containment pumps to the sump, some allowance must be included for a single failure. The most limiting single failure for tank capacity results if the containment sump valve for one of the trains failed to open upon a low level signal from the RWST. Should this worst single failure occur, the associated RHR and containment spray pumps in that train will continue to draw from the RWST at a rate of 7800 GPM. If you assume it takes 5 minutes to recognize and correct the condition, then an additional 39,000 gallons would have to be added to the tank to compensate for the single failure.

5. Unuseable volume - Once the invert of the tank pump suction pipes are reached the pumps lose suction and any remaining water in the tank is unusable. This unusable volume must be included in the design calculations and for a 375,000 gallon tank it is approximately 14,000 gallons.

The design parameters for instrument error, transfer allowance and single failure have changed since the original sizing of the tank. The following table is a summary of required capacities under the old and revised design parameters:

Design Parameter	Required RWST Volume Old	New
1. Injection capacity	350,000 gal	350,000 gal
2. Instrument error	7,000 gal	21,000 gal
3. Working allowance	3,000 gal	3,000 gal
4. Transfer allowance		24,000 gal
5. Single failure		39,000 gal
6. Unusable volume	14,000 gal	14,000 gal
Total	3 ,000 gal	451,000 gal

As shown by the table, the original 375,000 gallon tank would have met all the old design parameters but is substantially undersized for the new or revised parameters.

Analysis of Safety Implications

If the tank size had remained at 375,000 gallons, it is possible that the pumps taking suction from it would have run out of water and lost suction. The safety injection and charging pumps are multistage pumps and upon loss of suction may cease and become inoperable. Thus, the path from the discharge of the residual heat removal pumps through these pumps may have been lost. However, even with worst single failure for tank sizing, the containment spray and residual heat removal paths into the reactor coolant system and containment respectively would have remained operable and water could have been supplied to the core and containment atmosphere.

No accident analysis was made of a loss of coolant accident under these conditions since the design has been changed and these conditions no longer credible.

rective Action

The RWST storage capacity has been increased from 375,000 gallons to 475,000 gallons. This larger size is more than adequate for all the design considerations and leaves some margin for possible future changes.

No work on the tank foundation, piping or erection has started and thus, no field modification needs to be taken to enlarge the tank. However, design drawings for the tank, piping and foundations were complete and certified for construction and will have to be modified. The spray chemical addition tank will also have to increase in size proportional to the RWST or the concentration of chemicals in it will have to increase to compensate

for the RWST enlargement. A decision on what will be done to the spray chemical addition tank will be made in the near future and documented in the Final Safety Analysis Report.