UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

STAFF EVALUATION

I. INTRODUCTION

On December 14, 1992, Virginia Electric and Power Company (VEPCO) submitted the North Anna Units 1 and 2 IPE in response to Generic Letter 88-20 and associated supplements. The IPE submittal was supplemented and revised by the licensee's letter of July 29, 1993. On December 22, 1994, the staff sent questions to the licensee for more information. The licensee responded in a letter dated April 27, 1995.

The IPE submittal and associated information findings were based on a "Step 1" review and involved the efforts of contractors Science & Engineering Associates, Inc., Scientech Inc., and Concord Associates to review the front-end analysis, the back-end analysis, and the human reliability analysis (HRA), respectively. The summary of contractors' findings is provided below, and details of the contractors' findings are in technical evaluation reports in Attachments 2, 3, and 4.

In accordance with GL 88-20, VEPCO proposed to resolve Unresolved Safety Issue (USI) A-45, "Shutdown Decay Heat Removal Requirements", USI A-17, "Systems Interactions in Nuclear Power Plants "and Generic Issue (GI)-23, "Reactor Coolant Pump Seal Failure" by the IPE.

II. EVALUATION

North Anna plant has two units; each unit uses a Westinghouse 3-loop PWR with a large dry subatmospheric containment. The North Anna IPE has estimated a core damage frequency (CDF) of 7.1E-5/reactor-year from internally initiated events, including the contribution from internal floods. The North Anna CDF compares reasonably with that of other Westinghouse 3-loop PWR plants. Loss of coolant accident (LOCA) contributes 29%, loss of offsite power 28%, transients 26%, steam generator tube rupture (SGTR) 10%, internal flooding 5%, interfacing system LOCAs 2%, and anticipated transients without scram 1%. The important system/function contributions to the CDF listed in decreasing importance are the emergency diesel generators, the turbine driven auxiliary feedwater pump, high head safety injection for either feed and bleed or following power restoration, and electrical switchgear room cooling. The licensee's Level 1 analysis appeared to have examined significant initiating events and dominant accident sequences.

Based on the licensee's IPE process used to search for decay heat removal (DHR) vulnerabilities, and review of North Anna plant-specific features, the staff finds the licensee's DHR evaluation consistent with the intent of the USI A-45 (Decay Heat Removal Reliability) resolution.

The licensee performed an HRA and identified that the important operator actions are restoration of the emergency switchgear room (or main control room) cooling within 10 hours, and initiation of high head safety injection. The staff concluded, however, that there were limitations in the HRA approach used by the licensee. Human errors related to calibration of equipment were not treated in the HRA. Although it is unlikely that the omission of

calibration errors critically impacts the licensee's overall conclusions from the IPE, the licensee may have missed the opportunity to identify potential contributors to plant safety.

The licensee evaluated and quantified the results of the severe accident progression through the use of a containment event tree and considered uncertainties in containment response through the use of sensitivity analyses. The licensee's back-end analysis appeared to have considered important severe accident phenomena. Among the North Anna conditional containment failure probabilities: early containment failure is 1% with containment overpressure the primary contributor; late containment failures is 11% with containment overpressure being the primary contributor, and bypass is 14% with SGTR the primary contributor. The containment remains intact 74% of the time. Radiological releases are dominated by SGTR sequences. The licensee's response to containment performance improvement program recommendations is consistent with the intent of GL 88-20 and associated Supplement 3.

VEPCO identified several insights and unique plant safety features at North Anna:

(1) Ability to use component cooling water from the opposite Unit for reactor coolant pump seal cooling.

(2) Charging pumps cooled directly with Service Water instead of component cooling water.

(3) Automatic switchover of emergency core cooling system from injection to recirculation.

(4) Heating, ventilating, and air conditioning is required for the electrical switchgear rooms.

(5) Requirement to use the recirculation spray system to cool containment.

The licensee used importance measures to identify vulnerability. For a component failure or an operator error to be defined as a vulnerability, it must contribute more than 10% to the overall CDF or be a factor of 3 higher than the next highest similar event. Based on this definition of vulnerability, the licensee did not identify any severe accident vulnerabilities. Plant improvements, however, were identified. These improvements (as characterized by the licensee), listed below, have been implemented:

(1) Revise periodic test procedures to verify that auxiliary feedwater full flow recirculation valves are closed.

(2) Revise periodic test procedures to verify that quench spray piping and recirculation spray piping is restored after testing.

(3) Revise emergency operating procedures to add the alternate Safety Injection (SI) header to the 'response not obtained' column if the normal SI header fails.

(4) Stagger Low Head Safety Injection pump tests to test one train every 45 days and each pump every 90 days.

(5) Administratively eliminate pre-planned dual maintenance outages for chillers serving the main control room and the emergency switchgear rooms.

(6) Improve maintenance practices to minimize total time main control room and emergency switchgear room chillers are out of service.

(7) Provide procedural guidance for trouble-shooting and repairing main control room/ emergency switchgear room chiller protective circuitry.

In addition, the licensee stated that the following plant improvements regarding internal flooding have also been implemented:

(1) Install backflow prevention devices in charging pump cubicle floor drains.

(2) Reinforce the present fire barrier in the piping penetration between the auxiliary building and the quench spray pump house to limit the flooding flow rate reaching the auxiliary building.

(3) Add a dike to protect chiller room/fan room doors and modify chiller room/turbine building doors.

(4) Periodic inspection/replacement of charging pump cubicle drain back flow prevention devices.

(5) Periodic inspection of all flood dikes and barriers.

(6) Revision of periodic test procedures to test alarms and all automatic equipment actuations for flooding level switches.

(7) Revision of abnormal procedure for auxiliary building flooding to include steps which identify and isolate remotely isolable floods and Refueling Water Storage Tanks floods.

III. CONCLUSION

Based on the above findings, the staff notes that: (1) the licensee's IPE is complete with regards to the information requested by Generic Letter 88-20 (and associated guidance NUREG-1335), and (2) the IPE results are reasonable given the North Anna plant design, operation, and history. As a result, the staff concludes that the licensee's IPE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities, and therefore, that the North Anna IPE has met the intent of Generic Letter 88-20.

It should be noted, that the staff's review primarily focused on the licensee's ability to examine the North Anna plant for severe accident vulnerabilities. Although certain aspects of the IPE were explored in more

detail than others, the review is not intended to validate the accuracy of the licensee's detailed findings (or quantification estimates) that stemmed from the examination. Therefore, this SER does not constitute NRC approval or endorsement of any IPE material for purposes other than those associated with meeting the intent of GL 88-20.

Enclosure 2

NORTH ANNA NUCLEAR PLANT INDIVIDUAL PLANT EXAMINATION

TECHNICAL EVALUATION REPORT

(FRONT-END)