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REGION II
101 MARIETTA STREET, N.W.
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Report Nos.: 50-348/92-17 and 50-364/92-17

Licensee: Southern Nuclear Operating Company, Inc.
P.O. Box 1295
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Docket Nos.: 50-348 and 50-364 License Nos.: NPF-2 and NPF-8

Facility Name: Farley 1 and 2

Inspection Conducted: June 8, 1992 - July 10, 1992

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EXECUTIVE SUMMARY

This special, announced, NRC team inspection assessed the capacity of the Electrical Distribution System (EDS) to perform its intended functions and the adequacy of the engineering and technical support provided to maintain the operability of the EDS.

It was concluded that the EDS and the engineering and technical support provided were generally adequate, but that further evaluation of certain findings identified by the inspection would be required. These findings included three violations, a deviation, and 13 other items of concern. Considered particularly serious were: (1) inadequate determination of causes and of corrective actions for relays which failed to meet Technical Specification (TS) surveillance test acceptance limits; and (2) system safety margins that appeared lower than intended. The former is identified as a violation (348, 364/92-17-01). Further NRC evaluations of the latter (safety margins) are planned before determining the need for any enforcement action, and these are identified as unresolved items (348, 364/92-17-05, -07, and -08).

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Summary descriptions identifying these and the other significant findings of the inspection are as follows:

Three Violations:

(1) Violation 348, 364/92-17-01, Inadequate Determination of Causes and of Corrective Actions for Relays Which Failed to Meet Technical Specification Surveillance Test Acceptance Limits.

There were inadequacies in the determination of causes and corrective actions for relay settings which failed to meet TS surveillance test limits. Examples were identified involving diesel generator load sequencer timing relays and 4.16 kV undervoltage relays. In the case of the load sequencer relays, a lack of timeliness and completeness in the determinations resulted in the sequencer for one train potentially having settings outside TS limits for an operating period of over a year. For the undervoltage relays cause determination was not timely in that it had not been initiated for three failures that occurred in March/April 1992, and the determination had not been completed for a fourth that occurred in the same period. (Sections 4.3.1.2 and 4.3.1.3)

(2) Violation 348, 364/92-17-02, Failure to Calibrate Timer Used for Diesel Generator Start Time Tests.

The automatic timer used for TS Emergency Diesel Generator (EDG) start tests had never been calibrated. (Section 4.3.4.2)

(3) Violation 348, 364/92-17-03, Inadequate Support Installations.

The diesel generator muffler sliding supports and the diesel fuel oil vent dryer tank supports were inadequately installed. Additionally, procedural instructions to verify the muffler supports could accommodate thermal expansion from muffler heat up during diesel operation were not accomplished. Licensee analyses demonstrated the immediate adequacy of the supports. The vent dryer tanks were removed during the inspection. Further licensee evaluation and corrective action is planned for the sliding supports at the next refueling. (Sections 3.4 and 3.6.3)

Deviation:

Deviation 348, 364/92-17-04, Failure to Ensure Cathodic Protection of Diesel Generator Fuel Oil Piping and Tanks

Contrary to an FSAR commitment to provide cathodic protection for the Emergency Diesel Generator fuel oil piping and tanks, the licensee failed to ensure adequate cathodic protection for a period of years. The licensee was aware of problems with the cathodic protection and had initiated actions to address the problems. However, the licensee failed to determine if the condition of the piping or tanks was significantly degraded from past deficient operation and failed to institute ground potential measurements to verify satisfactory system operation. (Section 3.6.4)

Other Findings:

(1) Unresolved Item 348, 364/92-17-05, Degraded Grid Voltage Relay Settings Specified by Technical Specifications are Inadequate.

Current calculations indicate that the degraded grid voltage relay settings (TS values) are inadequate to ensure sufficient voltage to all safety loads below the 600 V level. The licensee ensures acceptable voltage through administrative controls, with the offsite dispatch center having the primary responsibility. Licensee personnel indicated that a study was in progress to further address deficiencies in the current degraded grid relay settings. The licensee is requested to respond to this item providing its plans and schedule. (Section 2.2)

(2) Unresolved Item 348, 364/92-17-06, Lack of Coordination Calculation for 208 V Subsystems.

There was no calculation analyzing the coordination between the 600/208 VAC transformer primary protection and the protective devices for the 208 VAC motor control centers (MCCs). The team was particularly concerned that there could be miscoordination between transformer protection and protection for non-Class 1E loads fed from the MCCs. Faults stemming from the non-Class 1E loads in an accident could potentially cause both trains of 208 V Class 1E loads to be lost through a trip of the transformers. Licensee personnel argued against this concern on the basis that the cables and raceways used for both Class 1E and non-Class 1E loads were the same. The licensee is requested to provide its official position on this matter, including its plans and schedule for any analysis and hardware changes to be performed. (Section 2.4.1)

(3) Unresolved Item 348, 364/92-17-07, Auxiliary Building Battery Voltage is Marginal for Present Load Requirements.

Recent licensee calculations indicated that battery power to the auxiliary building DC distribution system provided little voltage margin for actuation of some important safety-related equipment. In relation to this the team identified three concerns:

- The TS and FSAR imply two hours of adequate battery voltage in the absence of other DC sources. The licensee's calculations demonstrated only a one minute capability. Licensee personnel stated that this was sufficient in that, within one minute of a loss of offsite power, EDGs would be in operation providing DC power through the chargers.

- The calculations were non-conservative in that the assumed conductor temperature appeared low and the effects of battery operation design temperatures as low as 60 degrees F had not been considered. Also, the current drawn during the first minute was lower than that to be included in the next revision of the FSAR contained in the Plant Change Notice B-92-8099.

- The licensee did not appear to have proper justification for the adequacy of voltage to actuate 4 kV breakers and for EDG field flashing, which should occur within the first minute. In the case of EDG field flashing, there was insufficient data to fully demonstrate the adequacy of the present minimum expected voltage. The method used to demonstrate adequate closing coil voltage to 4 kV switchgear, testing a small sample, was questioned. Subsequent to the inspection the team was informed that adequate field flashing voltage had been verified.

The licensee is requested to respond to the above concerns stating its position and any plans and schedule to address (a) the marginal adequacy of the voltage, (b) discrepancies and ambiguities between design capabilities demonstrated by calculations and the design indicated in the FSAR and the TS requirements, (c) non-conservatisms in the calculations, and (d) justification for the adequacy of the limited test data applied in demonstrating sufficient voltage for operation of the 4 kV switchgear. (Section 2.4.3.1)

(4) Unresolved Item 348, 364/92-17-08, Some Safety-Related Equipment Rooms Could Experience Temperatures Above Those Stated in the FSAR.

Recent calculations indicated that certain auxiliary building rooms containing safety-related equipment could experience accident temperatures in excess of those originally identified in the FSAR. Licensee personnel reported that a previous informal survey indicated significantly higher temperatures than given in the FSAR would be acceptable. They stated that none of the rooms would experience temperatures above that established as acceptable in the informal survey for the first 16 days of an accident. The licensee is requested to respond to this item providing its plans and schedule to ensure that all equipment is capable of performing its safety-related functions in the increased temperature environments. (Section 3.10.1)

(5) Unresolved Item 348, 364/92-17-09, Updating of Controlled Vendor Manual

A section of the licensee's controlled copy of the vendor manual for the 600 V load center switchgear was an out of date revision (Rev. B versus Rev. G). A licensee engineer had recognized this discrepancy and obtained the appropriate revision but the official controlled copy had not been replaced. The team was concerned that the vendor had not provided the updated manual section to the licensee and questioned whether there was a breakdown in the system for updating vendor information. The licensee is requested to respond to this item indicating its findings and corrective action. (Section 4.4)

(6) Inspector Followup Item 348, 364/92-17-10, Battery Test Procedures Did Not Verify Design Adequacy.

TS periodic battery test procedures were not formulated to demonstrate that batteries would provide the voltage required by design but did demonstrate TS requirements would be met. During the inspection licensee personnel indicated the test procedures would be revised to demonstrate that both design and TS requirements were met. The licensee is requested to respond to this item providing its plans and schedule. (Section 4.3.2)

(7) Inspector Followup Item 348, 364/92-17-11, Invalid Diesel Generator Start Test Failures Not Identified or Reported.

In response to an industry recommendation, the licensee initially performs all TS EDG start tests using only one air supply header in order to facilitate early detection of degraded air supply conditions. In the event of a start failure, the licensee retests using both headers, which is the normal alignment. The licensee classified any failed "one header" EDG starts as invalid tests on the basis that they did not represent the full start capabilities present to respond to an accident. However, the licensee did not also count and report the failed one header starts as invalid failures. According to the TSs both valid and invalid failures are to be reported to the NRC annually. The licensee is requested to provide its official position on this matter and to indicate any plans to revise the criteria it uses for counting and reporting invalid failures. (Section 4.3.4.1)

(8) Inspector Followup Item 348, 364/92-17-12, Weaknesses in DC Ground Fault Detection.

There were a number of weaknesses in the licensee's DC ground fault detection system. The licensee was aware of deficiencies in the design and was instituting modifications. The team observed that a procedure for use of the system was also lacking. The licensee is requested to indicate their plans and schedule to address weaknesses in this area. (Section 2.4.3.2)

(9) Inspector Followup Item 348, 364/92-17-13, Inadequate Motor Overload Protection.

Motor overload protection may be set too high for some 600 V motors and there is no overload protection for the Reactor Coolant Pump motors. Licensee personnel indicated that the 600 V motor vendor had been contacted and was in the process of verifying the adequacy of the protection. The licensee is requested to provide its official position on the adequacy of the motor overload protection for both the Reactor Coolant Pump motors and the 600 V motors. (Section 2.3.2)

(10) Inspector Followup Item 348, 364/92-17-14, No Periodic Testing to Verify Continued Capabilities of Most Safety-Related Molded Case Circuit Breakers.

Important molded case circuit breakers (MCCBs) were not being periodically tested to verify their settings. The only MCCBs being periodically tested were the electric penetration MCCBs required to be tested by the Unit 2 TSs. The Unit 1 TSs did not require penetration MCCBs to be tested. The licensee's position was that periodic testing of MCCBs, except as required by TS, was unnecessary. This matter is being evaluated internally by the NRC. (Section 4.3.3)

(11) Inspector Followup Item 348, 364/92-17-15, No Preventive Maintenance for Oil Static 230 kV Cable System.

There was no preventive maintenance (PM) for the oil static 230 kV cable system (e.g., on associated pumps and instruments). The team perceived this as a weakness considering the importance of the cables. Licensee personnel indicated there were plans to develop PMs and revise procedures for this equipment. The licensee is requested to respond to this item indicating its plans and schedule to implement the preventive maintenance. (Section 4.4)

(12) Inspector Followup Item 348, 364/92-17-16, Recommended Preventive Maintenance Not Being Performed on Oil-Filled 4160/600 V Transformers and TDAFW Uninterruptable Power Supply Panels.

The preventive maintenance recommended by the vendor manuals was not being performed on oil-filled 4 kV/600 V transformers and TDAFW Uninterruptable Power Supply panels. The licensee is requested to respond to this item indicating its position and any plans and schedule to implement preventive maintenance for the equipment. (Section 4.4)

(13) Inspector Followup Item 348, 364/92-17-17, Circuit Breaker and Fuse Configuration Control Discrepancies.

Inspection of a selected sample of fuses and circuit breakers identified a number of instances in which the fuses and the breaker instantaneous trip settings were not as specified by the respective fuse list and design drawings. None of the breaker setting or fuse differences were found to be operability concerns. However, further evaluation and correction of installation or design documents is desirable. The licensee is requested to respond to this item indicating its position and any plans and schedule to provide corrections. (Section 4.2.1)

Strengths:

In addition to the above matters of concern, the team also observed a number of strengths or positive findings. Examples included the actions undertaken to address DC ground fault detection and EDG problems, knowledgeable engineering personnel, good preventive maintenance observed for the generator end of the EDGs, the computer program for EDG transient analysis, availability of thermography and time domain reflectometry equipment for predictive maintenance, and ongoing actions to upgrade the service water system.

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1.0 INTRODUCTION

This inspection was performed by a team consisting of NRC Region II personnel and contractors. NRC Temporary Instruction 2515/107, "Electrical Distribution System Functional Inspection (EDSFI)", issued October 9, 1990, provided guidance for the inspection.

The primary objective of the inspection was to assess the capacity of the Electrical Distribution System (EDS) to perform its intended functions. This was accomplished by examining and evaluating the design, installation, modification, operation, maintenance, and testing of the EDS and of the portions of mechanical systems which support its functions. Electrical components and functions considered included offsite circuits as the preferred emergency source from the switchyard, diesel generators and batteries as emergency onsite power sources, transformers to provide required voltage levels, inverters and chargers to supply differing current needs, appropriate circuit protection devices and settings, and conductors and connections sufficient for the required currents. Supporting mechanical components and functions included the diesel engines to power the emergency generators, the systems which support the diesels (air, exhaust, cooling, fuel supply, etc.) and the service water and HVAC to cool and ventilate electrical equipment.

A secondary objective of the inspection was to assess the capability and performance of the licensee's engineering organization in providing engineering and technical support for EDS related activities. This assessment was conducted by evaluating the adequacy of selected examples of modifications, problem identification and resolution, and support provided in testing and analysis of results.

This report identifies violations of regulatory requirements, a deviation from a commitment, and other findings with negative connotations. All are described in the text that follows. In addition, the violations, deviation, and other significant findings are listed and briefly described in the Executive Summary at the beginning of this report.

2.0 ELECTRICAL SYSTEMS DESIGN

The offsite source of power for startup, shutdown, and emergency operation of the Farley Nuclear Plant is the Southern Electric transmission system. Farley is connected through lines from separate 230 and 500 kV sections of its high-voltage switchyard. These switchyard sections are interconnected by a 230/500 kV autotransformer, such that either section may feed the other. Offsite power for emergency loads is provided to the plant from the 230 kV section of the high-voltage switchyard via four underground oil static cables. The cables connect to 230/4.16 kV startup transformers in the low-voltage switchyard. Two startup transformers per unit power the plant's 4.16 kV emergency busses. During normal operation, power from the Farley Unit 1 and 2 main generators is stepped-up to transmission voltage levels through respective 22/230 and 22/500 kV main transformers located in the low-voltage switchyard. It then passes fr. a these transformers through overhead cables to the high-voltage switchyard for transmission.

The in-plant AC System is divided into two sections, normal and emergency. Power for the system is received at 4.16 kV. Normal power to each unit's non-emergency 4.16 kV plant busses is provided from the main generator busses through two 22/4.16 kV unit auxiliary transformers per unit. Normally, the emergency 4.16 kV busses receive power from the startup transformers, as noted previously. In the event of a loss of offsite power, the emergency 4.16 kV busses are powered from three 4075 kW and two 2850 kW diesel generators.

The 4.16 kV busses power large pumps directly. Various smaller loads are supplied through stepdown transformers, load centers, motor control centers, chargers, and inverters. The emergency load voltages provided are 600, 208, and 120 VAC; and 125 and 48 VDC.

Three separate battery sources temporarily supply important emergency loads if all AC power sources (diesel and offsite) are unavailable. These are the auxiliary building batteries, the service water intake structure batteries, and the batteries for the Turbine Driven Auxiliary Feedwater (TDAFW) Uninterruptable Power Supply (UPS).

2.1 Conclusions

It was concluded that the EDS design was generally adequate. In most instances electrical equipment ratings, capacities, and settings were fully satisfactory and were supported by calculations. However, the following findings were identified which require further evaluation and, if necessary, correction:

- The degraded voltage relay settings implemented in accordance with the Technical Specifications were inadequate but had been compensated for with administrative controls. The offsite transmission system dispatch center had the principal responsibilities in initiation of control actions to ensure against degraded voltage.

- The battery voltage was marginal for starting some auxiliary building safety-related DC loads and the batteries were not capable of providing the two hours of adequate voltage indicated by the FSAR and Technical Specifications.

The licensee had identified the marginal voltage conditions and had initiated a change to the FSAR.

- There was no analysis to demonstrate coordination between the protective devices at the 208 V motor control centers (MCCs) and the 600/208 V transformer primary protection. The MCCs powered some non-safety-related loads which might be postulated to experience multiple faults and cause tripping of both trains of 208 V loads.

- The licensee had identified deficiencies in the design of the DC ground fault detection scheme. The team identified concerns with the procedures for using the equipment.

- The accident worst case ambient temperatures in some equipment rooms were determined to be higher than originally considered in the design. (See Section 3.10.1)

- Motor overload protection for some large 600 V motors appeared set too high and the reactor coolant pump motor did not have overload protection.

2.2 Offsite Power

The licensee's provisions for offsite power as the preferred source for Engineered Safety Features were determined to be adequate. The team confirmed that the power was supplied through physically independent circuits from the Southern Electric transmission system. The connection to the Southern Electric System grid and the controls from its dispatch center were reviewed with site and dispatch center personnel. From this review, the team determined that sufficient capacity and stability had been supplied. The connections and site equipment design observed by the team resulted in prompt availability of offsite power for emergencies. Provisions for transfer from the preferred offsite source to onsite emergency power appeared satisfactory except with regard to automatic transfer in the event of degraded voltage conditions, as described below.

Licensee personnel informed the team that the minimum allowable voltage had not been established. However, analyses had shown that the degraded grid voltage relay set point specified by the Technical Specifications was too low to ensure sufficient steady state voltage at certain safety-related 208 V loads. Voltage limits that would ensure satisfactory operation of safety-related equipment had been determined and were being implemented through administrative controls. The team was informed that the limits for steady state voltage at the 230 kV switchyard bus were 233.7 kV (101.6 percent) to 239.7 kV (104.2 percent). The switchyard lower voltage limit (101.6 percent) corresponded to 95 percent at the 4160 V safety-related bus during maximum normal plant operation loading conditions. For an accident scenario this resulted in a minimum expected steady state voltage of 93.7 percent at the 4160 V safety-related bus. The team confirmed that this voltage translated to adequate voltage throughout the safety-related system. The minimum acceptable degraded voltage relay setpoint specified by TS Table 3.3.4 was 87.45 percent at the 4160 kV safety-related bus.

The team found that the offsite transmission system dispatch center had the principal responsibilities in initiation of the control actions to ensure that adequate voltage was provided for all safety-related loads. A review by the team revealed that the key features of the controls were as follows:

(1) The team was informed that the transmission system dispatch center ha- computer-based real time capabilities to "look ahead" ·ne contingency from any actual present system state. The computers are reportedly programmed to automatically run a defined set of contingencies every 30 minutes. One example of these contingencies is the emergency tripping of the Farley Unit feeding the 230 kV system. Should the contingency calculation indicate a potential voltage slightly above the 101.6 percent limit (or lower) the transmission system dispatch center receives an alarm. In response, the dispatch center is to take action to strengthen the voltage at the Farley switchyard and notify nuclear plant operations.

(2) Abnormal Operating Procedure AOP-5.2 was found to specify the actions to be taken by the plant to address degraded grid concerns. The team's review revealed that AOP-5.2 is entered when the dispatch center notifies the plant that the offsite grid is one contingency away from being degraded or is already degraded, or when the plant finds the average voltage of 4160 V busses F or G is less than 4000 V (96.1 percent of 4160 V). Once entered, AOP-5.2 requires: returning to service any major component that has been out of service, verifying correct diesel alignment, evaluating continued plant operation, directing the switchboard operator to undertake correction of the degraded grid, frequent monitoring of the F and G 4160 V busses, and plant shutdown if the 4160 V bus voltage is less than 3950 V for more than 1 hour (essentially a 1 hour administrative Limiting Condition for Operation).

Since the dispatch center's "real time" contingency calculation computer program dealt only with steady state conditions, transient voltages were investigated separately. The licensee performed four transient calculations for review by the team. These included, for example, the transient voltage profile at the switchyard bus for a turbine trip with delayed generator trip and a generator trip. The results demonstrated the adequacy of the current administrative limits.

The team concluded that the administrative controls described above result in a reliable offsite power. However, the automatic controls intended through the degraded voltage relay settings specified in the TSs were not fully provided. Licensee personnel stated that a study is expected to be completed later this year which is to propose actions to resolve this matter.

The adequacy of the licensee's actions for ensuring degraded voltage protection will be evaluated further by the NRC. This is identified as Unresolved Item 348, 364/92-17-05, Degraded Grid Voltage Relay Settings Specified by Technical Specifications are Inadequate. The licensee is being requested to respond to this item providing its plans and schedule to further address concerns in this area.

2.3 Medium-Voltage System

2.3.1 Short-Circuit Calculations

The team reviewed the licensee's short-circuit calculations (Calculation No. SE-92-2204-1-PE), which were carried out using a computer program. The calculations and results were found to be acceptable. The equipment ratings for cables, bus bars, circuit breakers, etc., were shown to satisfactorily perform their intended functions.

2.3.2 Protection and Coordination

From a review of the protection and coordination calculations (Calculation No. E-35), the team noted that protective relay setting for reactor coolant pump motors (pages 241 to 241J and coordination study curves SK-E-193 and -193) indicated weak areas of protection. The motors had narrow tolerances between the thermal limits and the full load and starting currents. The relay settings were selected to avoid spurious tripping during acceleration and running, thus making it impossible to protect the motor on overloads. From curve SK-E-193, it was evident that both relays used in the motor protection (IAC66K and CO11) were set above the thermal limits of the motor for acceleration and running conditions. Therefore, the motors were not provided with protection for overload conditions. Licensee personnel indicated that they relied upon vibration and temperature monitoring to protect the motors. The team considered these methods questionable for protecting a large motor critical to plant operation. The thermal limit curve on page 241J indicated that, if the motors were allowed to run at 90 percent of the rated voltage, they would be damaged in nine minutes. The team considered this a design weakness. Another concern regarding the adequacy of motor protection is described in Section 2.4.1 below. The licensee is being requested to provide its official position on the adequacy of the motor protection in both cases. This is identified as Inspector Followup Item 348, 364/92-17-13, Inadequate Motor Overload Protection.

The team found that coordination curves SK-E-119, -120, -127, and -128 in calculation E-35, did not show motor starting currents and motor thermal limit curves against the overload relay settings. Therefore, the proper protection of the motors represented in the curves had not been directly verified. In response to concern expressed by the team, licensee personnel reviewed the motor protection and found that the motors in question had characteristics closely matching those of curve SK-E-126, which correctly demonstrated protection for the 600 HP service water pump motor. The team found this to be a satisfactory basis for demonstrating acceptable motor protection. Licensee personnel stated that the incomplete curves would be revised to incorporate the missing motor data.

2.3.3 Load Flow and Voltage Drop Calculations

The team reviewed calculations SE-91-1925-12-PE "Dynamic Motor Start Voltages", SE-91-1925-13-PE "As Built Load Study", and SE-91-1925-9-PE "As Built Load Study Update". These calculations satisfactorily demonstrated that, within the licensee's administratively controlled grid voltage limits, the 4.16 kV buses provided adequate voltage to start and operate safety-related medium-voltage loads.

2.3.4 Cable Sizing

The team reviewed calculation No. 22 for 4.16 kV cable sizing criteria. This calculation indicated that the cables selected for 4.16 kV application were acceptable with respect to the type of cable, method of installation, current carrying capacity, temperature rating and short-circuit withstand capability.

2.3.5 Diesel Generator Loading

A detailed study on EDG loading was provided in calculation No. E-42. The team's review found this load study was done in a conservative manner. Newly added loads were taken into consideration including the transformer losses. Cable losses had been omitted; however, it appeared that these would be too small to be significant.

2.3.6 Diesel Generator Transient Analysis

A review of calculation No. SE-90-1845-2-PE revealed that the diesel generators with heaviest loading (EDG 1B and EDG 1C) would start and accept loads as required for the worst accident scenario. The diesel generator terminal voltage and frequency were restored to within 10 percent and two percent of nominal within three seconds. In some load steps the generator voltage briefly reached lower than the set limit of 75 percent of nominal voltage, but the motors continued to accelerate without stalling and performance was acceptable.

A computer tabulation of motor slip against starting time given in the calculation showed that at certain time intervals of the acceleration period, the slip reached negative values, indicating that the machine was in the generating mode. However, the team found that the machine was actually motoring. The computer program denoted an increase in generator frequency above the nominal value of 60 Hz as negative slip of the motor during the motor starting periods. Licensee personnel indicated a clarification note would be added to the calculation for the benefit of the future users.

2.3.7 Diesel Generator Neutral Grounding

Review of calculation No. SE-91-2118-1-PE, "Grounding Resistor Calculation", revealed that peak transient voltages exceeded a recommended 260 percent. During the operation of diesels 1C and 2C under accident scenarios, normal generator protection would be bypassed and the 4.16 kV system would be on continuous operation with high impedance grounding during a ground fault. The calculation showed the peak transient voltage for this condition was 290 percent. In response to the team's concern that the recommended maximum transient voltage was exceeded, licensee personnel revised the calculation. More realistic loads were considered. The team found the results of the new calculation acceptable.

The team found no documentation indicating that high neutral grounding impedance was a criteria in the selection of the type of cables used in the 4.16 kV system. Discussions with licensee personnel revealed that the cable specifications called for 155 mil insulation thickness, a 173 percent insulation level. The team determined that this thicknesses met the insulation level requirement for high impedance neutral grounding.

2.3.8 Diesel Generator Characteristics

The plant had five EDGs, of which three were rated at 4075 kW and the other two at 2850 kW. The team noted that the generator characteristics of the 4075 kW generator used in various calculations were different. The manufacturer's operating manual carried one set of characteristics, calculation SE-90-1845-1-PE used another, and the protection and coordination study (Calculation E-35) used yet a third. The team indicated they considered this a design control weakness. In response, licensee personnel confirmed that the characteristic data given in calculation

No. SE-90-1845-1-PE was correct and indicated that all the values used would be reverified and the associated documents revised. The revisions to calculation E-35 would result in changes within the diesel generator protection and coordination of relay settings. However, the team determined that these changes would not impact on the safety of the 4.16 kV distribution system.

2.3.9 Diesel Generator Reverse Power Protection

Calculation E-35 showed that for EDGs 1-2A, 1B, and 2B, the reverse power protection relay setting calculation was based on the engine rating of 4063 kW instead of the generator rating of 4760 kW. The team considered this a design weakness. In response to team's concern, licensee personnel reviewed the protection study and found that the present relay setting would provide more conservative protection for the correct generator rating of 4760 kW by operating faster than presently shown in the calculation. They stated that the calculation would be corrected.

2.3.10 Transformer Nameplate Discrepancy

The 26 MVA startup transformers 1A and 1B (Unit 1, trains A and B) carried nameplates indicating winding impedances H-X: 4.7 percent, H-Y: 4.7 percent and X-Y: 3.3 percent for 1A and H-X: 4.8 percent, H-Y: 4.7 percent and X-Y: 3.5 percent for 1B. This conflicted with the test report for transformer 1A (Westinghouse Serial No. REP-3798-1) which indicated the winding impedances were H-X: 7.33 percent, H-Y: 7.3 percent and X-Y: 13.89 percent. Calculations, such as those for short-circuit and voltage drop, were performed using the test data and were considered acceptable by the team. For further confirmation, the team also examined the nameplate data of Unit 2 startup transformers 2A (7.3 percent, 7.2 percent and 13.8 percent) and 2B (7.2 percent, 7.2 percent and 13.9 percent) and found they were both similar to the test values given above. However, it was not clear to the team or to the licensee why the Unit 1 startup transformer nameplates carried unusual impedance data. Licensee personnel stated the Unit 1 transformer nameplate values would be verified with Westinghouse, the transformer manufacturer.

2.3.11 Computer Programs for Calculations

The licensee's short-circuit calculations, load flow and voltage drop calculations, motor starting studies and emergency diesel generator transient analysis were performed using computer programs. In general, these programs were found to be thorough and the system components were very well modelled to achieve accurate results. The capability provided through the diesel transient analysis program was considered a particular strength, although licensee personnel exhibited a minor weakness in interpreting one aspect of output data (see Section 2.3.6).

2.4 Low-Voltage Systems

The team's review covered the 600, 208, and 120 VAC subsystems; the two 125 VDC safety-related subsystems; and the 48 VDC Turbine Driven Auxiliary Feedwater (TDAFW) Uninterruptible Power Supply (UPS). At the 600 VAC level the review concentrated on the load center switchboard 1D and MCC switchgear boards 1A, 1F, 1S, and 1U. Factors such as available short-circuit currents, equipment capacity, coordination of protective equipment, and voltages at the loads were examined.

2.4.1 600 and 208 VAC Systems

The short-circuit currents potentially available were derived in calculation SE-92-2204-1-PE Rev. 0, which used a proprietary computer program STAUXR3.2. The team reviewed the calculation and found that it was run with conservative assumptions. The maximum fault current at bus 2D was found to be 19.4 kA compared with a circuit breaker rating of 22 kA rms symmetrical. For 600 and 208 VAC MCC busses the maximum fault current was found to be 15.6 kA at bus 1F compared with a breaker rating of 18 kA rms symmetrical. The team checked the basis and the accuracy of this calculation and concluded that the protective devices were adequately sized and the withstand rating of each bus was also satisfactory.

In checking the coordination of protective devices in the 600 VAC system, the team focussed on the incoming and outgoing circuit breakers of load center 1D; which supplied safety-related motors, battery chargers and feeds to 600 VAC MCC loads. The coordination calculations were outlined in document E-35R10, which formulated the circuit breaker settings and provided current-time curves showing the performance of the breaker and its relationship to upstream and downstream devices (including cables). The team found that satisfactory coordination and protection had been achieved except that long time delay trip settings of circuit breakers supplying motor loads were apparently set too high, permitting operation of the loads at excessive currents. A typical example was for the Control Rod Drive Mechanism Motor Generator Set 1A motor (150 HP), where the circuit breaker setting could cause tripping at 160 percent of motor full load current. ANSI Standard C37.16-1988 recommends that the trip device be set not greater than 130 percent of full load rating for a service factor of 1.0 (the service factor for the motors in question). A mistake in the calculation, which identified motor current varying inversely with the square of the motor terminal voltage instead of inversely with the motor terminal voltage, contributed to the discrepancy. The licensee was contacting the motor vendor to determine whether the setting was acceptable for their motor. Another concern regarding the adequacy of motor protection is described in Section 2.3.2 above. The licensee is being requested to provide its official position on the adequacy of the motor protection in both cases. This is identified as Inspector Followup Item 348, 364/92-17-13, Inadequate Motor Overload Protection.

For the 208 VAC system, the team found that there was no calculation analyzing the coordination between the 600/208 VAC transformer primary protection and the protective devices for the 208 VAC motor control centers (MCCs). The team was particularly concerned that there could be miscoordination between transformer protection and protection for non-Class 1E loads fed from the MCCs. Faults stemming from the non-Class 1E loads in a design accident could potentially cause both trains of 208 V Class 1E loads to be lost through a trip of the transformers. Licensee personnel disagreed with this concern on the basis that the cables and raceways used for both Class 1E and non-Class 1E loads were the same. The licensee is being requested to provide its official position on this matter, including its plans and schedule for any analysis and hardware changes to be performed. This is identified as Unresolved Item 348, 364/92-17-06, Lack of Coordination Calculation for 208 V Subsystems.

The team reviewed load voltage evaluations documented in calculations SE-88-1196-7R5 and SE-91-1975-1R4. They found that these calculations demonstrated adequate voltage at the loads when the licensee's 101.6 percent of 230 kV minimum administrative limit was maintained at the switchyard. One minor exception was noted; the 208 VAC Reactor Cavity Hydrogen Dilution Fan No. 2, which had a terminal voltage of 87.34 percent. Plant Change Order PCN-91-2-7366 had been issued to modify the power cable to this motor to ensure adequate voltage. A separate calculation SE-91-1976-1R3 examined the control circuit voltages at the various motor starters. In all cases, the team found that the line contactors and associated relays were supplied with sufficient voltage at the administratively controlled minimum switchyard voltage.

2.4.2 120 VAC System

For the 120 VAC Vital and Regulated System, the team reviewed calculations E-114R0, E-82R5, and E-143R0, which covered the evaluation of short-circuit currents, protective device coordination, and load voltages. In all cases, the team concluded that the design of this system was satisfactory at the minimum administrative limit of switchyard voltage.

2.4.3 125 VDC Systems

2.4.3.1 System Capabilities

The team reviewed the calculations for the Auxiliary Building (AB) and Service Water Intake Structure (SWIS) 125 VDC systems. They concluded that the calculations demonstrated satisfactory capabilities, except for the voltage provided to some loads from the AB system batteries.

The team found that calculation E-26R0, which determined the short-circuit current for the battery systems, was correct except for a minor error in the determination of battery to main bus cable resistance. This error was promptly corrected by the licensee. The calculation demonstrated that the maximum short-circuit current was within the withstand and interruption ratings of system busways and circuit breakers. All equipment could withstand or interrupt the available short-circuit currents.

Calculation E-95R3 developed the battery sizing. The team's review found the sizing to be adequate. Both the AB and SWIS batteries had excess capacity. The AB batteries had a 2.6 percent margin and, though the margin was not determined by the team for the SWIS batteries, it appeared much larger.

Calculation E-130R10 demonstrated that the circuit breakers were also oversized, with a margin of over 34 percent.

Calculation E-35R10 examined circuit breaker coordination and feeder cable size. The team found that the calculation was satisfactorily performed and demonstrated satisfactory coordination and feeder cable sizing.

Calculation E-96R3, supported by information contained in calculations E-115R1 and E-116R0, evaluated the DC voltages at various loads. The voltage appeared marginal for future or even present loads. Concerns were identified by the team with regard to both the calculation and the actual ability of the AB batteries to supply adequate voltage to all loads:

- TS 4.8.2.3.2.c.5, providing criteria for an AB battery surveillance, stated that the surveillance should verify that "the battery capacity is adequate to supply and maintain in OPERABLE status all of the actual emergency loads for two hours ..." FSAR 8.3.2.1 stated each battery has "adequate storage capacity to carry vital loads without charger support for a period of two hours". Also, FSAR 8.3.2.2 stated "in the event of failure of a battery charger, the battery will continue to supply the DC load without interruption for a minimum of two hours." The team observed that, although the batteries had been sized to supply the loads for a two hour period, the voltage calculation covered only the first minute of the load profile. The basis given for this was that the AC supply to the battery chargers would be restored within one minute, owing to the start up of an EDG on the occurrence of a Loss of Offsite Power (LOSP) condition.

- The team found that calculation E-98R3 was non-conservative in assuming initial conductor temperatures of 50 degrees C for cables supplying 4 kV switchgear and EDG control circuits, since local hot spots, the influence of other current carrying cables in the same raceways, and HVAC calculations showing temperatures of greater than 40 degrees C had not been considered. Also, the effects of battery operation at a low design temperature of 60 degrees F had not been considered; and the current drawn during the first minute was lower than that to be included in the next revision of the FSAR contained in the Plant Change Notice B-92-8099.

- The licensee did not appear to have proper justification for the adequacy of voltage to 4 kV breakers and EDG field flashing for even first minute requirements. In the case of EDG field flashing, there was insufficient data to fully demonstrate the adequacy of the present minimum expected voltage. Subsequent to the inspection the team was informed that adequate field flashing voltage had been verified. The method used for demonstrating adequate closing coil voltage to 4 kV switchgear, testing a small sample, was questioned. Vendor data for 4 kV breaker close and trip coils had been ignored in favor of measured test data that would produce a lower calculated volt drop. These measurements did not use acceptable statistical sampling techniques and did not follow an approved test procedure. Further, new acceptance values had not been included in the procurement specification for replacement parts to ensure capabilities of the replacements.

The licensee is being requested to respond to the above concerns stating its position and any plans and schedule to address (a) the marginal adequacy of the voltage, (b) discrepancies and ambiguities between design capabilities demonstrated by calculations and the design indicated in the FSAR and the TS requirements, (c) non-conservatism in the calculations, and (d) justification for the adequacy of the limited test data applied in demonstrating sufficient voltage for operation of the 4 kV switchgear. This matter is identified as Unresolved Item 348, 364/92-17-07, Auxiliary Building Battery Voltage is Marginal for Present Load Requirements.

2.4.3.2 Ground Fault Detection

The team's review found that the licensee employed similar ground fault detection systems on both the AB and SWIS batteries. In the event of a ground fault on either pole on the 125 VDC system, a meter will deflect in a direction signifying which pole has been grounded, and by an amount consistent with the magnitude of the ground fault current. Calculations E-122R1 and E-129R1 had been prepared by the licensee to examine for conditions conducive to the pick up and drop off of components, due to the ground leakage current passing through the coil of a connected component. The most extreme case was that of a General Electric type HFA relay, identified as having a drop off current of 3.8 mA. This corresponds to a fault meter current of 0.35 mA, at which the meter trip points were set to alarm.

The team observed several weaknesses in the ground fault detection. They checked the accuracy of the calculations and found them to be deficient in assuming only an infinite resistance to ground of the negative pole, whereas in practice, this resistance would have some finite value. This value could well be comparable to that of the positive pole to ground, since both positive and negative conductors are generally carried in the same cable. The team also questioned the principle of the scheme being used, since a measurement of zero or acceptably low fault current would not necessarily be due to an insignificant ground fault. For the method used, it could be the result of failure of components or connections or to nearly equal ground resistances on opposite voltage legs of conductors. The team found that the alarm setpoint appeared set too high. Lastly, they found that there was no formal procedure for taking action for meter readings below the setpoint, resulting in a range of circuit conditions that could produce significant faults that would not be cleared.

Licensee personnel indicated they had been aware of deficiencies in the design and that modifications had been initiated that would first be installed and evaluated on the SWIS batteries. The team noted the need for a procedure for use of the system. The adequacy of the licensee's corrections to weaknesses in DC ground fault detection systems and procedures will be examined in a subsequent inspection. This is identified as Inspector Followup Item 348, 364/92-17-12, Weaknesses in DC Ground Fault Detection. The licensee is being requested to provide their plans and schedule to address weaknesses in this area.

2.4.4 Containment Electrical Penetrations

The team checked the adequacy of the containment electrical penetrations through a review of protection calculations E-48 through E-57 and extracts from penetration test reports (e.g., test documents 7597-20-E22-45-1 and 7597-20-E22-83-2). Guidance given in IEEE Standard 317-1983 and NRC Regulatory Guide 1.63 were used by the team in assessing the calculations and test data. The team found that the penetrations were adequately designed to withstand the thermal and electromagnetic effects of short-circuit currents and that the penetration conductors were adequately protected against short-circuits and sustained overloads by appropriate fuses or circuit breakers. The design was in conformance with NRC Regulatory Guide 1.63 regarding primary and backup protection.

2.4.5 Turbine Driven Auxiliary Feedwater Uninterruptible Power Supply

The Uninterruptible Power Supply (UPS) for the Turbine Driven Auxiliary Feedwater (TDAFW) consisted of a packaged Class 1E unit. It was powered by a 208 VAC MCC bus with a 48 VDC battery system as an alternative source if all AC power was lost.

The team checked the rating of the battery as calculated in E-106R1 and found it to be satisfactory. They expressed concern that there was no protective device or other means of isolation between the battery and the equipment panel. An inadvertent short-circuit on the terminating cable lugs (spaced only 0.5 inches apart) would give rise to current of up to 3.6 kA, creating a hazard for personnel and possible fires/explosions in the equipment.

3.0 MECHANICAL DESIGN AND MAINTENANCE

The team evaluated the adequacy of the design and maintenance of the mechanical systems required to support the EDS during normal operation and postulated accidents. The EDG and associated support systems (e.g., diesel fuel oil storage and transfer, starting air, etc.), the service water system supply to the EDG, and the HVAC for safety-related electrical equipment spaces were included in the evaluation. The licensee's provisions for corrosion protection of underground EDG fuel oil piping and tanks were examined.

3.1 Conclusions

The team concluded the design and maintenance of EDS mechanical support systems were generally adequate to support normal operation and postulated accident conditions. However, several areas require further review and evaluation and are identified below as items requiring a licensee response and further NRC inspection. These included equipment supports which had been inadequately installed and maintenance inspected, cathodic protection deficiencies, and safety-related equipment room temperatures that were higher than intended in the original design.

3.2 Emergency Diesel Generators

3.2.1 Conformance of Procurement With FSAR and TSs

The team reviewed FSAR Section 8.3, Technical Specification Section 3.8.1, EDG purchase specification SS-1123-2 (Revision 4, February 21, 1989), and the Colt procurement proposal. The information concerning the EDG set was found to be consistent.

3.2.2 Visual Examination

The team performed a general visual inspection of the EDGs. The EDGs themselves, support equipment, and the building were observed to be generally well maintained. Several oil leaks and a cooling water leak were noted but they were considered minor. Loose chains and chain hoists were noted. These might present a seismic concern, but licensee personnel stated that the seismic calculation indicated chain movement would be limited to 18 inches and the hoists would be parked to avoid the possibility of damage. Other components and piping on or surrounding the EDGs appeared seismically adequate. For example, tubing lengths on the EDG were supported approximately every three feet, which was consistent with the site's "Guidelines for Site-Routing and Supporting of two inches-and-under Piping", FNP-O-PMP-302R4.

3.3 EDG Air Intake System

Presumably for long term structural integrity, procedure FNP-O-MP-12.2, Section 7.2.6, requires "condition of paint checked". The team noted peeling paint on the intake box holding the air filters, and rust and through-wall corrosion on the air filter frame near the base of the filter elements. On becoming aware of these conditions, licensee personnel issued two Maintenance Work Requests to address the situation.

3.4 EDG Exhaust System

To accommodate for exhaust muffler thermal expansion, each muffler had a support attached that was intended to slide on a fixed steel plate as the muffler expanded. Slotted straps on the supports were loosely bolted to the plate and pad to provide freedom of movement in the direction of expansion, while restricting damaging movement from seismic or wind forces. The fixed steel plate was anchored to both a raised concrete pad and the roof slab. The concrete pad itself was keyed to the roof slab. The design was similar for both the large and small EDGs, except that the concrete pads were much closer to the top of the roof slab for the large diesels. Maintenance Procedure FNP-O-MP-12.2, "Diesel Generator Intake and Exhaust Visual Inspection", required a verification that the exhaust silencer (muffler) is free to slide through the thermal expansion support.

The team inspected the mufflers for the small EDGs and found that the concrete pads had spalled concrete at the ends and numerous cracks which appeared to exhibit a regular pattern. They expressed concern that this damage had been caused by the restriction of the thermal expansion of the muffler, that the long term structural integrity of the support had been compromised, and that the support might not meet design requirements to withstand the loads imposed by a seismic or a tornado event. This would indicate that the original installation was inadequate to accommodate the thermal expansion and that the verification of freedom for expansion had not been accomplished as required by procedure

FNP-0-MP-12.2. Licensee personnel responded that the damage was probably caused by restrictions due to thermal expansion of the muffler, but that the damage appeared to be old and non-progressive. Due to the overall thickness of concrete and the embedded steel components, they stated that there was no immediate concern with respect to the ability of the support structure to withstand the loads from seismic or tornado events. They also stated that the damaged concrete pads would be repaired and the sliding supports modified to ensure unhindered thermal expansion.

The team inspected the sliding supports of large EDG mufflers. Again they identified inadequate installation and inadequate accomplishment of the verification of freedom for expansion required by FNP-0-MP-12.2. The team found that the visible portions of most of the sliding supports, and the concrete pads, were covered with roof tar and could not be readily inspected to verify their condition. Further, for the sliding support for EDG 1B, they noted that two of the nuts which hold the sliding support strap in place interfere with the thermal expansion of the muffler. These nuts were not covered with tar. They were readily visible. With the muffler cold, one nut was in contact with the sliding support, opposing any expansion of the muffler. The other nut was observed to similarly oppose muffler expansion and had made an imprint in the sliding support (i.e., the sliding support was pressed into the nut during thermal expansion in a previous diesel run).

After removing adjacent roof tar, licensee personnel inspected the 1B support. They stated that their inspection revealed no damage to the concrete or yielding of the metal support legs. To confirm the ability of the support to resist thermal expansion calculation SC-92-2204-006 was performed. The team was informed that the calculation indicated that the supports would deflect to accommodate the forces without damage. Licensee personnel also stated that the sliding attachment would be modified to permit unhindered thermal expansion and that FNP-0-MP-12.2 would be conducted to verify expansion capabilities.

The inadequate installation and subsequent inadequate verification that exhaust silencers (mufflers) were free to slide through the thermal expansion supports are considered to indicate inadequate instructions and/or failure to comply with instructions for activities affecting quality. They are considered examples of a violation identified as Violation 348, 364/92-17-03, Inadequate Support Installations. Another example is described in Section 3.6.3 below.

The team noted that there might be some water and heat damage to the supports. Licensee personnel stated a calculated (and conservative) temperature of 189 degrees F may be experienced beneath the pad of insulation placed on top of the roof underneath the large mufflers. Temperatures of 200 degrees F are considered acceptable for local areas, and 150 degrees F for normal operation. The team pointed out that the concrete pad was not insulated, was closer to the muffler, and had a steel support structure between the pad and the muffler which could readily conduct the heat. In addition, as the concrete pad was low and surrounded by tar, water could be trapped around the pad and seep into any cracks caused by the constrained thermal expansion.

Licensee personnel stated that inspections of the muffler supports and concrete pads and any necessary repairs would be performed at the next refueling outage.

3.5 Possible Ingestion of Exhaust Gas in Air Intake

During the inspection, the team noted that a large diesel's air intake was approximately 15 feet from the exhaust of a small diesel. The original calculation was performed in 1974, and the results documented in the FSAR, Section 9.4.7.3.6 and table 9.4-12, case 7. It concluded that there would be no effect on EDG performance. In reviewing the original calculation the team observed that there were differences in the present physical information, and in the original design parameters. A new calculation was performed (calculation 7597-020-M-2, dated July 2, 1992). The team concurred with the results of the new calculation, which confirmed the conclusions given in the FSAR. The relevant FSAR tables will require revision to reflect the new assumptions and gas concentrations.

3.6 EDG Fuel Oil System

3.6.1 Storage Capacity and Consumption Rates

The team reviewed calculations SM-89-1613-001, SM-89-1489-002, and SM-89-1489-001, which addressed the design of the EDG fuel oil day and storage tanks and the fuel consumption rates The team concluded that these calculations were satisfactory and demonstrated that fuel storage and transfer capacities were adequate to supply the diesels for periods of operation stated in the TSs.

3.6.2 Seismic Adequacy of Fuel Storage Tanks and Transfer Pumps

The team reviewed seismic analyses U-161194, U-161945, and U-162978 for the fuel oil storage tanks and for the associated fuel oil transfer pumps and pump motors, respectively. The analyses were considered to satisfactorily demonstrate seismic adequacy, except that the phenomena of fuel sloshing in a storage tank and its affect on the pump stem and flange had not been formally considered. In response to the team's questioning of this matter, licensee personnel generated a calculation that demonstrated the resultant stresses would be acceptable.

3.6.3 Vent Dryer Tanks

In a field inspection of a fuel transfer test, the team identified a tank that appeared inadequately supported. The tank observed was a vent dryer connected in the vent path to the fuel oil storage tank to dry the air that enters during fuel consumption. The vent dryer tank was located in the manway access to the storage tank, above the safety-related fuel oil transfer pumps. Although the vent dryer tank itself was not safety-related its proper support was necessary to ensure that it would not fall on and disable the transfer pumps during a seismic event. The tank, including desiccant was estimated to weigh about 450 pounds. Investigation by the licensee revealed similar installations in the manway accesses above all of the fuel oil storage tanks. The tanks and supports had been installed in a 1976 modification undertaken before initial plant operation. Licensee personnel stated that the installation was made in accordance with Change Notice SM-982 and drawing U-161182. The team identified deviations from the installation prescribed by SM-982 and an apparently insufficiently controlled installation process. For example:

- SM-982 showed the vent dryer tank to be mounted 6 inches above the fuel oil storage tank. Instead, it was located approximately 6 feet above the fuel oil storage tank.

- The vent dryer tank legs had been modified for the support arrangement without controlled drawings or instructions for ensuring acceptable installation. As-built drawings or installation data had not been prepared for subsequent evaluation of installation adequacy.

- Bolted clips to aid in preventing movement of the dryer tanks on the supports were loose in some installations, and would not fully perform as intended.

The deficiencies in installation described above indicate that installation activities for vent dryer tank support were not prescribed or accomplished in accordance with appropriate drawings, procedures, or instructions. As the installation activities required control to ensure against potential damage to fuel oil transfer pump capabilities from a seismic event, the deficiencies are considered to represent an example of a violation of the requirements of 10CFR50, Appendix B, Criterion V. This violation is identified as Violation 348, 364/92-17-03, Inadequate Support Installations. Another example of this violation is described in Section 3.4 above.

After the team questioned the adequacy of the vent dryer support, licensee personnel examined the conditions and promptly removed all of the vent dryer tanks. As calculations did not appear to have been previously performed, calculations were prepared to demonstrate the adequacy of the vent dryer tank supports to verify past EDG operability. The team reviewed these calculations (SC-92-2204-001 Revisions 0 and 1). They had some reservations regarding their adequacy; however, considering that the tanks had already been removed, the calculations were accepted.

3.6.4 Cathodic Protection

The team determined that the condition of the underground EDG fuel oil piping and tanks was indeterminant as a result of the licensee's failure to maintain the designed corrosion protection system. The report of an evaluation contracted to HARCO Incorporated in 1988 stated that the system was providing inadequate protection from galvanic corrosion. The cathodic protection system had been installed in 1982 and was not monitored from installation to 1988 when the study was accomplished. Due to the lack of monitoring, it is not known how long the system was not performing satisfactorily. The licensee accomplished actions to upgrade the system in 1991. The team was concerned with two deficiencies in the licensee's corrective actions. The first was that no action was taken to determine the condition of the fuel oil piping and tanks, which had not received the designed corrosion protection for an unknown period of up to nine years. The second was that a vendor recommendation to monitor ground potential to ensure proper protection was maintained had not implemented. Ground potential measurements provide a reliable indication of the effectiveness of the cathodic protection system operation. The licensee's failure to adequately monitor and maintain the cathodic protection system for fuel oil piping and tanks is identified as Deviation 348, 364/92-17-04, Failure to Ensure Cathodic Protection of Diesel Generator Fuel Oil Piping and Tanks.

3.7 EDG Cooling Subsystems

The team examined the performance and the long-term structural integrity of the heat exchangers on the EDGs. The flow path of service water provided for cooling the heat exchangers was from the diesel intercooler, to the jacket water, to the lube oil heat exchangers.

In discussions with licensee personnel the team found that a total of 15 heat exchanger tubes were plugged; nine on the 1-2A intercooler, two on the 1B intercooler, and the other four randomly distributed. An eddy current inspection program for the heat exchangers had been initiated and the first EDG to be inspected was 2B. Early results indicated that the intercooler tube bundle exhibited a significantly larger percentage of tubes with minor wall loss, as compared to the other heat exchanger tube bundles. EDG 2B had seen less service than EDG 1-2A.

The licensee, in response to recommendations contained in NRC Generic Letter 89-13, had committed to conduct performance testing on the heat exchangers. To date tests had been conducted on EDG 1-2A and EDG 2C. No manufacture's or start-up test data was available as a baseline for comparisons. The test results were compared with design data.

3.8 EDG Air Start Subsystem

The FSAR stated that the air receiver for each of the starting systems had capacity for a minimum of five consecutive starts (Section 8.3.1.1.7H), or for cranking five times without recharging (Section 9.5.6.2). The team found that a variety of problems had existed in this system, such that the five start capability might not exist at all times.

Calculation SM-90-1779-01R0 states that the small diesel has 10 starts from the maximum air receiver pressure of 250 psig, and the large diesel has 8 starts from the maximum pressure of 425 psig. The team found that these values were inconsistent with the results from the start-up test procedures 024-5-011, -012, -013, -014 and -015 for the 5 EDGs. These start-up tests, performed in 1977, (1979 for EDG 2B) tested for the capability for each air receiver to provide five consecutive starts. The large EDGs had difficulty in achieving five consecutive starts from one air receiver, starting at the maximum pressure of 425 psig. The small diesels achieved their five starts with a starting air pressure of 250 psig, but the tests were not carried on to determine the maximum number of starts available. However, in accomplishing the first two starts for the small diesels, the air receiver pressure fell from 250 psig to 185 psig. The calculation indicates that 10 starts are available at 250 psig, and eight starts at 225 psig. Therefore., for the first two starts, the calculated pressure should drop by only 25 psig, whereas the test value drop was 65 psig. Present low pressure alarm settings for the large and small EDGs are 350 and 150 psig, respectively.

Other problems which the team considered could impact on the five start capability were as follows:

- The pressure switches on the air compressors cut off the compressors before the maximum required air receiver pressure is achieved [documented in the surveillance test procedure FNP-O-STP-15(1)R4].

- Some air receiver relief valve settings have been found to be low. Each relief valve setting is checked only approximately once every three years.

- The relieving pressure of the relief valve is very close to the upper value of the air receiver pressure. This could lead to cycling of the valve, and eventual seat leakage.

- The old safety-related check valves were replaced with new ones, in December 1990. Since that time, there had been seven instances of leaking check valves, up to April 1992. Note: Licensee personnel stated that the failures stemmed from the original condition of the new valves prior to installation and that this had been corrected.

- There is no active on-line monitoring of leakage, or a specified allowed leakage. The low pressure alarm only activates at 350 psig for the large diesel air receiver, and 150 psig for the small-diesel air receiver. The air compressors cycle above these values, and in doing so, would mask the leakage.

When discussing the air start system capabilities and its limitations, it was stressed by the licensee that the air start system was duplicated, and each train could start the diesel.

The team's concern in this area was lessened by recognition that the licensee had recognized the need to improve the air start system. As will be discussed in Section 5.3, a Diesel Generator Task Force was formed by the licensee to address diesel problems, including those which stem from deficiencies in the air start system. Some improvements had reportedly already been made and a reduction in start failures was noted by the team. Additional improvements were under consideration. As discussed in Section 4.3.4.1, the licensee conducts their start tests using a single header. This gave the team further confidence in the licensee's recognition of the importance of the air start system.

3.9 Service Water System

The team conducted a general review of the service water system to ascertain whether a reliable source of cooling water would be available for the EDGs and their related auxiliaries, for both normal and accident conditions. Those areas which were checked demonstrated that service water design and operation was reliable and acceptable.

The team found that the licensee had undertaken a program to upgrade the service water piping from carbon steel to stainless steel. The program had been in progress for about five years. In response to testing of flow and radiographs of the piping, a significant quantity of service water piping (over 50 percent of the 2 1/2 inch and under safety-related service water piping) had been replaced. Work on larger piping was being initiated.

The team reviewed the seismic analysis and supporting drawings for service water strainer bypass and backwash piping located in the Service Water Intake Structure. The analysis was found acceptable.

3.10 Heating, Ventilation, and Air Conditioning

3.10.1 Auxiliary Building Room Temperatures

The licensee had initiated a comprehensive program to review and/or generate HVAC calculations for various areas in the plant. The team found that the calculated heat loads determined were generally higher than expected, especially for the auxiliary building. As a consequence, the temperatures for the auxiliary building rooms were higher than those stated in the FSAR.

The new auxiliary building heat load calculations (from the hot piping and mechanical components) were documented in calculation 34.2, "Heat Loads of Service Water Cooled Rooms". The team found that testing had been performed to demonstrate lower heat loads for some rooms, and the results had been incorporated into the calculations. The heat loads were analyzed with a variety of service water temperatures and documented in calculation 36.12, "Auxiliary Building Temperatures of Rooms Cooled by Service Water".

FSAR Sections 9.4.2.1.7 and 9.4.2.1.9 state that the HVAC for specified Engineered Safety Feature pump rooms, battery charger rooms, MCC rooms, and 600 V load center rooms is designed to maintain ambient room temperatures at or below 104 degrees F for equipment operation under accident conditions. For 106 degrees F service water (end of 30 day design basis accident), the calculated temperatures of the rooms were in excess of the 104 degrees F stated in the FSAR. The room temperatures were determined to vary from 114 to 131 degrees F. Licensee personnel noted that in 1975, an informal survey of manufacturers indicated that temperatures up to 124 degrees F would not impact operation of the equipment. They stated that more definitive documentation would be obtained. They further observed that none of the equipment rooms would experience a temperature exceeding 124 degrees for the first 16 days of a design basis event. This would provide time for any necessary compensatory measures. Although the team considers it likely that the high calculated temperatures only represent equipment aging concerns, the licensee should promptly ensure that there is no safety-related equipment that would immediately fail at the calculated temperatures. The resolution of both long and short term equipment concerns stemming from the higher than anticipated room temperatures will be further reviewed and evaluated by the NRC. This matter is identified as Unresolved Item 348, 364/92-17-08, Some Safety-Related Equipment Rooms Could Experience Temperatures Above Those Stated in the FSAR. The licensee is being requested to respond to this item providing its plans and schedule to ensure that all equipment has capabilities to function as designed in the increased temperature environments.

The team reviewed auxiliary building battery room HVAC calculations 36.8, 36.9, and 36.10. These calculations determined air flow, hydrogen concentration, and room temperatures. The calculations indicated satisfactory HVAC, though there was limited margin with regard to room temperature.

3.10.2 Diesel Building Temperatures

The team found that the EDG building heat loads were established in calculation SM-92-2216-01. The results of this calculation were factored into the room temperature calculation SM-92-2216-03. The expected room temperature with external air temperature at 95 degrees F was determined to be 122 degrees F. This was the maximum permitted by design, leaving no margin.

4.0 MAINTENANCE, TESTING, CALIBRATION, AND CONFIGURATION CONTROL

The team performed walkthrough inspections of the EDS to assess the material condition of the electrical equipment and panels. Portions of the "as installed" configuration of the EDS were examined to determine its compliance with design drawings and documents. The electrical maintenance program, procedures, surveillances, and work requests were reviewed to ensure the EDS was being properly maintained to function for the life of the plant. Data sheets from completed calibration and surveillance procedures were reviewed to verify the EDS operated in accordance with design specifications and requirements. The method used for fuse control was examined to determine if the correct sizes and types were installed. Procedures and drawings were reviewed to determine if an effective program had been developed and implemented for controlling setpoints for protective relays, circuit breakers, switchgear, and timing relays. Testing and surveillance procedures for the diesel generators and their load sequencers were reviewed to determine if specifications and design criteria were being met.

4.1 Conclusions

Overall, the team concluded that the Electrical Distribution System had been installed and maintained adequately to ensure that equipment would function in conformance with the original design. However, several violations and other concerns were identified which require further evaluation and may require corrective actions to ensure the continued adequacy of the EDS. The violations involved inadequacies in the determination of causes and corrective actions for relay settings which failed to meet acceptance limits in TS surveillance tests. Other areas of concern included failure to periodically test important safety-related molded case circuit breakers, discrepancies between design documents and installed equipment in regard to molded case circuit breaker settings and to fuses, the lack of preventive maintenance for certain equipment, weaknesses in battery tests, and a vendor manual found out of date.

Positive findings were identified by the team in the preventive maintenance performed on the generator end of the diesel generators and the use of thermography and time domain reflectometry for diagnostic and preventive maintenance.

4.2 Equipment Walkthroughs

The electrical components examined during inspection walkthroughs included fuses, overload heaters, motor contactors, protective relays, circuit breakers, switchgear, batteries, chargers, inverters, cables, cable trays, transformers, cubicles, and panels. The following electrical areas were inspected:

- The safety-related 125 VDC systems including associated switchgear, batteries, chargers, panels, and 120 VAC inverters.
- Safety-related 600 V distribution load centers, transformers, and panels.
- The 4.16 kV safety-related switchgear, cubicles, and panels.
- The emergency diesel generators and associated control panels.
- The safety-related 600 V motor control centers and associated transformers.
- The safety-related 208 V motor control centers.
- The main step-up, 230/500 kV auto, auxiliary, and startup transformers.
- The 230/500 kV switchyard, batteries, protective relays, oil static cable system, and control panels.

The inspections were conducted to determine the EDS conformance to design requirements. Design drawings used for field inspections were compared against the "as installed" plant configuration. The material condition of EDS equipment and housekeeping were also evaluated during the walkthroughs.

4.2.1 Configuration Control

The team concluded that configuration control was generally adequate. Deficiencies were noted in molded case circuit breaker settings and in fuse control. The deficiencies would not have effected the capacity of associated equipment to perform its functions.

Selected cubicles on 600 V MCCs 1U and 1F were inspected to verify equipment identification, starter size and type, circuit breaker type, size, and setting, thermal overload heater size and reset mode, and correct fuse size and type. Fourteen cubicles were inspected and the only deficiencies noted were differences between the as installed breaker instantaneous trip settings and design document settings. For 6 of 14 breakers examined, the settings were not in accordance with the design drawings. Examples included MCC 1U breaker T2 set one setting too high, MCC 1U breaker [illegible] two settings too low, and MCC 1F breaker G2 set one setting too low. The team verified that none of the settings resulted in an operability concern, as they would not have resulted in spurious trips or lack of coordination. The licensee responded immediately to investigate and correct the deficiencies through the initiation of Maintenance Work Requests (MWRs) 219917, 259154, 251450, 251451, 251452, and 251453.

The team noted an error in a breaker setting specified by Drawing B-177556, Sheet 1. The drawing required different breaker settings for MCC 1A compartment Nos. A7 and A4. Compartment A7 was Containment Spray Pump 1A Room Cooler Fan and A4 was RHR/LHSI Pump 1A Room Cooler Fan. Both loads had 5 Hp motors with identical full load current and locked rotor current values; however, the drawing called for different breaker instantaneous trip settings. The Residual Heat Removal/Low Head Safety Injection Pump 1A Room Cooler Fan setting was specified as "high" while the Containment Spray Pump 1A Room Cooler Fan setting specified as position 4. The Containment Spray Pump 1A Room Cooler Fan breaker setting was found to be lower than required by the licensee's setting criteria. The position 4 setting would cause a trip at approximately 1.2 times locked rotor current, which was outside the licensee's design setting criteria of 1.6 to 2.0 times locked rotor current. The team concluded that the setting was unlikely to cause spurious tripping. In response to the finding the licensee initiated Production Change Notice PCN-92-1-8233 to change the breaker setting for the Containment Spray Pump 1A Room Cooler Fan. This appeared to be an isolated case not requiring NRC followup.

The fuse control program was reviewed by the team to determine if correct fuse sizes and types were installed. A formal fuse control program had been implemented in 1989 for both units. The development of the fuse program was ongoing at the time of the inspection and some fuse data was not yet included in the fuse manuals. Priority had been given to inclusion of fuse data based on equipment significance. From discussions, the team verified that plant personnel were familiar with the fuse manual and were working closely with the Architect/Engineer to obtain engineering evaluations for acceptable fusing when the data was not yet in the manual. In their inspection the team identified discrepancies between the fuses specified by the manual and five installed fuses. Examples were a CLF-6 installed versus a NON-10 fuse specified for the 125 VDC bus 1A ground detector and a NON-10 installed versus a NON-6 specified for 125 VDC bus 2B remote voltmeter. As with regard to the circuit breaker setting discrepancies noted previously above, the team found no operability concerns for the installed fuses.

The discrepancies between design documents and the as installed configuration for circuit breaker settings and fuses are identified as Inspector Followup Item 348/364/92-17-17, Circuit Breaker and Fuse Configuration Control Discrepancies. Although none of the breaker setting or fuse differences were found to be operability concerns, further evaluation and correction of installation or design documents is desirable. The licensee is requested to respond to this item indicating its position and any plans and schedule to provide corrections.

4.2.2 EDS Equipment Material Condition

During the walkthroughs of the EDS, the material condition of equipment and plant housekeeping was checked. The EDS material condition and housekeeping were considered acceptable. However, minor concerns were identified by the team and are described in the following paragraphs.

In switchyard battery room No. 2, corrosion was noted on cell 21. Battery electrolyte levels were excessively high and plate warpage was observed in some cells. The licensee indicated plans to install new switchyard batteries per an already prepared Production Change Request, PCR-0-8212. These batteries are not considered safety-related.

The team noted corrosion of the annunciator terminal strip in the oil static cable control panel located in a switchyard building. Valve operator handles were observed loose in the bottom of the panel. The licensee initiated work orders to investigate and correct the terminal block corrosion.

The 4.16 kV switchgear was found to be in good condition; however, a portable breaker switchgear grounding device was left unsecured in the switchgear room where it posed a potential seismic hazard to safety-related equipment in the room. In the Service Water Intake Structure the team noted that the eyewash/bodywash equipment was not secured and it posed a potential seismic hazard to nearby safety-related batteries. On being informed of these conditions, management immediately initiated corrective actions.

The 600 V load centers were found to be in good condition while the 125 VDC switchgear was in fair condition. Corrosion was noted on the fuseblocks for 125 VDC breakers LA05 (Unit 1) and LA09 and LB12 (Unit 2). The licensee initiated MWR Nos. 235694, 235695, and 235697 to investigate and correct the condition. All four 125 VDC switchgear local control panels were excessively dirty and some had loose material (light bulbs, tie wraps, and breaker extension handles) left inside. MWR Nos. 259161, 259162, 259163, and 259164 were written to investigate and correct.

The 600/208 V MCCs were inspected and the team found MCC 1U was in good condition while MCC 1F was excessively dirty.

The Auxiliary Building 125 VDC batteries, battery chargers, and inverters were inspected and found to be in good condition. The team noted minor corrosion on Auxiliary Building battery 1A, cell ? negative post. The licensee implemented MWR No. 235692 to correct the condition.

During the walkthrough of the Emergency Diesel Generator (EDG) rooms the team noted a leak from the 1-2A EDG jacket water expansion tank. Several oil leaks were noted on the 1-2A EDG; in particular, standing oil was noted on the lube oil high temperature alarm switch. The team inspected the EDG 2B Engine Control Cabinet and noted loose wiring tray covers and fuse FU-13 missing a fuse label. The licensee initiated MWR No. 235693 to investigate and correct.

4.3 Calibrations, Surveillances, and Testing

4.3.1 Protective and Timing Relays

4.3.1.1 General

The procedures, relay manual, and completed calibration data sheets were reviewed for selected examples of startup transformer and 4 kV switchgear protective relays. The procedures and calibrations were found satisfactory. The calibration data for metal clad breakers in the 4 kV and 125 VDC switchgear was satisfactory. The team noted that the Auxiliary Building battery charger voltage relays and the 125 VDC undervoltage relays were not being calibrated. The licensee indicated that these relays would be added to the calibration program. Significant findings were noted related to the calibration and surveillance testing of the sequencer timing relays and the emergency bus undervoltage relays, as described in 4.3.1.2 and 4.3.1.3 below.

4.3.1.2 EDG Load Sequencer Test Failures

Each Farley unit has two load sequencers which will respond to a Safety Injection Actuation Signal (SIAS), a Loss of Offsite Power (LOSP), or both together. These sequencers are train and unit designated, the A and B train sequencers for Unit 1 identified B1F and B1G and those for Unit 2 identified B2F and B2G. They are used to shed loads and then to start and sequence on required equipment loads following a SIAS and/or LOSP. Each of these sequencers contains a Loss of Offsite Power (LOSP) section and an

Engineered Safeguards System (ESS) section. As a result, they may be referred to as ESS/LOSP sequencers. The essential loads required for safe shutdown and accident mitigation have been grouped into six separate load block steps each for ESS and LOSP. In response to a SIAS without a LOSP, load shedding will occur after which the sequencer ESS section will deliver a simultaneous closing signal to all six required load circuit breakers to connect them to the preferred source of power, the offsite grid. If offsite power is not available and a SIAS is received, following load shedding the ESS and LOSP sections of the sequencers are reportedly designed to consecutively energize each of their six load block steps at five second intervals (0, 5, 10, 15, 20, and 25 seconds). If there is only a LOSP, following load shedding just the LOSP sequencer section will run, sequencing on each of its load steps at the five second intervals. The sequencers use Agastat electro-pneumatic timing relays to load the diesels at the required time intervals.

The manufacturer of the sequencer timing relays recommends they be replaced every 10 years. The team was informed that, in accordance with this guidance, they were replaced in the following order:

Unit 2, "A" train sequencer (B2F) - October, 1990

Unit 2, "B" train sequencer (B2G) - November, 1990

Unit 1, "A" train sequencer (B1F) - March, 1991

Unit 1, "B" train sequencer (B1G) - April, 1991

The team reviewed the results of the TS 4.8.1.1.2.c.9 sequencer operability tests performed since timing relay replacement. For diesel emergency loading, TS 4.8.1.1.2.c.9 requires that the sequence timer have each load sequence step occur within limits of $\pm$10 percent of its required value or 0.5 seconds, whichever is greater. This results in sequence step surveillance test limits of 0 - 0.5, 4.5 - 5.5, 9 -11, 13.5 - 16.5, 18 - 22, and 22.5 - 27.5 seconds for the six ESS and six LOSP timer steps. The review revealed that failures were experienced in four of the first six and five of the first eleven tests. The failures were:

- April 1, 1991, the Unit 2, "A" train sequencer (B2F) failed the TS operability test (Surveillance Test Procedure FNP-2-STP-80.3). ESS step six occurred at 20.46 seconds vice the required 22.5 - 27.5 seconds.

- Also on April 1, 1991, the Unit 1, "A" train sequencer (B1F) failed the TS operability test (Surveillance Test Procedure FNP-1-STP-80.3). ESS step 5 occurred at 25.19 seconds vice the required 18 - 22 seconds.

- On April 2, 1991, the Unit 2, "A" train sequencer (B2F) failed its operability retest (Surveillance Test Procedure FNP-2-STP-80.3). ESS step 3 occurred at 8.88 seconds vice required 9 - 11 seconds.

- On April 10, 1991, the Unit 1, "B" train sequencer (B1G) failed its operability test (Surveillance Test Procedure FNP-1-STP-80.3). ESS step 3 occurred at 7.62 seconds vice required 9 - 11 seconds.

- On April 28, 1991, the Unit 1, "B" train sequencer (B1G) failed its operability test (Surveillance Test Procedure FNP-1-STP-80.3). ESS step 2 occurred at 5.73 seconds vice required 4.5 - 5.5 seconds.

The team observed that although all three of the load sequencers tested during April 1991, had failed, the licensee failed to test or otherwise evaluate the acceptability of the fourth (B2G) at that time.

Immediately following each of the two sequencer B2F failures noted above (April 1 and 2, 1991), the licensee initiated Incident Reports (IRs) 2-91-102 and -103 to provide for determining and recording corrective actions for the failures, including actions to preclude recurrence. The team found that IRs had not been issued for the other sequencer failures, reportedly because the failures occurred when Unit 1 was in Mode 5 and the sequencers were not required to be operable. Both Units 1 and 2 were returned to operation in mid-May 1991 without the causes of the failures having been identified. The team's review of copies of the IRs revealed that the cause of the failures was not determined until almost five months later (August 28, 1991). The two sequencer B2F failures were attributed to procedural deficiencies in the Agastat timing relay calibration procedures (FNP-0-EMP-1549.01, and 1549.02). The replacement Agastats had been mostly two- step relays, the first step closing the lower contacts of the relay to send a breaker closing signal and the second opening the relay upper contacts to terminate the signal. The two sets of contacts work in tandem with a set ratio between their respective closing and opening times that can only be adjusted internally. The time delay for either set of contacts can be set externally from a common setting dial but adjustment of one will also effect the other. The calibration procedures had failed to provide guidance to ensure this relation was recognized and that the delay times for both sets of contacts were verified after correcting the delay time for either. The IRs indicated that, while the calibration procedure had not been corrected before returning the failed sequencers to service, the final calibrations of the failed relays had been performed with the delay time for both sets of contacts monitored simultaneously to ensure they were correctly set. The calibration procedures were corrected in November 1991.

The above IRs stated that a review of maintenance history indicated there was not a generic problem. There was no mention of the three additional sequencer failures that had also occurred in April 1991, bringing the total to five. Also, there was no recognition that sequencer B2G had been calibrated using one of the deficient procedures but had never been subsequently checked to determine if its timing relay settings were outside TS limits. In its next regularly scheduled TS 4.8.1.1.2.c.9 surveillance test on June 17, 1992, two B2G timing relays failed to meet the TS limits. ESS step 4 occurred at 17.17 seconds vice required 13.5-16.5 seconds, and LOSP step 3 occurred at 13.04 seconds vice required 8-10 seconds. This testing was conducted in accordance with surveillance test procedure FNP-2-STP-80.3, which is required to be performed at a frequency not exceeding 18 months.

Because of the number of failures experienced in the April 1991 testing, the team expressed a general concern as to the reliability of the sequencer relay settings. In response, the licensee tested B1F, B1G, and B2F sequencers during the inspection on July 8, 1992. The B1G and B2F sequencer tests were satisfactory, but the B1F sequencer failed due to the contacts for relay 2-6F (step 6) failing to close. This specific failure appeared to be unrelated to the calibration problem identified above, but remained an indication of apparent unreliability. The licensee indicated that the frequency of sequencer operability tests would be increased to verify reliability of the diesel load sequencers.

The team was informed of revised test methodology developed for the subsequent testing of the sequencers. This methodology corrected two deficiencies in the TS surveillance test procedures (FNP-1/2-STP-80.3). The deficiencies may have contributed to the April 2, 1991 B2F failure but were not recognized and documented in the licensee's IR 2-91-103 investigation. First, there was no requirement to re-center a relay time that was near the acceptance limit. The second is that timing was performed with a stopwatch, a technique typically considered no more accurate than $\pm$0.5 seconds in similarly timing safety-related valve position changes. The B2F failure in retest on April 2, 1991, may have been primarily due to one or both of these procedural deficiencies. The team's review of the data from the failed B2G test on April 1 revealed that ESS load step 3 was at 9.08 seconds, just inside the TS 9 - 11 seconds limits. In the April 2 test it was determined to be 8.88 seconds, just outside the limits. A small drift in the relay time or, more likely an inaccuracy in measurement of the time, could have easily accounted for the failure.

Licensee actions described in the above paragraphs of this section are considered to indicate inadequacies in the prompt determination of causes and implementation of corrective actions for significant conditions adverse to quality. The conditions adverse to quality are relay settings which failed to meet TS surveillance test limits. The inadequacies in the prompt determination of causes and implementation of corrective actions are as follows:

(1) Although three of four ESS/LOSP load sequencers failed TS acceptance criteria in testing during April 1991, and the cause had not been determined, the licensee returned to power without verifying the operab' ity of the fourth (B2G).

(2) The licensee did not determine th .ause of the above (April 1991) failures for approximately five months (until September 1991), during which period the acceptability of the one sequencer, B2G, continued unverified.

<u>Note:</u> As of April 1991, both trains of Unit 2 had operated for approximately three months with sequencer times which may be presumed to have been outside TS operability limits.

(3) A.though calibration procedure deficiencies were identified as the cause of the failures in September 1991, and sequencer B2G had been calibrated with one of the deficient procedures, the licensee again failed to promptly take any action to ensure that the sequencer was acceptable. B2G failed in its next regularly scheduled TS 4.8.1.1.2.c.9 surveillance test, on June 17, 1992. This was over eight months after identification of the procedure deficiency.

(4) The determination of cause in September 1991, documented on IRs 2-91-102 and -103, was inadequate in that:

- The recorded determination indicated there was not a generic problem, whereas five failures had occurred in one month and another apparently related failure remained undetected (i.e., B2G).

- It failed to recognize two deficiencies in sequencer test procedures FNP-1/2-STP-80.3. The first was that the procedures did not provide for re-centering the settings found near the acceptance limits. This would aid in avoiding failures due to expected drift or measurement inaccuracy. The second was that the potential measurement inaccuracy associated with the stopwatch timing employed by the procedures. The inaccuracy expected of such timing is $\pm$ 0.5 seconds, which is as great as the TS acceptance limits on some of the sequencer steps.

This failure to provide prompt determination of causes and implementation of corrective actions for significant conditions adverse to quality is considered a violation of the requirements of 10CFR50, Appendix B, Criterion XVI. It is identified as <u>Violation 348, 364/92-17-01, Inadequate Determination of Causes and of Corrective Actions for Relays Which Failed to Meet Techni-</u>

cal Specification Surveillance Test Acceptance Limits. Another example of this violation is described in Section 4.3.1.3.

The safety significance of sequence timer relays being outside TS required values is the possibility of overloading the diesel, dropping emergency bus voltage and frequency below tolerance due to load blocks starting simultaneously, or exceeding the starting times of Engineered Safety Feature equipment assumed in various accident analyses due to load blocks being started late. During and after the inspection, the licensee conducted studies which reportedly demonstrated that the sequencer failures experienced would not have prevented the diesels from providing the emergency power for a design basis accident.

4.3.1.3 Loss of Voltage and Degraded Voltage Relay Testing

Each 4.16 kV emergency bus undervoltage circuitry contains a set of loss of voltage and degraded voltage relays (both nominally termed undervoltage relays). TS 3/4.3.2 and TS Tables 3.3-4 and 3.3-5 require testing these relays' trip voltage and response time setpoints. These tests are performed while the plant is shutdown.

The team reviewed the data sheets associated with these tests conducted during the last two outages for both units. The team noted four examples where the "as found" settings were outside the TS acceptance criteria. Specifically:

- On March 20, 1992, during the performance of the Unit 2, "A" train emergency bus degraded voltage relay response time test (FNP-2-STP-934.1), the 27F3/1-2 relay was found to be outside acceptance criteria in that it's trip setpoint was 86.3 volts vice required 103.95-107.11 volts and response time was greater than 20 seconds vice required 8.93-9.87 seconds.

- On April 1, 1992, during the performance of the Unit 2 "B" train emergency bus degraded voltage relay response time test (FNP-2-STP-934.1), the 27G3/3-1 relay was found to be outside the acceptance criteria in that it's response time was 8.17 seconds vice required 8.93-9.87 seconds.

- On April 1, 1992, during the performance of the Unit 2, "B" train emergency bus degraded voltage relay response time test, the 27G4/1-2 relay failed as it's response time was 10.23 seconds vice required 8.93-9.87 seconds.

- On April 1, 1992, during the performance of the Unit 2, "B" train emergency bus loss of voltage relay response time test (FNP-2-STP-933.1), the 27G2/2-3 relay was found to be outside acceptance criteria in that it's trip setpoint was 91.6 volts vice required 92-97.6 volts.

In all four examples the relays were recalibrated to meet acceptance criteria and reinstalled in the emergency bus protective circuitry.

Of the four examples listed above, only one (relay 27F3/1-2) resulted in an IR being generated to investigate the failure. This IR (2-92-93) was still open as of the end of the NRC inspection. For the other three examples there were no evaluations initiated which would address the cause and corrective actions needed to prevent recurrence.

The relay response time test procedures (STP-933.1 and 934.1) require the Shift Supervisor to be informed when the "as-found" data exceeds acceptance criteria. The Shift Supervisor determines if an IR should be initiated. The team questioned why IRs had not been written for investigation of three of the four failures and were initially informed that it was not required because they did not result in a TS LCO. Later in the inspection licensee management stated that it was their intention that anytime one of these relays was found outside of TS acceptance criteria, an IR should have been written.

The multiple failures of relays to meet TS requirements referred to above is considered a condition adverse to quality. The licensee's failure initiate determination of cause and corrective actions, including corrective actions to prevent recurrence, for the multiple relay failures is considered a violation of the requirements of 10CFR50, Appendix B, Criterion XVI. It is considered another example of the violation described in Section 4.3.1.2 above, identified as Violation 348, 364/92-17-01, Inadequate Determination of Causes and of Corrective Actions for Relays Which Failed to Meet Technical Specification Surveillance Test Acceptance Limits.

4.3.2 Battery Test

Technical Specification surveillance requirements 4.8.2.3.2.c.5 for Auxiliary Building batteries and 4.8.2.5.2.c.5 for the Service Water Intake Structure batteries require either (1) service testing to verify that the battery capacity is adequate to supply and maintain the emergency loads operable for two hours or (2) verification that the individual cell voltage does not fall below 1.75 V when subjected to the load profile for loss of coolant and loss of offsite power operations. The team reviewed the results of the last Auxiliary Building battery TS tests. The procedure used (STP 905.1) did not require monitoring of individual cell voltages or battery terminal voltage during the first minute of the test when the battery experiences peak loading. The individual cell voltage acceptance criteria of 1.75 VDC agreed with the TS acceptance criteria but did not agree with the system voltage requirements of design calculations.

The team reviewed Safety Injection/Loss of Offsite Power test data and found that it demonstrated battery terminal voltage readings during the first minute. Licensee personnel indicated that they would enhance the battery procedures to provide an acceptance criteria for battery terminal voltage at the end of the first minute and a requirement to monitor battery terminal voltage at that step. This finding is being identified as Unresolved Item 348,364/92-17-10, Battery Test Procedures Did Not Verify Design Adequacy. The licensee is being requested to respond to this item providing its plans and schedule to revise the procedures.

4.3.3 Molded Case Circuit Breaker Testing

The team reviewed the program for testing molded case circuit breakers (MCCBs). The licensee had an established program for extensive testing of MCCBs but had reduced the scope of the program based on a letter from the Nuclear Management and Resources Council (NUMARC). The licensee tested MCCBs for safety-related use upon receipt or prior to use. However, once installed in the plant, the only routine testing of MCCBs was the testing required by Unit 2 TS for containment penetration MCCBs. There was not even any periodic exercising of the remaining safety-related MCCBs to help ensure they would operate.

The team reviewed a copy of the NUMARC letter, which was dated October 17, 1990, and entitled "Periodic Testing of Molded Case Circuit Breakers". The letter noted that there had been problems with factory calibrations, particularly for instantaneous trip units, but that these problems could be identified and corrected through acceptance or pre/post maintenance testing. It concluded by stating that "it is not clear that the perceived benefits achieved by periodic testing of MCCBs are commensurate with the resources required to conduct such testing".

Licensee personnel indicated that the Unit 2 TS containment penetration MCCB testing showed a breaker failure rate of 1.6 percent including failure to reset and a failure of 0.5 percent for failure to trip. Based on the failure rate data and on the NUMARC letter position the licensee decided not to routinely test safety-related MCCBs, except as required by TS.

The team expressed concern that the licensee did not have a program to periodically test all important MCCBs to ensure they operate properly when subjected to abnormal current levels. Aging could cause the lubricant in the breakers to dry out or other degradation might occur which would affect breaker trip calibration. The team does not consider the initial installation calibration to be sufficient for the life of the plant. This finding is identified as Inspector Followup Item 348,364/92-17-14, No Periodic Testing to Verify Continued Capabilities of Most

Safety-Related Molded Case Circuit Breakers. This matter is being evaluated internally by the NRC.

The team reviewed 22 data packages for the Unit 2 TS MCCB testing. The test results indicated that the breakers were operable and would trip when intended except for 2 breakers which were replaced. There were many minor documentation discrepancies which indicate that attention to detail in record keeping for this program was marginal.

4.3.4 Emergency Diesel Generator (EDG) Testing

The team reviewed surveillance testing and failure reporting documentation for the EDGs. Deficiencies were identified related to classification of failures for reportability and calibration of a timer used for Technical Specification EDG start time testing.

4.3.4.1 Single Header Start Testing

Farley performs TS surveillance operability tests on the EDGs with a single air start header aligned. This practice was a result of the licensee's implementation of an industry recommendation to periodically verify single header start capability. In practice, if the EDG achieves the specified start parameters, i.e. frequency, speed, and voltage, within 12 seconds the licensee considers the test valid. If the EDG does not achieve the given parameters within the 12 seconds, the test is designated an invalid test and the failure is not counted and reported to the NRC in accordance with TSs. The team considers that the failure as well as the test should be designated and counted as invalid. The applicable Regulatory Guide (RG), 1.108, specified by the TS Table 4.8-1, provides criteria which supports these designations. TS 6.9.1.12 requires that the number of all failures and tests, valid and invalid, is to be reported to the NRC annually. From EDG logs the team identified 10 examples of invalid failures that were not counted or reported. The team did note some ambiguity in the failure definition criteria described in the RG 1.108 position (C.2.e) referenced by TS Table 4.8-1. The criteria were in terms of valid failures without mentioning invalid failures. However, the TS dealing with reporting requirements, TS 6.9.1.12, referenced a RG position that stated that all failures, valid and invalid were to be reported. The license is being requested to provide its official position on this matter and to indicate any plans to revise the criteria it uses for counting and reporting invalid failures. This item is identified as Inspector Followup Item 348, 364/92-17-11, Invalid Diesel Generator Start Test Failures Not Identified or Reported.

4.3.4.2 Start Time Testing

A surveillance start timer was used to verify that TS 4.8.1.1.2.-a.4 EDG start time acceptance criteria was met. The team found that the surveillance test start timer for each diesel was not in a calibration program and there was no record of previous calibration. The surveillance start timer is an integral device of the EDG start circuit and provides a digital time readout when the slower of two variables, frequency or voltage, achieves the acceptable range. Although calibrated stop watches are used in conjunction with the start timer for the test, the test procedures (e.g., FNP-0-STP-80.1) indicate the start timer results are to be used for times ≤12 seconds (the acceptance limit) unless the timer fails to operate. It was not clear why the procedures limited the use of the surveillance start timer to times ≤12 seconds. In most cases both stopwatch and surveillance start timer times were recorded and indicated acceptable values. The team identified one example where the test was accepted as valid when the frequency was above the 12 second acceptance criteria as determined by the stop watch. Failure to ensure measuring devices used for quality activities are properly calibrated is identified as Violation 348, 364/92-17-02, Failure to Calibrate Timer Used for Diesel Generator Start Time Tests.

4.4 Preventive Maintenance

The team reviewed the preventive maintenance (PM) program for selected portions of the EDS. The following areas were reviewed: oil static cable, startup transformers, 4.16 kV switchgear, 600 V switchgear and 4.16 kV/600 V station service transformers (SSTs), motor control centers (MCCs), batteries, battery chargers, 125 VDC switchgear, and the turbine driven auxiliary feedwater (TDAFW) uninterruptable power supply (UPS). There were weaknesses identified with the PM program for the SSTs, the oil static cable support equipment, and the TDAFW UPS.

The team noted that no routine PMs were in place for the oil-filled SSTs. The licensee had implemented a quarterly inspection program to check for transformer oil leaks as part of its inspection of equipment containing polychlorinated biphenyls. Nitrogen was added to the SSTs when requested via the licensee's Maintenance Work Request process. The lack of PM on the SSTs was noted by the licensee's Reliability Centered Maintenance review effort. Licensee personnel indicated that initially an operator log check will be implemented on the SSTs and then an evaluation for PM. The vendor manual for the SSTs recommended periodic leak checks, temperature checks, oil level checks, pressure checks and checking the pressure relief device. The vendor manual also recommended periodic oil sampling for moisture and dielectric strength.

During review of the TDAFW UPS system the team noted that there were no routine PMs for the UPS panel. This panel consisted of a rectifier, battery charger, and inverter. The TDAFW UPS vendor manual recommended a PM inspection at a six months to one year interval. The PM recommended was to clean the panel, verify all connections were tight, and to check and exercise the breakers, contactors, switches and relays. The licensee indicated that they would perform thermography on the UPS cabinets. The failure to implement vendor recommended preventive maintenance for the UPS panel and for the SSTs, as described in the previous paragraph, is considered a weakness and is identified as Inspector Followup Item 348,364/92-17-16, Recommended Preventive Maintenance Not Being Performed on Oil-Filled 4160/600 V Transformers and TDAFW Uninterruptable Power Supply Panels. The licensee is being requested to respond to this item indicating its position and any plans and schedule to implement preventive maintenance for the equipment.

The team found that there was no preventive maintenance for the oil static 230 kV cable system (e.g., on associated pumps and instruments). The team perceived this as a weakness considering the importance of the cables. Licensee personnel indicated there were plans to develop PMs and revise procedures for this equipment. The licensee is being requested to respond to this item indicating its plans and schedule to implement preventive maintenance for this equipment. This matter is identified as Inspector Followup Item 348, 364/92-17-15, No Preventive Maintenance for Oil-Filled 230 kV Cable System.

During the PM review of 600 V load centers, the team noted that the vendor manual Section "Instructions for Low Voltage Power Circuit Breakers Types DS-206, DS-416 and DS-532" contained within the licensee's controlled vendor manual for the 600 V switchgear was out of date (Revision B versus Revision G). A licensee engineer had recognized this discrepancy and obtained the appropriate revision but the official controlled copy had not been replaced. The team was concerned that the vendor (Westinghouse) had not provided an the updated manual to the licensee and questioned whether there was a breakdown in the system for updating vendor information. This finding is identified as Unresolved Item 348,364/92-17-09, Updating of Controlled Vendor Manuals. The licensee is being requested to respond to this item indicating its findings and corrective action.

5.0 ENGINEERING AND TECHNICAL SUPPORT

The team assessed the adequacy of the engineering and technical support provided to maintain the Electrical Distribution System. This assessment was based on evaluations of the capabilities and performance of the technical organizations in problem identification and resolution, modifications, and routine plant EDS activities

5.1 Conclusions

Engineering and technical support for EDS related activities was considered adequate overall. Assigned problems were effectively resolved. Design changes appeared satisfactorily controlled and developed. The interface with offsite design organizations appeared generally satisfactory. A database had been recently updated for use in equipment failure trending and reliability centered maintenance studies, with potential for improved problem identification capabilities.

However, in several areas the team observed apparent weaknesses or was unable to judge the support due to the lack of documented performance. Support for problem identification appeared too limited, as observed with regard to cause determination for routine equipment deficiencies documented on Maintenance Work Requests. Support for routine maintenance and testing could not be fully assessed, as involvement was not always recorded. Unlike most plants, Farley had no systems engineering organization to provide monitoring and aid in improving system conditions. Modifications were developed by offsite organizations but specification of post modification testing and acceptance criteria was the responsibility of onsite organizations - the team was concerned that this could lead to cases where the implemented design might not be adequately verified.

5.2 Organization and Staff

Engineering and technical support for EDS related activities was provided by both on and off-site organizations. The on-site organizations focused on programs for inspection, testing and monitoring the performance of equipment; maintenance support; and implementation of design changes. The principle groups responsible for this support were Systems Performance (12 engineers), Maintenance Engineering Support Group (10 engineers), and Plant Modifications and Maintenance Support (12 engineers). Approximately 10 additional engineers provided maintenance and procurement support in other groups. Unlike most plants Farley had no systems engineering organization. The off-site Design Engineering organization was the main source of design engineering support, though some minor modifications (termed minor departures) were developed on-site by Plant Modifications and Maintenance Support. The off-site organization contracted the design work, most of it being provided through the plant's Architect/Engineer - Bechtel, the NSSS vendor - Westinghouse, and for balance of plant - Southern Company Services. A strong continuing association had been maintained with these vendors and the review of modifications described in Section 5.5 below indicated the interfaces with these vendors were operating effectively.

5.3 Problem Identification and Resolution

The engineering and technical support for the EDS appeared satisfactory in addressing important problems assigned for resolution. However, support did not appear to have been sufficiently directed to problem identification. Some new programs were found in place which offered potential for improved problem identification but actual examples of their effective application were not available. The team's review was not detailed or extensive enough to judge the timeliness of the engineering and technical support in resolving problems following identification.

In evaluating the engineering and technical support for problem identification and resolution, the team examined whether adequate support had been provided in determination of equipment failure causes. Discussions with engineering staff indicated they became involved in failure cause determinations only when requested. The team's review of routine maintenance records, as documented on the plant's Maintenance Work Requests (MWRs), revealed many instances where equipment failure causes were listed as unknown or were not identified. Further evaluation suggested that, with limited engineering support, cause determination would have improved. Sixty EDS related MWRs initiated between 1988 and 1992 were included in the review. Examples of those which lacked cause determination included MWRs 132512, 209463, and 252150 for slow diesel generator starts; MWR 231372 for an air compressor that would not shut off because of an out of calibration pressure switch (reason out of calibration not identified); and MWR 161953 for a battery charger output breaker found open.

A technical problem which was recognized and received engineering evaluation was a large number of diesel generator failures that occurred during May to September 1991. The importance of the diesel failures was recognized and resulted in the formation of a Diesel Generator Task Force in August 1991. The group identified many areas for improvement and some of the corrective actions proposed were accomplished. These corrective actions had positive results as demonstrated by a reduction in Diesel Generator failures. In 1991 seven failures were experienced. In the first six months of 1992 there had been only one.

The team found that the licensee had recently updated the maintenance database for equipment failure trending and reliability centered maintenance studies, providing the potential for significant improvement in equipment problem identification capability. Due to the recent nature of this effort, there were insufficient examples available to evaluate the effectiveness of this new database. Engineering programs for inservice testing, thermography, and vibration trending provided more tangible examples of engineering problem identification activities but licensee personnel questioned by the NRC team were unable to identify any documented examples applicable to the EDS.

5.4 Routine Plant Activities

It was not evident to what extent the engineering groups were involved in routine plant activities due to a limited amount of documentation related to this area. For example, a surveillance test of diesel generator 1-2A was performed on March 16, 1992, with no listed deficiencies. An MWR on this date indicated that the diesel's load oscillated between 1000 kW and 4200 kW. There was no documented evaluation of how this load oscillation impacted the test acceptability. However, the team discussed this with the involved engineering personnel and the NRC Resident Inspector and both indicated that the issue had been satisfactorily addressed.

Another area of routine activity in which engineering support was not evident was related to sequencer Agastat relay testing and degraded grid relays as discussed in Section 4.3.2 of this report. The timer failures and grid relay as-found conditions were issues which warranted engineering involvement. It is not clear if engineering was aware or involved in these issues.

In conclusion, assessment of engineering involvement in routine activities, such as maintenance and testing, was limited due to a lack of documentation demonstrating this involvement. It was apparent that the engineers in the maintenance organization provided technical support without recourse to other groups. Additionally, review of the engineering Problem Report Log indicated a degree of involvement.

5.5 Modifications

Modifications at Farley are documented as Plant Change Notices (PCNs) for significant modifications and Minor Departures for those that are very limited. The PCNs were developed primarily by the offsite design organization through contracts with vendors. Minor Departures were developed by the onsite staff. The team reviewed a sample of seven EDS related PCNs to determine if the changes properly addressed the identified concerns, appropriate post modification testing was specified, and acceptance criteria were clearly stated. These PCNs involved changes to diesel lube oil temperature controls and jacket water temperature alarms (PCNs S84-2-2659 and S87-0-54720), transformer tap settings (PCN S90-2-7081), pick-up delays for load centers (PCN B-90-2-6842), inverter replacement (PCN 84-2-2905), and replacement of emergency bus underfrequency relays (PCN B-88-2-4805).

The team concluded that design controls for EDS related modifications were adequate. However, they observed that the statement of acceptance criteria and post modification test requirements could be improved. At Farley, because design changes are developed by an offsite organization and post modification testing is determined by an onsite organization, there is a potential for errors in specifying appropriate acceptance criteria and testing. The result could be a post modification test which does not fully verify the intent of the design change. The team's review did not identify any deficiencies.

A general review of approximately 10 minor departures for proper scope and safety reviews did not identify any deficiencies. The minor departures reviewed were within the scope of the program and adequate safety reviews were accomplished.

6.0 ACTION ON PREVIOUS INSPECTION FINDINGS

(Closed) Inspector Followup Item 50-348,364/90-03-03, Clarification of EDG Loading Restriction.

An April 23-27, 1990, NRC inspection of Nuclear Support noted that the diesel generator load study calculation contained manufacturer recommendations that the diesels be loaded to at least 50 percent of their continuous rating. Plant procedures did not specifically address this 50 percent threshold. The licensee was requested to obtain clarification of the minimum loading requirements under emergency operations and revise plant procedures, if required.

The EDSFI team reviewed Coltec Industries letter dated September 17, 1990, which provided the requested clarification. The letter recommended that the diesels be run at greater than 50 percent load for at least 1 hour in each 12 hour period if the engine is to be run for longer than 12 hours at less than 30 percent of engine rating. The team noted that this precaution had been included in FNP-0-SOP-0, "General Instructions to Operations". This resolves the original concern. The item is closed.

7.0 EXIT INTERVIEW

The inspection scope and findings were summarized on July 10, 1992, with those persons indicated in Appendix B. The team leader described the areas inspected and discussed the inspection findings. No dissenting comments were received from the licensee.

Although proprietary materials were reviewed during the inspection, proprietary information is not contained in this report.

The substance of violations, a deviation, and other pertinent findings identified in this inspection is described in the Executive Summary at the beginning of this report.

One previously identified item was closed as a result of this inspection, Inspector Followup Item 50-348,364/90-03-03, Clarification of EDG Loading Restriction.

APPENDIX A - ACRONYMS AND ABBREVIATIONS

A	Amps
AB	Auxiliary Building
AC	Alternating Current
AECL	Atomic Energy Commission of Canada, Limited
ANSI	American National Standards Institute
DC	Direct Current
EDG	Emergency Diesel Generator
EDS	Electrical Distribution System
EDSFI	Electrical Distribution System Functional Inspection
ESF	Engineered Safety Feature
ESS	Engineered Safeguards System
F	Farenheit
FNP	Farley Nuclear Plant
FSAR	Final Safety Analysis Report
HP	Horse Power
HVAC	Heating, Ventilation, and Air Conditioning
IEEE	Institute of Electrical and Electronics Engineers
IR	Incident Report
kA	Kiloamp
kV	Kilovolt
kW	Kilowatt
LCO	Limiting Condition for Operation
LOCA	Loss of Coolant Accident
LOSP	Loss of Offsite Power
MCC	Motor Control Center
MCCB	Molded Case Circuit Breaker
MVA	Megavoltamperes
MWR	Maintenance Work Request
NRC	Nuclear Regulatory Commission
NRR	NRC Office of Nuclear Reactor Regulation
PCN	Production Change Notice
PCR	Production Change Request
PM	Preventive Maintenance
PSIG	Pounds per Square Inch Gauge
RII	NRC Region II
RG	Regulatory Guide
RMS	Root Mean Square
SIAS	Safety Injection Actuation Signal
SNC	Southern Nuclear Operating Company
SWIS	Service Water Intake Structure
10CFR50	Title 10, Code of Federal Regulations, Part 50
TDAFW	Turbine Driven Auxiliary Feedwater
TS	Technical Specification
V	Volts
VAC	Volts Alternating Current
VDC	Volts Direct Current

APPENDIX B - PERSONS CONTACTED

Licensee Employees

*R. Hill, General Manager - Nuclear Plant, FNP
R. Coleman, Manager - Plant Modification and Maintenance Support, FNP
*R. Collins, Switchboard Operator, SNC
*L. Enfinger, Manager - Administration, FNP
*P. Hayes, Senior Engineer, SNC
*D. Jones, Manager - Engineering, SNC
*J. Thomas, Manager - Maintenance, FNP
*J. Osterholtz, Manager - Technical, FNP
*R. Hayes, Senior Engineer, SNC
*S. Fulmer, Superintendent of Operations Support, SNC
*C. Nesbitt, Manager - Operations, FNP
*R. Yance, Manager - Systems Performance, FNP

Licensee Contractors

J. Banks, Southern Company Services
D. Butani, Bechtel Corporation
T. Crawley, Southern Company Services
J. Ellison, Alabama Power Company
D. Gambrell, Southern Company Services
R. Lyon, Southern Company Services
H. Maheras, Southern Company Services
D. McComb, Southern Company Services
*G. Morris, Ogden Environmental and Energy Services
*G. Overbeck, Ogden Environmental and Energy Services
*D. Shelton, Engineering Manager, Southern Company Services
*J. Sundergill, Bechtel Corporation

NRC Employees

*S. Hoffman, Project Manager, NRR
*F. Cantrell, Section Chief, RII
*E. Merschoff, Director, Division of Reactor Projects, RII
*J. Johnson, Deputy Director, Division of Reactor Projects, RII
*M. Morgan, Resident Inspector, Farley
*J. Raleigh, Acting Resident Inspector, Farley

*Attended exit meeting