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

July 21, 1994

MEMORANDUM FOR: William T. Russell, Director
Office of Nuclear Reactor Regulation

FROM: Ashok C. Thadani, Chairperson
NRR Standing Panel for DPOs and DPVs

SUBJECT: DIFFERING PROFESSIONAL VIEW RE UNCOORDINATED BREAKERS AT CATAWBA NUCLEAR STATION

In a memorandum to W. Russell, Director, NRR dated May 6, 1994, Mr. Charles Morris, Electrical Engineering Branch, NRR, expressed a differing professional view (DPV) regarding the resolution of a breaker coordination issue identified during an electrical distribution system functional inspection (EDSFI) conducted at Catawba Nuclear Station. In the view of Mr. Morris, the most important concern is the need for review, at a level higher than the branch, of the acceptability of the licensee position to solely change the commitment in the FSAR, when the as-built design does not meet the current licensee's commitment, and revising the commitment would be inconsistent with Standard Review Plan (SRP) position and industry standards and practices. The licensee's argument for changing the commitment is that a fully redundant safety train will perform the requisite safety functions in the as-built design even with the potential for the low probability faults that have been identified.

The NRR Standing Panel were Ashok Thadani as Chairperson and Brian Grimes as a management member. The panel commenced a review of the DPV that included informal discussions with Brian Sheron, Director, Division of Engineering; Carl Berlinger, Branch Chief, Electrical Engineering Branch; Eric Weiss, Section Leader, Component Section - Section B, Electrical Engineering Branch; Jeffery Jacobson, Special Inspection Branch; and Charles Morris, Electrical Engineering Branch. The panel also consulted with Edward Wenzinger, Region I, for purposes of independent review and assessment.

Background

During the period January-February 1992, the NRC conducted a special Electrical Distribution System Functional Inspection (EDSFI) at the Catawba facility. NRC Temporary Instruction 2515/107, "Electrical Distribution System Functional Inspection (EDSFI)," issued October 9, 1990, provided guidance for the inspection. The inspection consisted of a selective review of the Electrical Distribution System (EDS) design calculations, relevant procedures, representative records, installed equipment in the field, and interviews with engineering and technical staff. The findings of the inspection were discussed with the licensee's staff on February 14, 1992, and documented in NRC Inspection Report Nos. 50-413/92-01 and 50-414/92-01 dated March 18, 1992.

As part of the results of this inspection, one safety significant deviation from a written commitment was identified. Namely, the deviation involved failure to meet IEEE Standard 308-1974 in that the incoming breakers to all the essential 600 V ac Motor Control Centers (MCCs) are not coordinated with the outgoing breakers from the MCCs for all faults, and the 125 V dc Vital Instrumentation and Control Power System (EPL) molded-case breakers in the distribution centers are not coordinated for all faults.

NUREG-0800, Standard Review Plan, states on page 8.3.2-5 that acceptance [of a design] is based on meeting the specific guidelines in Regulatory Guide 1.32, which endorses the Institute of Electrical and electronic Engineers (IEEE) Standard 308. IEEE Standard 308, section 5.3.1, states that, "protective devices shall be provided to limit the degradation of Class 1E power systems." The licensee's Final Safety Evaluation Report (FSAR) states on page 8-75 that the system meets the requirements of this standard. FSAR Section 8.3.1.1.2.2 states that protective devices on the 600 V ac essential power system (EPS) are set to achieve a selective tripping scheme so that a minimal amount of equipment is isolated by an adverse condition such as a fault.

Contrary to the above, the licensee's analysis, prepared during the inspection, showed that coordination did not exist for fault currents above 3,500 Amperes (A) to a maximum fault current of 9,000 A on the battery charger output cables. A fault on the battery charger feeder cable could cause both the charger and battery to be isolated from the remainder of the distribution system and loads.

Additionally, all 600 V ac MCC outgoing feeder breakers had thermal elements and the incoming MCC breaker had an instantaneous element; hence, the incoming and outgoing MCC breakers were not coordinated for maximum expected short circuit current. A fault on any MCC outgoing feeder could cause the MCC incoming breaker to trip resulting in a complete loss of the MCC.

The licensee's response to the EDSFI report findings were provided to the headquarters staff by a memorandum from Region II dated May 12, 1993, with a request that NRR review the response. With respect to the deviation noted above, the licensee concluded in their response that the coordination deficiency was acceptable and proposed to amend the FSAR to reflect this exception to their commitment to breaker coordination. The licensee's basis for this conclusion was that the type of fault to cause mis-coordination was of limited scope and low probability, mis-coordination was not likely to cause a significant plant transient, a fault would only impact a single train, and there was no history of this type fault at any Duke Power facility.

In an attempt to better understand the basis of the licensee's response, the impact on plant risk of those breakers, and to obtain assurance that the consequences were not significant, the staff sent a request for additional information (RAI) to the licensee on December 6, 1993. In the RAI, the staff asked for the locations of faults of any kind which could lead to mis-coordinated breakers, the identity of the breakers, the loads served, and the consequences of losing the safety loads affected.

The licensee responded by meeting with the staff on February 7, 1994, and submitting on March 2, 1994, copies of breaker coordination curves and system one-line drawings showing the most probable worst-case fault locations, the associated fault currents, and the breakers which would not coordinate in case of dc double-line or ac three-phase faults. The calculations on which the fault currents were based and the list of loads which would be lost due to mis-coordination were included with the submittal. However, formal request for the change to the FSAR and support information for concluding that the identified faults are of low safety significance has not been formally submitted on the docket by the licensee.

While final management review and acceptance had not been granted to the licensee, there was a perception on the part of Mr. Morris that the staff was prepared to accept the licensee's proposal to change the FSAR commitment and allow the subject breakers to remain with the existing potential for limited mis-coordination. The mis-coordination is limited because only three-phase faults in the 600 V ac EPE systems and only double-line faults on the 125 V dc vital I&C power system at specific locations might cause upstream breakers to trip before the breaker immediately adjacent to the fault would trip, causing more loads to be lost than would otherwise have been necessary.

Discussion

The NRR Standing Panel initially met with Brian Sheron, Director, Division of Engineering (DE), on May 6, 1994, to gain a better understanding of the breaker coordination issue and the regulatory basis for the current Agency position on this issue. As a result of this meeting, the NRR Standing Panel requested that answers be prepared to a number of questions and additional documentation related to breaker coordination that was broader than the scope of the DPV be provided. This information would be provided to the panel for discussion at the subsequent meeting of the Standing Panel on this DPV. On May 9, 1994, the NRR Standing Panel met with Messrs. Sheron, Weiss, Berlinger (supervisors in DE), and Jacobson (Special Inspection Branch) to discuss the responses to the questions previously requested by the panel, a brief discussion of the historical activities associated with breaker coordination issues, and potential options to resolution of the concerns raised in the DPV.

The Standing Panel also discussed with Messrs. Sheron, Weiss, Berlinger, and Jacobson the specific faults identified, the systems impacted by these faults, and the consequences of failures as a result of the faults. The potential for faults on the 125 V dc Vital Instrumentation and Control Power System (EPL) were discussed. Since the EPL is an ungrounded system, single line faults would not disable the system. A ground fault detector would alert the control room operator to the presence of these single line faults by both an annunciator and a computer alarm.

The postulated faults resulting in uncoordinated breakers in the 125 V dc EPL system require either a simultaneous positive-to-ground and negative-to-ground fault to occur, or a double line (positive-to-negative line) fault to occur. The former type of fault requires that two failures occur which is beyond the

design basis of the plant. The licensee had evaluated the latter type fault to have a very low probability. The licensee's review of plant data at Catawba since 1985 and for all U.S. plants since 1990 indicated that no reported cases were found that involved double line faults attributed to cable failures. The risk of failure at Catawba was evaluated by the licensee to be further reduced since 2-kV rated, interlocked armor cable was used throughout the plant. If an upstream breaker such as the 125 V dc Distribution Center incoming breaker operate prior to the breaker nearest the fault, the redundant train of power would be available to supply safety-related instrumentation and control loads. The safety significance of a single failure resulting in the loss of one load group of the EPL system is analyzed in Table 8-10 of Appendix 8 of the Catawba FSAR.

Similar discussions were held by the NRR Standing Panel with the supervisors in DE on the 600 V ac system. The licensee had made arguments similar to the 125 V dc system that the most likely postulated faults for the 600 V ac system would be at the load termination for each branch circuit based on the reliability of the 2-kV armored cable. The licensee identified no three-phase faults attributed to cable failures. Because the cable impedance between the load and its breaker limits the current, faults at the load input terminals, in many cases, leaves the breakers coordinated. The licensee had evaluated the worst case load, not fully coordinated for a postulated three-phase fault, and determined that there is no safety impact.

On May 9, 1994, subsequent to the meeting with the DE supervisors associated with the breaker coordination issue, the NRR Standing Panel met with Charles Morris to discuss his concerns with the proposed staff approach to resolving the breaker coordination issue. It was noted that the supervisors in DE and Mr. Morris agreed on several issues including the reliability of the 2-kV armored cable, that faults at the load end are the most creditable faults, and that double line faults are less likely that three phase faults. Both Mr. Morris and the DE supervisors felt that these faults have a very low likelihood of occurrence, but Mr. Morris contended that it would be difficult to make this conclusion in the absence of data. Additionally, Mr. Morris felt that the licensee's judgement on the reliability of the cable and the postulated fault locations needed further technical analysis since other locations not evaluated could result in uncoordinated breakers and the reporting data has limited information on breaker coordination problems.

On July 20, 1994, the Chairperson of the Standing Panel met with the DE supervisors associated with the breaker coordination issue and with Mr. Edward Wenzinger, Region I, as an independent reviewer. There was general agreement that the technical issue associated with the DPV was not one of meeting specific agency rules and regulations, but one of good engineering practice in minimizing the amount of equipment lost due to the above described faults. Common mode failure did not appear to be an issue since the breakers associated with this issue are located outside containment and the licensee has a bunkered safe shutdown facility.

In reviewing the DPV, the NRR Standing Panel determined that the crux of the concerns associated with the DPV is: (1) the lack of formal submittals by the licensee in response to the deviation providing justification to change the FSAR commitment instead of minimizing the amount of equipment due to faults described above, and (2) while there is a general feeling that these faults do not have a very high probability of occurrence and do not appear to involve common mode failures, the licensee has provided very little documentation on the docket to confirm these positions which would allow the staff to draw the conclusion that the safety impact is low.

As part of these discussions, the NRR Standing Panel was also presented information that indicated the systems could not be modified by replacing the breakers in order to meet the IEEE standard. The modifications necessary to meet the IEEE standard would probably require replacement of the MCC enclosures as well as re-routing and re-running cabling. While the breaker coordination arrangement that exists at Catawba would not be accepted as a new design, it should be recognized that all areas that do not meet requirements do not always result in modifications. Relief may be granted in certain cases. However, the safety significance of the issue needs to be fully understood before the role of cost is considered. Cost can be a legitimate factor to consider after a technical evaluation by the licensee has determined systematically that it is of low safety significance.

Conclusions

On the basis of the review and discussion with the submitter of the DPV and the primary parties involved in the review of the issue, it was concluded by the NRR Standing Panel that:

(1) The licensee's response to the deviation identified (i.e., the proposed change to the FSAR) needs to be formally submitted on the docket. The resolution to these issues need to be reviewed and accepted by the NRC staff, and documented in an SER.

(2) Based on the documentation reviewed, it is incumbent upon the licensee to provide as part of their formal submittal, sufficient supporting information to make conclusions regarding the safety significance of the proposed FSAR change.

(3) If the vulnerability to faults in the as-built design is of low safety significance, the staff may approve relief from the SRP and IEEE criteria as reflected in the licensee's current FSAR commitment.

Recommendations

Based on the conclusions above, the NRR Standing Panel recommends that:

(1) Division of Engineering (DE), NRR, through NRR Projects and Region II, inform the licensee that resolution of the uncoordinated breaker concerns identified in NRC Inspection Report Nos. 50-413/92-01 and 50-

414/92-01 dated March 18, 1992, will require a formal submittal, for review and acceptance by the staff, on the licensee's approach.

(2) DE, through NRR Projects and Region II, inform the licensee that, as part of the formal submittal to resolve the uncoordinated breaker issue, they should provide a reasonable and systematic approach to conclude that the proposed change to the FSAR has minimal safety impact.

Ashok C. Thadani, Chairperson
NRR Standing Panel for DPOs and DPVs

Enclosure:
DPV memo to W. Russell dated May 6, 1994