Enclosure

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

SUPPLEMENTAL SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STATION BLACKOUT EVALUATION

VERMONT YANKEE NUCLEAR POWER CORPORATION

VERMONT YANKEE NUCLEAR POWER STATION

DOCKET NO. 50-271

1.0 INTRODUCTION

The NRC staff's Supplemental Safety Evaluation (SSE) pertaining to the Vermont Yankee Nuclear Power Corporation's (VYNPC) responses to the Station Blackout (SBO) Rule, 10 CFR 50.63, was transmitted to the licensee by letter dated June 18, 1993. The staff's SSE found the licensee's proposed method of coping with an SBO to be acceptable except that the licensee needs to make additional modifications so that the alternate ac (AAC) power source can be tested initially and once every refueling outage per NUMARC 87-00, Appendix B (B12 and B10).

However, on July 22, 1993, VYNPC representatives met with the NRC staff to discuss the status of Vermont Yankee's (VYs) SBO implementation plan and schedule. During the meeting, NRC staff members requested VYNPC to submit additional information regarding: 1) the status of the design upgrade and plans for periodic testing of the AAC power source, 2) the design of the AAC source and how it is protected against the effects of weather related events, 3) the time required to manually load the safety buses from the tie line, and 4) the agreement between VYNPC and New England Power Company (NEPC) regarding the use of the Vernon Station as an AAC source. The licensee provided the requested information by letter from Leonard A. Tremblay to Document Control Desk, dated September 2, 1993.

Subsequently, by telecon dated February 10, 1994, the staff requested additional information on the structural design criteria for the Vernon Hydro switchyard, as well as the probabilistic wind occurrences (severe and extremely severe weather conditions) for the Vernon Station site. The licensee provided the requested information by letter from Leonard A. Tremblay to Document Control Desk, dated March 11, 1994.

2.0 EVALUATION

The licensee's responses to the staff's concerns are evaluated below.

2.1 Design Change Status and Plans for Testing of AAC Power Source

The licensee indicated that VY has installed a new 3750 kVA, 13.2 kV - 4.16 kV transformer on its property, installed an underground 4.16 kV cable from the transformer to connect to the existing underground 4.16 kV Vernon Station tie line, and installed an underground 13.2 kV cable from the transformer to the 13.2 kV section of the Vernon Station switchyard. Initial testing of the cable and transformer has been completed. During the interim phase, the 13.2 kV section of the switchyard is fed directly from one hydro station generator via an underground cable, as well as from the 69 kV section of the switchyard. The permanent connection from the 13.2 kV section of the hydro switchyard will use an existing circuit breaker within the switchyard.

The licensee stated that VYNPC has completed its connection to the existing underground 4.16 kV cable on August 21, 1993. VYNPC will no longer rely on the overhead portion of the Vernon tie line.

VYNPC tested the AAC power source during the 1993 refueling outage by connecting the 4160 volt tie line to the Class 1E switchgear at the Vermont Yankee Station. The tie line was loaded to 1928 kW which is 80% of maximum SBO load of 2300 kW, by using the maximum available 4.16 kV system loads. The licensee further indicated that VYNPC will perform load testing of the Vernon tie line (AAC power source) during each scheduled refueling outage.

Based on its review, the staff finds the licensee's design change and the load testing of the AAC power source meet the requirement of NUMARC 87-00 items B12 and B10 and are acceptable.

2.2 Description of the AAC Source and Compliance with SBO Rule

The licensee stated that Vernon Station generation will be connected to two indoor 13.8 kV generation busses separated by a normally open tie breaker. Each bus will be connected by underground cable to its associated generator step-up transformer located in the 69 kV switchyard. Each step-up transformer is sized to carry the full station output. The 69 kV switchyard is arranged in a dual bus configuration. The output of the station will feed four 69 kV transmission lines and a 13.2 kV feeder to Green Mountain Power Company. The 69 kV lines can be supplied by either bus.

An underground cable runs from the structure in the 13.2 kV section of the hydro station yard to a 13.2 kV - 4.16 kV transformer located on VYNPC property. From the transformer a 4.16 kV cable runs underground to the VY switchgear room. The only portions of the AAC that may be potentially affected by weather related events are the portions within the outdoor switchyard.

The licensee stated that the proposed design using Vernon Station meets the requirement of an AAC source as follows:

1) The AAC source can be connected to VYNPC's emergency busses, but it is not normally connected to these buses. The 4 kV breakers in the VYNPC switchgear room which connect the tie line to either of the busses are open during normal operation, but can be closed readily from the VYNPC Control Room. The Vernon Station is also not normally connected to the offsite or onsite emergency power systems at VYNPC.

2) The AAC power source has minimum potential for common mode failure with VYNPC's offsite or onsite power.

   Vernon Station generators are not normally connected to the VYNPC emergency busses, the equipment is of different manufacture than the VYNPC onsite power sources, the equipment is maintained and operated by a separate organization; therefore, it has minimum potential for common mode failure with VYNPC's onsite power system.

   Vernon Station is connected to a 69 kV transmission system which is not directly electrically connected to VYNPC's offsite power sources, thus providing electrical independence and minimizing the potential for common cause failure due to electrical faults, switching problems, or other grid related losses of power. Vernon Station is connected to its own switchyard which is physically separated from VYNPC's switchyard (by about a mile) and the transmission lines emanating from the station are routed on separate rights of way. The majority of the lines emanating from the station are routed in different directions from the lines supplying offsite power to VYNPC.

   The proposed AAC power source is subjected to a limited exposure to weather related events. The only portion of the electrical configuration which could be considered exposed to the weather is the rigid bus within the switchyard, and a short (15 feet) length of armored cable in transition from the switchyard bus to the underground duct bank. Because of its construction, this bus is not prone to the same weather-induced failure (ice, snow, wind, trees) as an overhead cable. The small section of armored cable is attached to a steel structure, and will not be prone to weather-induced failures. From the switchyard, all cable is run underground to a pad mounted transformer. The connections at the transformer are totally enclosed and protected from the weather. Cable from the transformer secondary is run underground to the VY 4 kV switchgear.

   In response to the staff's request for additional information, the licensee, by letter dated March 11, 1994, indicated that the switchyard at the Vernon Hydro Station was composed of original 69 kV section built primarily of carbon steel around 1920 and the

newer 13.8 kV section built primarily of aluminum around 1970. Both structures are lattice framed. The licensee stated that the switchyard structures and components were designed in accordance with the requirements of National Electrical Safety Code (NESC). The NESC designated the Vernon area as a "heavy" loading district based upon the prevalence of high-wind velocity and thickness of ice which accumulates on wires. The licensee with the help of the switchyard structural engineers at New England Power Company (NEPCo) determined that the design of the cables and conductors for both structures incorporated a radial thickness of ice equal to one half (1/2) inch. Additionally, the design of both structures incorporated an extreme wind speed equal to ninety (90) miles per hour. The licensee indicated that the above requirements exceeded those of the Uniform Building Code. The licensee determined that the annual probability of exceedance of wind speed of 90 miles per hour (mph) is approximately 4E-3. The annual probability of exceedance of wind speed of 125 mph is 7.2E-4 per licensee submittal dated September 30, 1991.

3) The AAC power from Vernon Station is available within 10 minutes after the onset of SBO by closing two breakers from the VYNPC control room.

4) The AAC power source has sufficient capacity and reliability for operation of all systems required for coping with SBO and for the time required to bring and maintain the plant in safe shutdown (non-design-basis accident). The capacity of the AAC source is sufficient to power the maximum loss of offsite power (LOOP) loads for one emergency bus for an indefinite time. The reliability and availability of Vernon Station has historically been well above 99% which exceeds the required AAC source availability of 95%.

Based on VY Individual Plant Examination (IPE) dated December 21, 1993, the core damage frequency (CDF) is 4.3E-6/year. SBO (Late SBO + Early SBO sequence caused by failure of DC-1 and DC-2 + Early SBO sequence) contributes 20% of CDF. The IPE indicated that the addition of severe weather events would cause only about a 10% increase in the total LOOP initiator frequency. The NRC staff did not complete its review of the IPE. However, based on the IPE, the staff determines the incremental CDF due to severe weather and extremely severe weather events is no more than 8.6E-8/year.

Based on its review and low frequency of wind speed exceeding 90 mph and low incremental CDF due to extremely severe weather events, the staff believes that the probability of failing the exposed rigid bus within the switchyard and short length of armored cable is extremely small. Hence, the staff finds that the proposed AAC power source meets the requirements of NUMARC 87-00, Appendix B.

2.3 Time Required to Manually Load the Safety Buses

The licensee stated that the time required to manually load a safety bus is not governed by the source of power to that bus, but rather by system requirements. There is no time restriction on the application of load after the closure of the Vernon tie line. Energizing a safety bus from Vernon tie line requires the closure of two circuit breakers from the VY control room. Breaker closure would be accomplished as soon as the operator has diagnosed that a LOOP has occurred, a diesel generator has failed to start, and one attempt to restart a diesel generator has been made. The SBO scenario is practiced in simulator training. Typical time for power restoration is less than 5 minutes, and is well within the required time of 10 minutes from the onset of an SBO. A timed test of this capability has been conducted during the 1993 refueling outage on Bus 4.

Based on its review, the staff agrees with the licensee that the AAC power source will be available within 10 minutes.

2.4 Agreement between VYNPC and NEPCo

The licensee indicated that VYNPC has confirmed with Vernon Station management that they will keep the Vernon tie line energized at all times to the best of the hydro station operator's ability. The licensee further stated that both the hydro station and New England Power Pool consider this line to be a high priority line. A contract is in place obligating Green Mountain Power/NEPCo to supply emergency power to VYNPC from the Vernon Hydro Station. This contract is available for NRC inspection through the onsite NRC Resident Inspectors if needed.

Based on its review, the staff assumes that the Vernon tie line will be energized at all times and can be used as an AAC power source.

3.0 SUMMARY AND CONCLUSION

The staff has reviewed the licensee's response dated September 2, 1993. The staff finds the licensee's responses to be acceptable. The staff concludes that the SSE (dated June 18, 1993) issues of testing the AAC source initially and once every refueling outage per NUMARC 87-00, Appendix B (B12 and B10) are resolved.

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Date: June 1, 1994