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Gentlemen:

In the Matter of) Docket No. 50-260
Tennessee Valley Authority

BROWNS FERRY NUCLEAR PLANT (BFN) - ELECTRICAL CABLE SEPARATION

As requested by the NRC Staff, this letter documents TVA's position on the BFN electrical cable separation issue. This position was communicated to the NRC Staff in a meeting on November 30, 1988. TVA has concluded that postulated electrical failures resulting from improper cable separation during refueling activities before restart are highly improbable and do not pose undue risk to the health and safety of the public. Therefore, the modification to correct the separation discrepancies affecting unit 2 (and common) systems will be completed before restart.

In a letter, dated November 10, 1988, TVA committed to completing the discovery phase of this program and to correct the problems identified on the systems required for fuel load before refueling of unit 2. The discovery phase has been completed and TVA has evaluated the impact of the identified improper cable separation on operability of the systems required for fuel load and restart. As stated above, TVA has determined that the modifications required can be deferred beyond fuel load without impacting plant safety. Enclosure 1 provides our basis to support this conclusion.

Enclosure 2 provides a summary list of commitments made by TVA in this letter. Please refer any questions concerning this submittal to Patrick Carier, BFN Site Licensing, (205) 729-3570.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

R. Gridley, Manager
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Regulatory Affairs

Enclosures
cc: See page 2

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U.S. Nuclear Regulatory Commission

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ENCLOSURE 1

BROWNS FERRY NUCLEAR PLANT UNIT 2
ELECTRICAL CABLE SEPARATION

Description of Issue

A recently completed review of the Browns Ferry Nuclear Plant (BFN) has concluded that electrical separation criteria have not been met in a number of instances in safety-related systems. Improper electrical separation could result in the loss of both trains of a safety-related system if an electrical fault resulted in damage to the power or control cables for both trains. This condition has been found to affect portions of the 125 VDC, 120/208 VAC, 250 VDC and 480 VAC electrical systems.

This engineering evaluation provides TVA's basis for deferring the implementation of modifications required to correct the separation discrepancies until restart.

Basis

1. Background

As identified in TVA's letter to NRC dated November 10, 1988, a review of electrical cable separation was being performed as part of the restart effort for BFN. This review has been completed and final verification is being performed. In this review, TVA evaluated the raceway routings of over 1300 electrical cables to ensure conformance to the separation criteria identified in the BFN Final Safety Analysis Report (FSAR), Section 8.9, and the BFN system design criteria. The general cable routing criteria for raceway systems is:

a. Electrical circuits of redundant divisions shall be physically separated, and maintain this separation for the complete route.

b. Nondivisional cables can be routed with one division provided the nondivisional cable does not subsequently route with the redundant division.

This review was initiated as a result of conditions adverse to quality identified by various other review programs (e.g., cable ampacity and drywell penetration modifications) being performed as part of the BFN restart effort. These conditions have been identified to NRC in Licensee Event Report (LER) 259/88032, dated October 22, 1988. As discussed with NRC on November 30, 1988, TVA will revise LER 259/88032 to update the status of the electrical cable separation review.

This review was performed by dividing the cables of concern into ten categories by voltage level and type of cable suffix. There are basically three types of cable designations at BFN: divisional, nondivisional, and IE. The IE suffix was used as a unique identifier very similar to the S or special suffix used at TVA's Sequoyah Nuclear (SQN) Plant. A complete review was performed on five of the 10 categories with sampling applied to the remaining five. The sampling technique which is

similar to previous SQN efforts yields a 95/95 confidence level. As previously committed in our November 10, 1988 letter, a detailed report of this review that will include the methodology and results will be submitted to NRC by December 23, 1988.

The following engineering analysis has been performed to assess the impact of the electrical cable separation discrepancies on plant safety.

2. Nuclear Safety Considerations

BFN unit 2 has been shutdown for over four years. Consequently, the decay heat power output from the fuel is extremely low (i.e., less than 0.4 MW for the entire unit 2 fuel pool) and the only fission product remaining in any significant quantity is Krypton 85 (Kr 85). During the modes of operation (e.g., refueling and vessel hydro testing) planned to occur before restart of the unit 2 reactor, the following general safety functions must be accomplished: (1) the fuel must be maintained cool, (2) the fuel must remain covered with sufficient water to ensure shielding for personnel on the refuel floor, and (3) in the event of fuel damage, the offsite and control room dose must be maintained within the guidelines established by 10 CFR 20.101, 10 CFR 50 Appendix A, and 10 CFR 100.11.

The effects of the electrical cable separation discrepancies have been evaluated for the credible hazards which could exist before restart. It should be noted that there are no common mode hazards that could affect all of the cables with separation problems. Since the plant is shutdown with extremely low decay heat and with cool water in the fuel pool and reactor vessel, there is no possibility of environmental extremes (i.e., harsh environments) from loss of coolant accidents (LOCAs) and/or high energy line breaks. Extensive fire related failures are not anticipated based on existing fire prevention/detection features and interim compensatory measures either in place or to be implemented by TVA before fuel load. The review to determine if additional compensatory measures are needed is ongoing. Raceways in the safety-related buildings are designed to survive seismic events without damage to required equipment; therefore, there are no seismic common mode failures. Since there are no common mode failures affecting cables, the only remaining credible failure mode is an individual cable failure.

Spurious operation of valves could occur because of electrical faults resulting from improper electrical separation. However, the type of electrical faults (i.e., hot shorts) required to achieve spurious operation of a valve is a highly improbable event (i.e., requires multiple failures). However, should a sufficient number of spurious operations occur, a drain path from the reactor vessel or spent fuel pool could be created. A review of the piping systems connected to the reactor vessel and spent fuel pool which have the potential for creating a drain path showed that the systems contain at least two valves in series while most systems contain three or more valves in series. Consequently, it is not credible that a sufficient number of hot shorts would occur so as to create a drain path.

The plant technical specifications (TSs) specify which systems are required to be operable for the various modes of operation. During reactor power operation, the TSs require that safety-related systems have redundant trains available for operation in order to provide single failure protection. During nonpower operations such as fuel handling, the TSs recognize that there are less stringent requirements for safety actions and therefore reduce equipment requirements and extend time periods allowed to return equipment to service. However, as discussed in more detail below, TVA's operational philosophy is to maintain as much equipment available as possible to provide fuel cooling and/or water injection. Providing multiple, diverse means for cooling/injection helps to ensure the ability to maintain safe operation in the unlikely event of multiple failures.

Considering the extremely low power output of the unit 2 fuel, the time required to respond to transients is very long. Therefore, considering the low likelihood of an isolated electrical failure occurring because of improper separation, the diverse means which the plant has to respond to the events and the slowness of transients in the plant's current configuration, it can be concluded that there is sufficient alternate equipment and time to maintain the plant in a safe condition during refueling, vessel hydro, and shutdown.

Although the loss of safety systems because of improper electrical separation is highly improbable, TVA has evaluated the consequences which could result from a postulated accident during refueling operations. Many of the calculations used as the bases for these evaluations were performed in the past for other purposes. However, the calculations utilize decay period assumptions appropriate at that time (i.e., 1 1/2, 2 or 3-year decay), and therefore conservatively bound the current four-year decay period conditions.

In the event that during the time when the vessel head is off, active cooling for the water in the reactor vessel pool and/or spent fuel pool were lost (i.e., residual heat removal and fuel pool cooling systems), it would require more than seven days for the pool to boil and more than 33 additional days for the water to boil down to the TS limit for minimum shielding height (8 1/2 feet.). Based on the guidance in Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants," a period of 30 days is considered an adequate period of time to evaluate a situation of this nature (e.g., loss of cooling source) and take corrective action. Thus, it is concluded that loss of active fuel pool cooling because of improper electrical separation does not represent a threat to nuclear safety in terms of maintaining the fuel cool or providing shielding to refuel floor personnel.

Offsite doses must be maintained within the guidelines specified by 10 CFR 100.11 while control room doses must meet 10 CFR 20.101 and 10 CFR 50 Appendix A. The NRC Standard Review Plan (NUREG 800) recommends (and the BFN FSAR commits to) maintaining offsite doses below 10 percent of the requirements of 10 CFR 100.11. To conservatively assess the potential impact on offsite doses, TVA has evaluated the potential consequences of a fuel handling accident concurrent with a failure to isolate secondary containment. Such an event would prevent the standby gas treatment system (SGTS) from performing its safety function of filtering releases to the environment. The evaluation took no credit for secondary containment or SGTS and is therefore equivalent to a ground level release of radioactive materials. The evaluation was conservatively based on a fuel decay of 1-1/2 years. The only significant radioisotope remaining is Kr 85 with essentially no Iodine present. The evaluation concluded that the site boundary and low population zone two hour doses are on the order of one hundred times lower than the limits specified in the FSAR and NUREG 800 and are thus on the order of one thousand times less than the 10 CFR limits. Should a fuel handling accident occur with the fuel in its present state, SGTS filtering of Iodine would not be required since essentially no Iodine is present. Filtering has no effect on Kr 85 since Kr 85 is an inert gas; however, as shown above, the low level of Kr 85 poses no radiological hazard.

Similar to the evaluation of offsite dose, an evaluation was conducted of the resulting control room operator dose following a fuel handling accident. The evaluation was based on fuel which had decayed for two years and took no credit for secondary containment, SGTS or the control room emergency ventilation system (CREVS). This analysis showed that the control room dose was on the order of 300 times lower than the 10CFR limits. It should be noted that the results of this evaluation were previously approved by NRC as a basis to allow CREVS to be inoperable until restart.

Following placement of the head on the vessel, the fuel in the vessel is isolated from the large mass of water in the fuel pool. The fuel in the vessel is cooled by means of the shutdown cooling mode of the Residual Heat Removal System. During this period, three potential events could occur: (1) loss of active cooling to the water in the vessel, (2) inadvertent draining of the vessel or (3) a LOCA during vessel hydro testing.

As discussed above, the creation of a drain path from the vessel because of simultaneous spurious operation of two or more valves in a piping system is not considered to be a credible event. Also, it should be noted that the time period associated with vessel hydrostatic testing is short (approximately two days in duration). In addition, TVA has performed an engineering evaluation which bounds the results of a postulated LOCA occurring during the vessel hydro evolution. This evaluation determined that in the event of total core uncovery concurrent with loss of core

cooling capability, it would take several hours before the fuel temperature would reach the point (2200° F) at which fuel damage is assumed to occur. Because of the extended time period of this transient and since TVA is utilizing the operational philosophy of maintaining multiple, diverse means available for injection, core reflood for mitigating this postulated event can be accomplished in a timely manner to prevent fuel damage and subsequent fission product release.

In summary, TVA has determined that from a nuclear safety perspective, it is acceptable to proceed with refueling operations on BFN unit 2 and complete the modifications required to correct the electrical separation discrepancies before restart.

3. Operational Considerations

The TVA operational philosophy is to maintain as many diverse systems available as possible at all times. This reduces susceptibility to cable separation problems or any other single failure mechanisms. The issues of concern, then, are operational safety and regulatory compliance. Since there is no increased risk to nuclear safety as a result of cable separation concerns, the intent of regulatory compliance is satisfied. However, overall plant safety can be further enhanced by optimizing operational safety. Nuclear industry experience indicates operational safety is enhanced by:

1. maintaining similarity of operation to the extent practical among similar units,

2. maintaining consistency of instructions, drawings, and checklists used to operate the plant, and

3. minimizing abnormal system lineups and unnecessary board transfers.

Such actions reduce the potential for personnel error, minimize challenges to engineered safety features, maximize equipment availability and generally reduce the complications of routine operation.

Recognizing that a cable separation failure is a low-probability event and the consideration that there is no increased risk to nuclear safety as a result of cable separation issues until restart, it would be most prudent from a plant safety standpoint to concentrate efforts in the area of improvement to operational safety. This can best be done by minimizing board outages, thus minimizing the number and duration of abnormal electrical lineups. Integrating cable separation work with other work identified as restart issues which require board outages will facilitate this end. In addition to providing an integrated approach to remaining electrical work, this approach has the added advantage of maintaining the availability of multiple and diverse sources of cooling water that are provided as part of the normal system lineups at BFN.

Conclusions

Based on the above evaluations, TVA has concluded that postulated electrical failures resulting from improper cable separation during refueling activities before restart are highly improbable and do not pose an undue risk to the health and safety of the public. Therefore, the modifications to correct the separation discrepancies affecting unit (and common) systems will be completed before restart.

Enclosure 2

BFN ELECTRICAL SEPARATION PROGRAM

Summary List of Commitments

1. TVA will complete the cable separation modifications which affect unit 2 (and common) systems before restart.

2. Based on ongoing reviews, interim fire protection compensatory measures determined to be necessary which are not currently in place will be implemented by TVA before fuel load to protect against failure of improperly separated cables because of a postulated fire.

3. TVA will revise Licensee Event Report 259/88032 to update the status of the electrical cable separation review.