New England Power

New England Power Company
20 Turnpike Road
Westborough, Massachusetts 01581
Tel. (617) 366-9011

NEP 1 & 2 Nuclear Project

March 22, 1979

NRC-N-107

Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

DOCKET NOS. STN 50-568 AND STN 50-569
TOTAL LOSS OF OFFSITE AND ONSITE AC
ELECTRICAL POWER

Dear Sir:

At the request of the Advisory Committee on Reactor Safeguards, New England Power Company (NEP) has evaluated the capability of its proposed nuclear units (NEP 1&2, Docket Nos. STN 50-568 and STN 50-569) to tolerate a total loss of both offsite and onsite ac electrical power as a function of time. We wish to note, however, that NEP considers the simultaneous loss of both offsite and onsite power to be a highly unlikely occurrence. As stated in our response to Question 15.1 (PSAR page S15-1), the event postulated is not designated a design criterion for nuclear power plants as defined by Appendix A of 10CFR50, "General Design Criteria for Nuclear Power Plants".

At your request, however, we have evaluated the effect of a total loss of ac power. The discussion is organized as follows:

1. Availability of electric power

2. Availability of support systems

3. Availability of systems to maintain a safe shutdown condition.

1. Availability of Electric Power

Provision of reliable sources of electric power is required by design criteria. Criterion 17 of Appendix A states the requirements for the offsite electric power system and the onsite electric power system for a nuclear power unit. The design of both NEP 1&2 meets and in some respects exceeds the requirements of Criterion 17 by providing the following power systems for each unit:

7903280316

B001/5
1/0

(a) Electric power from the transmission network to the switchyard through three independent transmission lines. Criterion 17 requires two physically independent transmission lines. In addition the two circuits from the switchyard to the onsite distribution system are designed for immediate access; Criterion 17 requires only one immediate access circuit.

(b) Emergency ac electric power from two redundant onsite safety related diesel generators per unit.

(c) DC electric power supplies from four redundant safety related batteries, and one non-safety related onsite battery per unit. Each safety related battery is sized for 200% capacity; Criterion 17 requires only that they have sufficient capacity.

In the unlikely event offsite ac power is lost, the emergency diesel generators start automatically. As stated above, two redundant diesel engine generator systems are provided for each unit. Each diesel generator system is provided with its own independent fuel oil system, air start system, lube oil system and other auxiliary equipment. When considered along with the frequent testing of these units, the simultaneous failure of both diesels in one unit to start when needed is highly unlikely. Furthermore, once Unit 2 is completed and operational, a total loss of ac power will require, in addition to loss of all offsite power, the simultaneous failure of four emergency diesel generators: the operation of only one emergency diesel generator is sufficient to supply the energy requirements of the required shutdown loads of both units.

The necessary instrumentation to maintain the plant in a safe shutdown mode is powered from safety related dc power supplies. The safety related dc power supplies consist of four 125 volt batteries for each unit. Two batteries are supplied for each safety train. Each battery is capable of supplying the total load requirements of one safety train for a 2 hour duration. Used consecutively, the four batteries can maintain full dc requirements to one safety train (that is, Train A or Train B) for 8 hours. By shedding all non-essential dc loads, the 8 hour duration can be extended to 144 hours.

It is very unlikely that offsite power will remain unavailable for periods in excess of one hour (NUREG-0305). Furthermore, even though all offsite ac power is lost to one unit, the offsite power may be available to the other unit and thus can be transferred to the affected unit. If offsite power is lost to both units and onsite power to one unit, the onsite power from one unit can be transferred to the affected unit. Power to the affected unit can be supplied either through the 345 kV offsite switchyard or through a 115 kV buried cable between the units' onsite reserve auxiliary transformers. Transferring power through the onsite 115 kV line could be accomplished within approximately 1 hour by opening and closing several motor operated disconnects. Additionally, a temporary connection could be made between units at the ultimate heat sink cooling tower common cell power supply. This could be accomplished in approximately 30 minutes. The capacity of this temporary connection, however, would be limited by cable ampacity to approximately 300 kVA, which would be sufficient to recharge the batteries to provide dc power indefinitely.

2. Availability of Support Systems

On a loss of ac power, the containment air coolers will be de-energized and not available for removing heat from the containment. The time-temperature response of the atmosphere inside containment is shown in Figure 1. The analysis is based on an initial temperature of 120°F and 45% humidity. After 48 hours, the temperature inside containment reaches approximately 200°F. This temperature is conservative and is based on a constant heat input into the containment and also on a reactor coolant pump seal leak rate of 5 gpm/pump into the containment. Post accident instrumentation qualified to operate in the more limiting Main Steam Line Break Accident environment, is available to monitor essential plant parameters.

Ventilation systems for the emergency feed pump room and the emergency batteries will also be non-functional on total loss of ac power. However, heat produced by the operation of the steam driven pump in the emergency feed pump room can be dissipated by opening doors and dampers to allow dispersal by natural circulation. Since the batteries produce very little hydrogen during discharge, ventilation for the battery areas is not required.

Air conditioning and air makeup for the control room will also be lost. However, because of the loss of power, very little heat will be produced in the control room and makeup air can be provided by opening doors.

Emergency lighting is provided where essential to control and monitor shutdown systems operation. The emergency lighting is powered from the safety related dc batteries.

3. Availability of Systems to Maintain Safe Shutdown Condition

A complete loss of both offsite and onsite ac power will result in a reactor trip from either a trip of the reactor coolant pumps, a trip of the turbine, or from a high pressurizer pressure signal. In any event, a loss of power to the control rod drive mechanisms will automatically allow the control rods to drop by gravity into the core.

The plant will be maintained in a safe shutdown condition as long as water inventory can be maintained in the primary coolant system.

The steam driven emergency feed pump and atmospheric steam relief valves are adequate for removal of core decay heat. On a loss of ac power, the steam driven emergency feedpump will start automatically. Emergency feedwater is supplied from the Condensate Storage Tank (CST). In accordance with Technical Specifications, this tank has a minimum 200,000 gallon supply of emergency feedwater and is sufficient to provide approximately 15 hours of decay heat removal. Additional water supplies are available in the demineralized water storage tank, primary make-up water storage tank, onsite wells and fire pond. The combined water volumes of these supplies (5,312,000 gallons not including wells) is capable of providing at least 100 days of decay heat removal. Two portable engine driven pumps and sufficient lengths of hose are available onsite to pump water from these supplies into the CST.

The total loss of ac power will cause an interruption of both component cooling water flow and seal water injection flow to the reactor coolant pump/motor assembly. Once both cooling flows are lost to the reactor coolant pump seals, hot reactor coolant will enter the seal. The seal coolant temperature will increase and eventually stabilize at the primary system temperature (approximately 500°F). Nominal seal water leakage during operation is 5 gpm per pump. Depending on seal behavior during the postulated event, this leakage could range from zero (0) gpm to values substantially higher than the nominal5 gpm. Primary system pressure will gradually drop depending on seal leakage flow rates, heat losses from the pressurizer, and heat transfer to the secondary coolant.

We are not aware of any analytical or test results predicting RCP seal leakage behavior during a simultaneous loss of both seal injection water and component cooling water. Predicting seal behavior by analysis would be extremely difficult because of the complexity of the seal assembly. Furthermore, little operating plant experience is available demonstrating seal behavior under these conditions. We are aware of several incidents where a total loss of ac power has been experienced, the longest duration being 40 minutes during preoperational testing. RCP seal integrity was maintained throughout these incidents; however, no data is available on seal leakage rates.

A conservative computer analysis was performed by Yankee Atomic Electric Company to address the concern over the effect of uncompensated long term leakage through the RCP shaft seals. The RCS was modeled as a network of volumes and flow paths. The conservation of energy, momentum and mass was applied to this network so that various transient parameters could be computed. These included:

(a) coolant temperature and pressure distribution in the Reactor Coolant System (RCS);

(b) pressurizer pressure and water level;

(c) pressurizer heat losses by conduction through vessel walls;

(d) secondary coolant pressure and inventory with heat transfer from primary coolant; and,

(e) core residual heat generation and natural coolant circulation.

The analysis shows that continued leakage through the RCP seals eventually results in loss of pressurizer liquid inventory. At this point the RCS pressure drops relatively quickly to the hot leg saturation pressure. Proceeding with the very conservative assumption that (1) the inception of hot leg boiling is a warning that natural convection coolant flow may deteriorate, and that (2) corrective action should be taken by the time the pressurizer becomes empty of fluid, the following conclusion can be made. Should the leakage rate through the RCP seals be 5 gpm per pump, at least

4-1/2 hours are available for corrective action to restore ac power. Should the leakage be higher or lower than the nominal value, the time available for corrective action would be determined by dividing 4-1/2 hours by the ratio of that leakage value over the nominal value.

Our evaluation has confirmed the importance of maintaining an available source of ac power, and shows that without ac power from the redundant sources identified, the plant can be maintained in a safe condition for a period of up to approximately 4-1/2 hours based on the nominal leakage rate of 5 gpm per RCP seal. Lesser times will result from higher leakage rates.

We have indicated our electrical distribution system design meets or exceeds present NRC design criteria. Additionally, if offsite ac power cannot be readily restored to the affected unit, the NEP 1&2 distribution systems provide the capability to transfer power between units. Furthermore, one emergency diesel generator is sufficient to power the shutdown loads for two units, if necessary.

In summary, we consider the simultaneous loss of both offsite and onsite ac power for NEP 1&2 to be a highly unlikely event because multiple single failures are required to postulate such an occurrence. Our position is that even if offsite power is lost, at least one emergency diesel generator will be available and operable. Furthermore, even if the postulated event were to occur, it is our position that ac power would be restored within the time available for corrective action by either (1) restoring one of the three incoming 345 kV power lines, or (2) starting one of the four onsite redundant emergency diesel generators. Because we believe the event would be terminated by restoring ac power, we have not pursued the possible course of events beyond the time durations already discussed.

Very truly yours,

J Harrington

Joseph Harrington
Project Manager

CONTAINMENT TEMPERATURE HISTORY

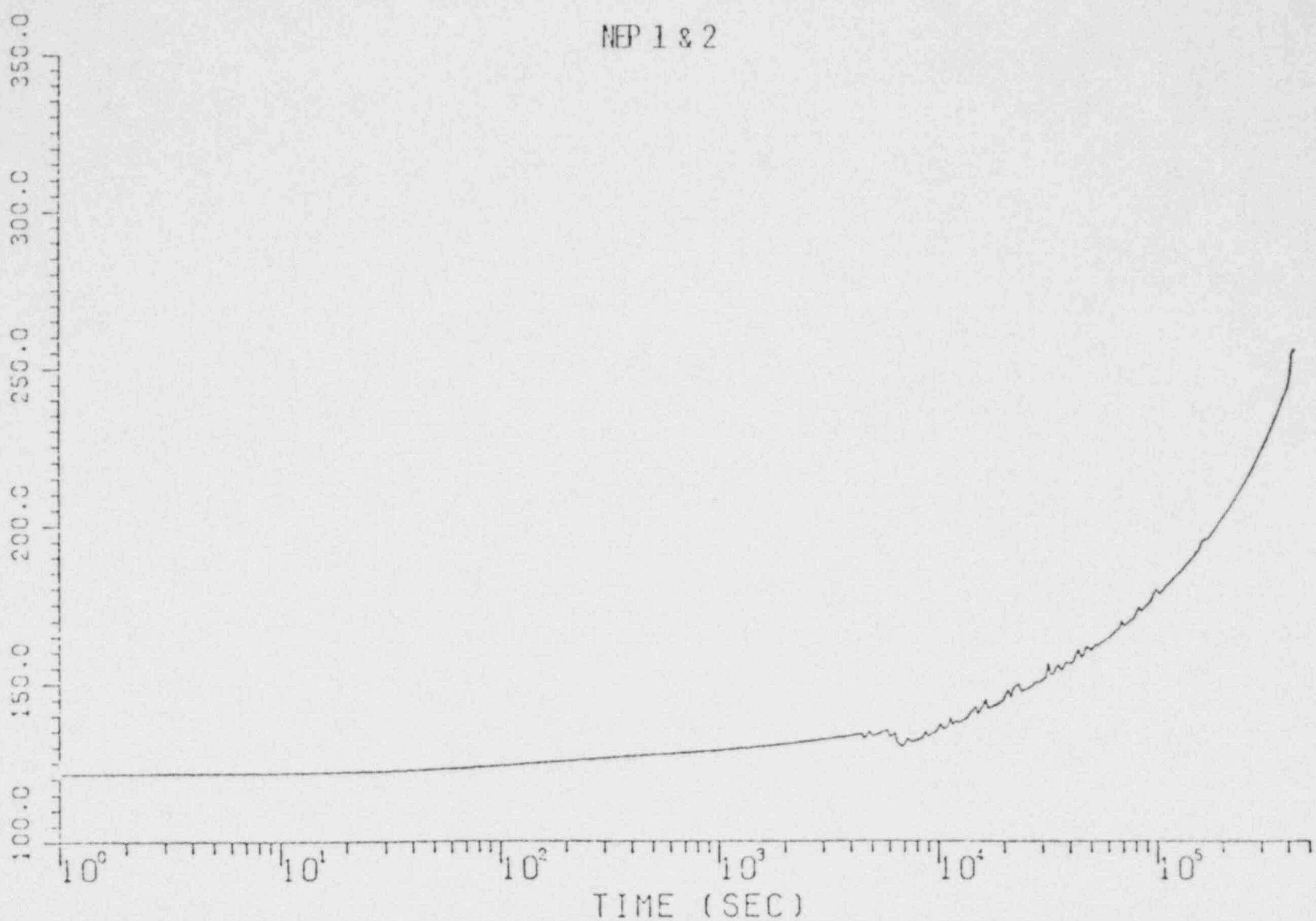

FIGURE 1