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REGION II
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ATLANTA, GEORGIA 30323

Report No.: 50-395/92-04

Licensee: South Carolina Electric & Gas Company
Columbia, SC 29218

Docket No.: 50-395 License No.: NPF-12

Facility Name: V. C. Summer

Inspection Conducted: March 2, 1991 - April 3, 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:

(1) The EDS has the capacity to perform its intended safety functions

(2) Engineering and technical support are adequate

The inspection team's overall findings were generally positive, reflecting good design, maintenance, and testing. Various strengths were observed. Examples included the availability of a computer program to analyze the DC system, a generally good fuse control program, good monitoring of fuel oil quality, and knowledgeable engineering personnel. Several matters of concern were identified, but their impact on the overall adequacy of the EDS and of engineering and technical support provided to maintain the EDS were limited. These matters included violations of

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regulatory requirements, a deviation from a commitment, and several other negative findings:

Four violations:

(1) Violation 395/92-04-01, Undersize Thermal Overloads and Inadequate Tubing Supports.

There were deficiencies in the translation of design bases into installed hardware. Two examples were identified by the team:

(a) Tubing mounted on the diesel generator was insufficiently supported. Examples were identified where seismic design support spacing requirements specified in the original calculations were not met (e.g., 84 inch actual support spacing on one span of air start tube versus specified maximum of 26.9 inches). New, more sophisticated, calculations prepared during the inspection indicated that the spacings would provide sufficient support for the postulated seismic conditions. Additionally, the team was informed that tubing supports meeting the original design requirements would be installed. (Section 3.4)

(b) Undersized thermal overloads (OLs) were installed for two safety related service water pump house ventilation fans. The 1.15 service factor of the fan motors was not recognized in determining OL selection. As a consequence, selection was based on the nameplate 50 HP rating, although the motors could actually operate at up to about 60 HP. The licensee replaced the undersize OLs during the inspection. Had they gone undetected the OLs could cause tripping of the fan motors. This condition should be readily apparent to operators in sufficient time to make corrections before temperatures became unacceptable. (Section 2.5.2)

(2) Non-Cited Violation 395/92-04-02, Incorrectly Taken Battery Test Results.

The voltage recorded at the end of the first minute of a Technical Specification battery service test was incorrect. It appeared the voltage had been recorded after the load had been removed, whereas the acceptance criterion was based on voltage measured with the battery still under load. Other voltage data taken during the test was sufficient to verify that the battery was acceptable. (Section 4.3.2)

(3) Violation 395/92-04-03, Deficiencies in the Control of Drawings, Design Calculations, and Databases.

The team identified deficiencies in drawings, a design calculation, and a database that had been obtained as apparently acceptable documents. Licensee personnel indicated they were aware that the drawings contained errors and omissions and that the acceptability of the calculation was questionable. Also, a note in the calculation acknowledged errors had been identified on the drawings. Examples of the associated errors and omissions were as follows:

(a) Motor Control Center Unit Listing drawings which provided electrical data on the loads powered from the Motor Control Centers had motor load data omitted in some instances and numerous incorrect entries of overload sizes, horsepower, etc. These drawings had been used for inspection and databases. (Section 4.2)

(b) A database used to determine overload heater sizes for a MOV voltage drop calculation contained incorrect sizes for some overloads. (Section 2.5.3)

(c) The above voltage drop calculation incorrectly omitted calculation of voltage drop due to overload resistances until it was revised in response to an NRC question. (Section 2.5.3)

The team did not identify any instances in which the above drawings, database, or calculation had either resulted in equipment deficiencies or caused deficiencies in equipment to go undetected.

(4) Violation 395/92-04-04, Inadequate Instructions for Application of Pre-Approved Disposition (PAD) 12.

PAD 12 was a standard pre-approved engineering disposition intended for failures due to normal wear or aging of items such as bearings, gears, valve packing, molded case circuit breakers, relays, fuses, etc. However, it did not adequately prescribe the criteria to be used to assure that a failure was due to "normal wear and aging", such that use of PAD 12 would be applicable. PAD 12 had been used to replace several molded case circuit breakers that failed in tests without documenting even simple disassembly and visual inspection for the condition that resulted in the failure. Without any inspection and documentation for the condition that caused the failure, the information necessary to identify adverse trends and significant conditions adverse to quality will not be available. The team did not identify any significant hardware deficiencies that had gone undetected because of the lack of controls on application of PAD 12.

The licensee initiated corrective actions for all of the above violations during the inspection; however, the action for (4) was temporary and the actions relative to the others will require review in a subsequent NRC inspection.

Deviation:

Deviation 395/92-04-05, Potential Deterioration of Emergency Diesel Generator (EDG) Underground Fuel Oil Piping and Tanks.

In an FSAR response to NRC Regulatory Guide (RG) 1.137, the licensee committed to provide cathodic protection (and protective coating) to ensure against corrosion of the EDG underground fuel oil tanks and piping. Periodic test data and evaluation by a consultant indicated the cathodic protection system had not been operated to provide the intended protection. This condition had apparently existed since installation in 1980. Licensee actions had been initiated to make the system operable but not to verify whether excessive deterioration already existed as a result of extended past operating deficiencies. Corrections to the system were not planned to be completed until 1993. Due to the importance of the equipment the extent of degradation should be verified. (Section 3.6)

Four Findings were identified:

(1) Unresolved Item 395/92-04-06, Interpretation of Valid Emergency Diesel Generator Start Failure.

The licensee's position was that an EDG failure to start would not be considered a valid failure if the EDG had been removed from service, as for maintenance. This appears contrary to the RG 1.108 position referenced by the Technical Specifications. This matter is under review by the NRC. (Section 5.4)

(2) Unresolved Item 395/92-04-07, Failure to Provide Backup Protection for Electric Penetrations in the Overload Range of Currents.

The FSAR indicates that the recommendations of NRC Regulatory Guide (RG) 1.63, Rev.1, are applicable to the electric penetrations at V. C. Summer. This RG recommends that each electric penetration assembly should withstand "the maximum possible fault current vs. time given single random failures of circuit overload protection devices". This ensures that each circuit passing into the containment has two protections, each of which is capable of precluding any period of fault induced current flow that could damage its penetration. For approximately 45 of Summer's electric penetrations, full protection was only provided by the primary device. Backup protection was provided against the maximum fault current possible but not against current in the overload or low level fault range. Licensee personnel indicated that the Summer design had been based on the interpretation that protection was only required against the maximum possible fault and that the NRC reviewer had been aware of this interpretation in accepting the original design. This matter is under review by the NRC. (Section 2.5.1)

(3) Inspector Followup Item 395/92-04-08, Preventive Maintenance Inspections for 7.2 kV Switchgear.

Insulated 7.2 kV bus bars were not periodically inspected as recommended by the vendor in General Electric Manual GEH-1802, Metal Clad Switchgear. In the "MAINTENANCE SECTION" of GEH-1802 it specifically stated that "The switchgear structure and connections should be given the following overall maintenance ... Inspect the busses and connections carefully for evidence of overheating or weakening of the insulation." (Section 4.3.3)

(4) Inspector Followup Item 395/92-04-09, Preventive Maintenance Trip Testing of Important DC Molded Case Circuit Breakers to Verify Their Settings.

Overcurrent trip testing was not performed on the important molded case circuit breakers used as feeders for the 125 VDC load center busses. The concern is that, in aging, lubricant in the breakers will dry out or other degradation will occur and affect the trip calibration. (Section 4.3.3)

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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 to perform its intended functions during normal plant operations and accident conditions. A secondary objective was to assess the capability and performance of the licensee's engineering organization in providing engineering and technical support for EDS related activities.

The assessment of the capability of the EDS was based on findings and conclusions obtained by examining and evaluating the design, installation, modification, operation, maintenance, and testing of the EDS and of the other systems which support its functions. Considerations in assessing engineering and technical support included adequacy of modifications, problem identification and resolution, support provided in testing and analysis of results, etc.

Electrical components considered in the review included the offsite circuits from the 115 and 230 kV switchyard; the EDG; the 7.2 kV and 480 VAC transformers; the 7.2 kV switchgear and related equipment; the 480 VAC switchgear, load centers, and motor control centers; the 125 VDC batteries, chargers and distribution systems; the 120 VAC distribution systems; protective relaying; AC grounding; and electric penetration protection. Additionally, the mechanical systems which are required to support the EDG and provide cooling for electrical components were specifically examined. These included the EDG engine, air start system, lube oil system, fuel oil system, and water cooling system; and the necessary HVAC for various EDS components.

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

2.0 ELECTRICAL SYSTEMS

The V. C. Summer electrical distribution system is divided into two independent systems, the Safeguards Power System and the Service Power System. The Safeguards Power System distributes power to the safety related loads and is the focus of this inspection.

The Safeguards Power System is divided into two independent and redundant trains, trains A and B. The preferred sources of power for this system are two independent offsite sources, 115 kV power from the nearby Parr Generating Complex and 230 kV power from the V. C. Summer substation. These voltages are stepped down to 7.2 kV and supply separate A and B train busses. Two Emergency Diesel Generators serve as onsite standby power to these 7.2 kV busses. The diesels are set to start automatically in the event of a safety injection or an excessive undervoltage on the 7.2 kV busses.

The 7.2 kV Safeguards busses power safety related service water equipment and trains A and B of a 480 VAC subsystem. The 480 VAC subsystem in turn powers A and B trains of Motor Control Centers (MCCs), switchgear, and a 120 VAC subsystem. In addition, through battery chargers, the 480 VAC subsystem provides normal power to a 125 VDC network and maintains the charge on two independent batteries which power the DC network when AC power is lost.

The 120 VAC subsystem powers vital instrumentation and controls and various Engineered Safety Feature support equipment. In the event of a loss of all AC power, the 125 VDC batteries provide instrumentation and controls vital 120 AC power through DC to AC inverters. They also serve various controls and alarms and provide EDG field flashing. When the 480 VAC subsystem is available the batteries float and are maintained charged from 480 VAC Safeguards power via battery chargers as noted in the previous paragraph.

2.1 Conclusions

Although several weaknesses were identified, the team judged that they were not of major significance and concluded that the EDS was capable of performing its intended functions during plant operating and accident conditions. In terms of equipment ratings and design features, the team found that the EDS generally exceeded basic requirements. For example, analyses indicated degraded voltage relay settings provided for appropriate transfer to backup Emergency Diesel Generators (EDGs) in the event of degraded voltage or a loss of offsite power, the EDGs were ample as a backup source to emergency loads, batteries and inverters had excess capacity to pick up vital instrument and control loads in the event of a loss of AC power, and settings and coordination of protective devices were generally satisfactory. Weaknesses were identified in the backup protection against fault currents that could damage containment penetrations, diesel generator start logic, selection of thermal overload protective devices for two motors, and in calculations to evaluate the adequacy of voltage supplied to Motor Control Centers.

2.2 Offsite Power

The licensee's provisions for offsite power as the preferred source for Engineered Safety Feature (ESF) loads were determined to be adequate. Stable, reliable power was provided to the safety related 7.2 kV busses from the two offsite sources. This assessment was based on the team's review of calculations and discussions with licensee personnel regarding matters such as transmission system voltage studies, dispatcher actions for maintaining voltage, degraded grid voltage protection, and surge protection. Transmission system voltage studies were discussed with an engineer from the Transmission and Distribution System Planning Department and with onsite electrical engineers. Based on information provided during the meeting, the team found that the analysis methodology met the requirements of General Design Criteria 17 with respect to the offsite power supply. Offsite voltage appeared adequately monitored and maintained. The licensee had instituted administrative controls on the offsite power supplies which called for monitoring voltages at the switchyard. There was a matrix of possible configurations, voltages, and corresponding action statements. Calculations reviewed by the team provided a basis for the voltages being maintained (calculation DC-820-005) and for the undervoltage relay settings (calculation DC-820-001). From a review with licensee personnel, the team determined that a satisfactory surge protection scheme was in place.

2.3 Medium-Voltage System

2.3.1 Short-Circuit Calculation

From a review of the short-circuit calculations (e.g., calculation DC-822-010), which were carried out with the aid of a computer program, the team concluded that the 7.2 kV circuit breakers were applied within their fault current ratings. The interrupting and momentary nameplate rating of the vertical lift switchgear were 41 kA and 66 kA respectively. The corresponding fault current duties were conservatively calculated to be 30.6 kA interrupting and 47.1 kA momentary.

2.3.2 Protection and Coordination

The application of protective relays such as overcurrent, transformer differential, and undervoltage protection were found to be acceptable by the team. Calculation DC-822-007R0 demonstrated proper selectivity of tripping. From a review of a sample of relay settings and equipment damage curves the team was able to verify proper protection.

2.3.3 Bus Transfers

The team determined that EDS alignment and equipment was such that the utilization of fast bus transfers was minimized, thus nearly eliminating problems associated with these transfers. Also, a review of the logic used for control of the automatic transfer between the preferred and standby power supply did not identify any problems.

2.3.4 Voltage Calculations

The licensee had a comprehensive voltage analysis that included nearly all the cases necessary to demonstrate that design requirements were met. The team identified some instances, however, where additional analyses were required to establish that existing calculations enveloped worst case scenarios within the design basis. To address the team's questions the licensee analyzed the following cases relating to system voltage:

- The licensee established that the loading scenario considered in the degraded voltage relay setting calculation was conservative relative to credible loading scenarios which could result from manual operator actions during post LOCA operations.

- The licensee established that the present degraded voltage relay setting would assure adequate voltage for restarting motors during post LOCA operations.

As a result of a report submitted pursuant to 10CFR50.72 on March 19, 1992 by another licensee, V. C. Summer determined that the auxiliary feedwater pump and reactor building spray pump should have been analyzed as "random" loads in the sequencing scheme rather than "definite time" loads. Analysis to show that the EDS had the capacity and capability to accept these randomly applied step loads continued until the last day of the inspection. The analysis determined that the EDS could accept these random loads at any time during a design basis scenario, except for the case where the two random loads were initiated together. If the two random loads were applied at the same time and the grid voltage was at the lower end of the acceptable range, calculations indicated that a degraded grid voltage relay trip would occur. This situation was considered improbable and the team observed that, even if it did occur, Emergency Diesel Generators provided standby power.

The licensee stated that additional analyses would be performed in the future to verify the model and assumptions used in system voltage calculations by comparing field measurements against a model of the same case.

The team considered that the preferred (offsite) power supply provided limited voltage margin above the minimum allowable voltages. There were two reasons for this situation:

- The switchyard high voltage busses sustain a relatively large voltage drop upon emergency tripping of the nuclear unit.

- Significant voltage losses take place within the safety-related distribution system.

2.4 Emergency Diesel Generators

2.4.1 Static Loading Analysis

From a review of Emergency Diesel Generator (EDG) loading calculations and a discussion of emergency procedures with operators, the team concluded that the generators had about a six percent margin for short term and long term loading. The team reviewed calculation DC-836-006, Rev. 6, to determine the adequacy of the EDG steady state loading capacity. The calculation demonstrated a maximum load of 4369 kW for short term post accident loading, versus a 4675 kW short time (2 hour) rating. Long term loading without optional loads was 4006 kW versus a 4250 kW continuous rating. Appropriate procedural controls were in place to assure manual loads were applied within the EDG's ratings. The team noted, however, that the basis for loading assumptions was not clearly documented in some cases. A review of selected loads with the licensee demonstrated that appropriate loading was considered.

2.4.2 Dynamic Loading Analysis

The team found that the EDG dynamic performance was demonstrated by calculation DC-836-008, Rev. 3. The calculation consisted of a transient analysis supplemented by dynamic performance data supplied by the diesel manufacturer, Colt Industries. The calculation was not a true dynamic analysis in that it did not model generator-load interactions throughout the range of load sequencing conditions. The team determined, however, that the existing calculation was generally conservative and demonstrated sufficient margin to assure proper EDG performance. It indicated that the largest single load could be started at any time. Possible "random" loads were adequately enveloped by the conservatisms (i.e., the large loads assumed) in the calculation. Licensee personnel stated plans to perform a new EDG dynamic analysis/motor analysis using a transients program. This analysis would be performed by the Transmission Department.

2.4.3 Protection and Controls

In reviewing the design of the protection and controls, the team found that the EDGs had a full complement of protective relays for protection against damage during test runs, and the team agreed that the settings were adequate. Generally, the trips provided for emergency conditions also appeared appropriate. However, the team noted that, as indicated in Figure 8.3-0h of the FSAR, there were three engine parameters measured during EDG starting that could produce signals which would disable the engine starting function:

Engine speed relay > 115 RPM
Jacket water pressure for engine speed > 375 RPM
Engine speed relay > 335 RPM

The current revision of NRC Regulatory Guide 1.9 recommends that these signals employ two or more independent measurements of the trip parameter with coincident logic for trip actuation, so that a single spurious signal from one of these inputs would not disable the engine start function at any time during the starting sequence. The licensee was not committed to the current revision of Regulatory Guide 1.9 but to the original version, which did not require coincident logic. The licensee's design represented reduced reliability relative to the EDG control system.

In discussions, licensee personnel indicated they would review this issue and, if appropriate, alarm these signals so that if they were present (such as from a stuck relay) the condition would be known. This would eliminate exposure to a spurious signal existing prior to an attempted start but would not eliminate exposure to signals generated during the starting function, such as from instrument drift.

2.4.4 Grounding Resistors

The team questioned the adequacy of the time rating of the EDG grounding resistors (200 A for one minute), the EDG ground fault detection and protection scheme, and the potential for transferring the ground fault from the EDG to the off-site network following a restoration of power from the network. In response, the licensee generated calculation DC-804-011, Rev. 0, "DG Ground Fault Relaying Coordination." The team found that this calculation resolved their concerns. It demonstrated that the grounding resistor was adequately protected by the branch circuits' ground fault detection and protection devices and the generator differential protection.

2.5 Low-Voltage Systems

2.5.1 Containment Electric Penetrations

The team determined that circuits which passed through the containment to support both safety related and non-safety related post accident loads were generally provided with adequate protection to ensure against damage to containment penetrations from faults originating in the containment. However, the team's review of calculation DC-847-013, Rev. 0, dated 2/3/92, "Electrical Penetration Evaluation", revealed approximately 45 electric penetrations which did not have the full range of dual protection recommended by the applicable NRC Regulatory Guide, RG 1.63, Rev. 1.

In accordance with the FSAR, RG 1.63, Rev.1, provides the guidance applicable to the electric penetrations for V. C. Summer. Section C.1, of this RG states that an electric penetration assembly should withstand "the maximum possible fault current vs. time given single random failures of circuit overload protection devices". This was intended to ensure that each circuit passing into the containment had dual protection against any period of fault induced current flow that could damage its penetration. For approximately 45 electric penetrations at Summer, only one protection was provided for the full range of possible fault currents and times that would exceed the penetration damage ratings. The 45 included the penetrations for containment loads such as Reactor Building Cooling Units and Pressurizer Heaters. The primary protective devices for these loads did cover the full range and ensure against exceeding the penetration damage ratings. However, the backup protective devices covered only the maximum fault current; protection was not provided in the overload or low level fault region. In many cases the backup device would require more than 240 seconds to interrupt the overload current equal to the one-minute rating of the penetration. This could result in damage to the penetration and breach of the containment, assuming a single failure of the primary protection.

The deficiency in the protection of the above penetrations was a result of the licensee's original design interpretation of the recommendations of Regulatory Guide 1.63, Rev. 1. Its interpretation was that protection was required against the maximum possible fault current. Licensee personnel stated that the NRC had been aware that protection would only be provided against the maximum fault possible and had accepted this position. The team was unable to either verify or refute this.

The licensee acknowledged that the problem of the backup devices not providing full protection had been identified in 1987

(Independent Safety Engineering Group activity sheet 11-19-87/LC). The licensee chose to justify the deficiency on the basis of a low probability of a scenario which might challenge an area of insufficient backup protection.

This item is being reviewed internally by the NRC to determine significance and the need for corrective action. Pending completion of the review it is identified as Unresolved Item 395/92-04-07, Failure to Provide Backup Protection for Electric Penetrations in the Overload Range of Currents.

2.5.2 Overload Protection of 480 VAC Loads

In order to evaluate the design criteria for selecting the overload (OL) protection of the various safety related loads, the team reviewed calculation DC-820-004, Rev. 0, dated December 30, 1991, "Circuit Breaker Sizing Criteria". The team observed that the criteria for selecting the rating and settings of the OL protection was appropriate for most applications but did not consider the condition when a load would be required to operate in the "service factor" region. The team requested a review of the 480 VAC safety related motor loads to verify that none of these loads would be prematurely tripped. In response to that request, the licensee identified two safety related motors that could operate above their nameplate current. These were the A and B train service water pump house supply fan motors. One of them was found to have its OL relay undersized and the other OL was marginally acceptable. This could result in tripping of the fan motors during an accident with degraded voltage. The resultant temperature increase in the area would be slow and should be detected by operators and corrected. The licensee promptly replaced the heaters in the two OL relays. The team was informed that the appropriate drawings that specified the overloads, drawings E-201-364 and -365, would be revised. The licensee's failure to select and install the correct thermal overloads is considered an example of a violation of 10CFR50 Appendix B, Criteria III and V. This is identified as Violation 395/92-04-01, Undersize Thermal Overloads and Inadequate Tubing Supports. Another example of this violation is described in Section 3.4.

2.5.3 Voltage Drop in MOV Circuits

Subject to additional testing and evaluation being performed in accordance with NRC Generic Letter 89-10, the voltages at MOVs appeared adequate. However, the team found that the most recent licensee calculation of voltage drops to MCC loads contained discrepancies which were not formally acknowledged and controlled and that the discrepancies appeared to stem from a database which had not been updated to reflect the installed hardware.

The calculation initially provided to the team in support of the adequacy of voltages at MCC loads was DC-820-003, Rev. 0, dated 2/17/92, "Class 1E MOV Thrust Evaluation". This calculation was based on voltage data from calculation DC-820-001, Rev. 15, dated 2/17/92 and entitled "ESF Undervoltage Relay Logic and Settings." The team observed a deficiency in DC-820-003, in that the resistances of the MOV overload (OL) relay heaters were not factored in as additional loads on the circuits. The licensee responded by preparing and providing a preliminary revision of calculation DC-820-003 (Rev. Special Attachment 11 dated 03/27/92) which included the OL relays, as listed in a computerized database prepared 2/2/90.

The team questioned why DC-820-003 had not originally included the thermal overload resistances. They observed that similar licensee calculations (0890-077-ER-001, Rev. 0) reviewed in a recent NRC MOV inspection (Inspection 395/92-02) included the OL resistances. Also, the team noted that some of the OL data used in the DC-820-003 calculation Special Revision was incorrect. For example, the OL resistance for Safety Injection Valve XVG 8889 was for a size 2 OL, whereas the team observed that the installed OL was size 4. The incorrect resistances appeared to stem from the use of a database that had not been corrected to reflect changes in the OLs actually installed in the field. Neither the licensee's series 201 drawings, which were referenced as a source of database information in DC-820-003, nor the database itself had been updated to properly reflect the installed hardware. "Notes and assumptions", 4(E), of DC-820-003, Rev. 0, stated that part of the database information taken from 201 series drawings contained obvious errors and had been corrected before use in the calculation. It suggested that a final comparison of the database information with nameplate data should be performed.

The team compared DC-820-003 with the calculations reviewed in the MOV inspection, which were identified 0890-077-ER-001, Rev. 0, dated 10/31/90, "G.L. 89-10 MOVs Thermal Overload Relay Evaluation" and 0980-077-EV-001, Rev. 1, dated 6/4/91, "G.L. 89-10 MOVs Minimum Terminal Voltages." DC-820-003 had been prepared by Gilbert Associates, while ER-001 and EV-001 had been prepared by ABB Impell. The comparison revealed differences in important input data for the Gilbert and Impell calculations. As an example, the database used in DC-820-003 for Residual Heat Removal Valve XVT 0602A gave the motor data as 0.66 HP, 2.30 full load amps, and 12.0 locked rotor amps, versus 1.9 HP, 3.5 A, and 26 A used in the ER-001 calculation.

Licensee personnel explained that calculation DC-820-003 was performed as part of an ongoing effort to computerize the existing manual calculations, and that the Impell calculations were done as part of a dedicated MOV program. The Impell calculations, being the older, did not use the latest values of MCC voltages, but had reportedly used updated valve thrust requirements and motor data and had considered OL resistances. They were considered the "official calculations". The team was informed that DC-820-003 did not originally incorporate overload heater resistances because the original manual calculations on which it was based did not consider the OL resistances. DC-820-003 was stated to be still under review and not a "formal" project document. The team observed that the calculation was not marked as "preliminary" and that its cover sheet had the same markings as any other formal project document. Licensee personnel were unable to show any document control practice that identified DC-820-003 as a document that was still under evaluation and not fully approved for use. Nor did they indicate any previously documented identification of discrepancies and initiation of corrective action.

In summary, calculation DC-820-003, which was originally provided to the team as an acceptable calculation, was subsequently described as still under review when various calculation discrepancies were identified. The team agreed that this calculation involved a special case of a contractor upgrading a previous calculation and accepted the contention that it was still under licensee review. However, the team found no special identification or other document controls to preclude its issuance as a fully adequate calculation approved for use. Also, it was apparent that the database identifying the OLs was incorrect and yet had been available and used in revising DC-820-003 during the inspection. This is considered a violation of 10CFR50 Appendix B, Criterion VI, requirements to assure the adequacy of documents that are issued for use in activities that effect quality. Another example of violation of Criterion VI involves the known uncorrected errors in the licensee's 201 series drawings, as referred to in the third paragraph above. Errors and omissions noted on the drawings during the team's inspection of motor control centers are described in Section 4.2. This matter is identified as Violation 395/92-04-03, Deficiencies in the Control of Drawings, Design Calculations, and Databases.

2.5.4 DC System Short-Circuit Calculations

The team's review of short-circuit calculation DC-832-018, Rev. 2, dated 2/18/91, for the DC System, verified that breakers and fuses were applied within their ratings. The team, however, questioned the contribution of the battery charger used in the calculation, which was the current limit setting of the charger (115 percent of its 300 A rating). In response, licensee personnel contacted the vendor and were informed that recent tests indicated the battery charger contribution could be as high as 1000 percent of its rating. A subsequent review of the capabilities of the bus bracing and the circuit breakers in the main distribution panels indicated that their ratings, as certified by the supplier, were still adequate. The licensee stated that the calculation would be revised to reflect the higher contribution from the battery chargers.

2.5.5 Capacities of Batteries, Charger, and Inverter

Calculations demonstrated that the batteries, in terms of positive plates required, had 25 percent capacity above that needed to meet the recommended minimum requirements. They were installed in 1990. The battery duty cycle indicated that the battery chargers had a current rating of 200 percent of the maximum steady state load.

Each inverter had a power rating of 142 percent of the maximum load, which was established by test and calculation. They were installed in 1991.

2.5.6 Voltage Calculations

The team found that the licensee had comprehensive analyses for the DC and vital AC systems. The DC voltage calculations were carried out with the aid of a special computer program which modeled the whole system, used an iterative technique and used realistic battery terminal voltages. The capabi[illegible]es of this special program were considered a strength. Fro[illegible] calculations the team concluded that all DC compo[illegible] would receive at least rated voltage for any design basis [illegible]enario. The availability and use of the above program were considered a licensee strength.

Voltages throughout the 120 V Vital AC System were calculated and found to be adequate. The team did, however, note that the transformer impedance was not correct. The licensee had used 2.5 percent, whereas the correct value was 2.75 percent. This resulted in about a 10 percent error in total system voltage drop. Correcting for this error, the drop was still within acceptable limits.

2.5.7 Coordination of Protective Devices in 125 VDC Vital Instrumentation and Control Power

In addition to the fault studies, the team reviewed calculation DC-804-007, Rev. 0, "Molded Case Circuit Breaker Coordination - D.C. System." The team observed that the diagrams did not show all of the protective devices per bus. Licensee personnel prepared new coordination curves and from these the team was able to conclude that, for the normal mode of operation (i.e., the battery floating on the bus), proper coordination was maintained. For the other mode of operation, battery disconnected and the battery charger supplying all of the loads, the coordination could not be maintained for all of the circuits. The team was informed that when the battery was disconnected, the train was inoperable and that this mode of operation was limited by the TS to two hours. The team accepted this explanation.

The team's review identified errors in the trip ratings given in the EDS Design Basis Document and drawing E-201-362, sheet 2, for the MCC XMC1DB2Y circuit breaker feeding the swing charger. Licensee personnel stated that the two documents would be revised.

2.5.8 DC System Ground Fault Detection

The team reviewed calculation DC-831-005, Rev. 0, "Evaluation of DC System Ground Detection Scheme Relay Set Points" and compared it with the description in the System Design Basis Document (DBD). The DBD stated that the automatic ground fault detection scheme had been disconnected and the fault detection was performed manually. Licensee personnel explained that a modification to the system was being implemented which included installation of an automatic ground detection circuit on each DC bus. Following the completion of the modification, all documentation will be appropriately revised. The team accepted this explanation.

2.5.9 Vital 120 VAC Instrumentation and Control Power

The team reviewed calculation DC-834-002, Rev. 0, "120 V Class 1E Vital AC System Design Bases." The only concern identified by the team was that, for the fault and coordination analysis, the inverters were not considered as the source. The team was informed that the scope of the calculation was limited to determining the adequacy of the short circuit ratings of the vital AC panels and breakers. At the team's request, the system was evaluated for the worst case in which an inverter could be the fault current source, a fault at one of the loads supplied through a 15 A breaker from panel XPN 5484-RH. This additional analysis indicated that the inverter was capable of supplying sufficient fault current to ensure a coordinated tripping of all branch circuit breakers.

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 interface with 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 and its sampling and chemical analysis to ensure diesel fuel oil quality were examined.

3.1 Conclusions

The team concluded the design of EDS mechanical support systems was adequate to support normal operation and postulated accident conditions. EDG loads were correctly incorporated in load study calculations. The minimum required fuel oil storage volume calculated and maintained w[illegible] in accordance with licensee commitments. The licensee's [illegible]pling and chemical analysis of fuel oil was good. HVAC design for EDS equipment spaces was adequate. Maintenance activities were adequate to maintain the design function of the EDG.

In addition to the positive findings regarding the design and maintenance of mechanical equipment described in the previous paragraph, the team also identified two negative findings. They found that the cathodic protection committed to as a corrosion preventing measure for EDG underground fuel oil piping and tanks was deficient and that small diameter tubing on the EDGs was inadequately supported.

3.2 EDG Loading

The team evaluated the major mechanical equipment load values used in the EDG load study calculation, DC-836-006, dated February 17, 1992. Equipment performance data and accident condition loads were translated into electrical load values and compared to values listed in the calculation tables. The team evaluation verified appropriate conversion of mechanical loads into electrical load values. The calculated accident electrical loads were within the rating of the EDGs.

3.3 EDG Support Systems

The EDG support systems consisted of cooling water, starting air, lubricating oil, and combustion air intake and exhaust. The systems' design was reviewed for functional capability, capacity, and seismic qualification. Design documentation demonstrated these systems were designed to support anticipated EDG operational requirements. Review of the service water system design demonstrated that a reliable source of cooling was provided for EDG auxiliaries.

3.4 Seismic Issues

As identified by the team and confirmed by the licensee, numerous examples of tubing mounted on both EDGs' skids did not meet vendor seismic criteria related to unsupported span lengths. Examples included a measured 84 inch span length between supports versus a specified maximum span of 26.9 inches for 3/8 inch copper air start tubing and a 70 inch measured span versus a specified 37.7 inch maximum span for 3/4 inch copper lube oil lines. It appeared this deficiency originated at the initial equipment installation. The tubing was used in the starting air supply, lubricating oil lines, cooling lines, and indication. The vendor EDG seismic calculation (Seismic Calculations for Skid Piping, Seismic Qualification File SQF-S-PS3-CO5-1) specified maximum tubing support spacings which ensured that tubing would behave in a rigid manner, i.e., natural frequencies would exceed 33 hertz. Above 33 hertz the tubing would not experience dynamic amplification of earthquake motion and would survive a postulated seismic event without damage. The failure to ensure implementation of seismic design basis criteria is identified as an example of <u>Violation 395/92-04-01</u>, Undersize Thermal Overloads and Inadequate Tubing Supports.

Following field verification that tubing supports were not installed as designed, the licensee acted promptly to identify and evaluate this deficiency. Seismic evaluation (through new more sophisticated calculations) of the worst case tubing spans demonstrated that no operability concern existed. The team was informed that corrective actions would be accomplished to install hardware to meet the original design criteria. This correction is to be performed during the next outage.

An additional minor issue identified by the team involved inadequacies in the licensee's securing tubing bundles. Several examples were noted in which bundles were secured with hose clamps which were loose or broken, rubber grommets protecting the tubing from movement in the clamps were deteriorated or missing, and one example of tubing was noted which had been deformed due to contact with a weld ridge. The licensee stated that the existing bundle and support clamps would be evaluated against mounting criteria and discrepancies resolved.

3.5 Fuel Oil Storage and Transfer System

The team reviewed the licensee's determination of the fuel oil storage volume required for 7 day EDG fuel consumption. The team noted several minor deficiencies in the fuel oil consumption calculation, DC06630001, dated February 24, 1992. The deficiencies were corrected during the inspection. The calculation conclusion, that the TS 3.8.1.1.b.2 minimum volume requirement was adequate for 7 day consumption, remained valid.

The team examined the licensee's activities to monitor and maintain EDG fuel oil quality. Procedures for chemical analysis of fuel oil were reviewed and the incorporation of TS required receipt and periodic sampling was verified. Additionally, the team observed laboratory techniques for obtaining storage tank samples and performance of particulate contaminant analysis. Trends of chemical analysis results were reviewed. The team concluded the licensee had implemented a good program for monitoring and maintenance of EDG fuel oil quality.

3.6 Corrosion Protection of Underground Fuel Oil Piping and Tanks

The licensee could not provide verification that EDG fuel oil underground piping and tanks had been adequately protected from galvanic corrosion in accordance with its commitment to Regulatory Guide 1.137. Over the lifetime of the plant, galvanic corrosion could result in reduced wall thickness of underground piping and tanks, which could degrade seismic and design pressure characteristics. Design provisions to preclude this equipment degradation included initial coating of surfaces and a cathodic protection system which maintains a specific voltage potential in the ground adjacent to the equipment. The licensee committed to provide this protection in its FSAR Appendix 3A response to Regulatory Guide 1.137. The team's review of documentation and discussions with licensee personnel revealed that the cathodic protection system, which was installed in 1980, had not been maintained or monitored in a manner which would assure that adequate protection had been provided for the piping and tanks. For a period of years the system was not monitored or was monitored on a very limited frequency. Monthly inspections of rectifiers and biannual measurements of ground bed resistance and ground potential voltage were recommended by the System Description and Maintenance Procedure for the Cathodic Protection System. No inspections or measurements were recorded from system installation in 1980 until 1984. The recommended monthly inspections of rectifiers were only performed annually in 1984, 1985, and 1986, and three times in 1989. Ground potential readings recommended biannually were taken in 1986, not again until 1989, and only became routine in 1990. The ground potential readings were consistently outside recommended design parameters. Ground resistance readings were begun in 1989.

The team noted the licensee was aware of cathodic protection system deficiencies. Modifications had been developed to upgrade system hardware and an industry specialist performed a system evaluation in 1991. The specialist concluded that the EDG fuel tanks and fuel oil lines were not receiving adequate cathodic protection. He indicated that the apparent cause was shielding, due to deficiencies in the original installation design. The modifications were scheduled for implementation in 1993. The licensee had not proposed inspecting the piping and tanks for possible degradation resulting from the degraded system performance. The team concluded no immediate operability problem existed due to the long time period anticipated for substantial wall thickness degradation. However, an inspection of the piping and tanks to verify the extent of any degradation was warranted. Licensee personnel stated an inspection would be accomplished.

The licensee's failure to adequately monitor cathodic protection system performance and assure the system would provide intended corrosion protection to fuel oil piping and tanks is identified as Deviation 395/92-04-05, Potential Deterioration of Emergency Diesel Generator Underground Fuel Oil Piping and Tanks. The team noted that the licensee had already taken significant actions intended to remedy the deficiencies in the cathodic protection but determined that a deviation should be issued because of the long period of time the condition had existed and because no plans were in place for verification of the condition of the piping and tanks. The licensee had not informed the NRC of its failure to meet the commitment.

3.7 Heating, Ventilation, and Air Conditioning

The team reviewed HVAC design for the EDG rooms and other safety related equipment spaces to ensure ambient conditions were maintained within equipment design requirements. Overall, the design documentation verified that HVAC design was generally adequate to maintain ambient conditions within equipment specifications. The FSAR stated that the design temperature used for HVAC design was 95 degrees F and that this temperature would be equaled or exceeded less than 1 percent of the time. The team found that the actual maximum outside temperature experienced at the site had been 107 degrees F and questioned whether the original design basis selection of 95 degrees F had been adequate. Licensee personnel explained that outside air temperatures exceeding the design temperature selected were infrequent, of short duration, and the 24-inches thick concrete walls of the building prevented any rapid temperature increase. They performed an analysis to address the possible impact on equipment and determined that it would be minimal. Additionally, the team noted that the EDG rooms were continuously monitored by devices which were on scheduled calibration intervals. The control room would receive indication of rising temperatures within reasonable time to initiate compensatory action. Based on a review of the licensee's analysis and its monitoring of temperatures, the team had no concern on this issue.

3.8 EDG Periodic Maintenance

The team reviewed periodic maintenance activities accomplished to assure the EDG maintained its design capability. Vendor recommendations for periodic maintenance and inspections were appropriately incorporated into procedures and scheduled in accordance with recommended frequency. Acceptance criteria specified by the vendor were correctly stated in the procedures. Review of documentation from completed maintenance activities indicated the EDGs have been maintained in an appropriate state of readiness. Review of this documentation with the engineering staff demonstrated the staff awareness of equipment status and indicated the engineering staff was appropriately involved in these activities.

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. Relay setting lists and drawings were reviewed to determine if an effective program had been developed and implemented for controlling setpoints for protective relays, overload relays, circuit breakers, switchgear, and timing relays. Testing and surveillance procedures for the emergency diesel generators were reviewed to determine if specifications were being met.

4.1 Conclusions

Overall, the team concluded that the licensee's Electrical Distribution System was installed in conformance with the approved design and was well-maintained. However, several concerns were identified. Positive findings in support of this conclusion include the cleanliness and visibly good condition of equipment inspected, application of a comprehensive fuse control program, testing of the 480 V MCC molded case circuit breakers, appropriate maintenance on 7.2 kV switchgear circuit breakers, and properly performed surveillances and tests on the Emergency Diesel Generators. The more significant areas of concern identified included drawings with omissions and incorrect information, the lack of any periodic trip setting tests for [illegible] DC molded case circuit breakers, and a failure to [illegible] riodic inspections of insulated 7.2 kV busses.

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 associated components, equipment, and panels in the following electrical areas were inspected:

- The safety related 125 VDC system, batteries, chargers, 120 VAC inverters, and panels.
- The safety related 480 V system, distribution load centers, switchgear, and motor control centers.
- The 7.2 kV system, switchgear, cubicles, and panels.
- The 7.2 kV emergency diesel generators and control panels.
- The main step-up and the auxiliary transformers and regulators.
- The 230 kV switchyard, batteries, protective relays, and control panels.
- The 115 kV Parr switchyard, batteries, protective relays, and control panels.
- The 480 V motor control centers and the 7.2 kV switchgear in the Service Water Pump House.

The inspections were conducted by the team to determine the EDS conformance to design requirements. Design drawings used for field inspections were compared against the "as installed" plant configuration. The team examined all the cubicles in the 9 different safety related MCCs. The fuses, motor starters, thermal overloads, transformers, and circuit breakers were examined as well as the general material condition of the panels.

The Motor Control Center Unit Listing drawings (201 series) for the Class 1E MCCs were furnished by the licensee for the team's use as the master drawings for the "as installed" inspection. These drawings provided a compilation of engineering data such as load description, load size, horsepower, full load current, locked rotor current, motor starter size (contactor), thermal overloads, circuit breaker size and type, and fuses. This data was used by the licensee to identify the specified components in each MCC cubicle and for engineering studies and calculations.

The team identified numerous omissions and incorrect data on the above drawings. Incorrect data was identified on virtually every drawing used in the inspection. As an example of incorrect data, drawing B-201-359-05R7 showed Safety Injection Valve XVG 8889 to have a B 36.00 overload for its motor, whereas the team observed the installed overload was B 4.00. As an example of omissions, drawing B-201-359-02R5 for Component Cooling Valve XVB 9503A, failed to give the motor full load amps or locked rotor amps. The licensee was aware that these drawings had discrepancies, as reported in calculation DC-820-003, Rev. 0, Section 4(E) and as stated to the team during the inspection. However, no action had been taken to correct and update these load list drawings or to restrict their use. This is identified as another example of Violation 395/92-04-03, Deficiencies in the Control of Drawings, Design Calculations, and Databases; which was described in Section 2.5.3 above. The "as installed" equipment was verified to be design acceptable by using other documents (e.g., calculations, elementary diagrams and schematic diagrams).

The 115/230 kV lines from the switchyards to the plant were observed to be supported at the side of the turbine building. The team questioned whether the connections were ever inspected for looseness and degradation. Licensee personnel stated an inspection program to examine these connections would be implemented on a regular basis. The team considered this appropriate. Licensee personnel indicated they had become aware of concern for the subject supports from recently reported EDSFI findings.

The team noted that the wire bundles inside the emergency diesel generator panels were loose. These were previously attached with "stick on" supports that came off. The licensee agreed to correct this minor problem with better supports.

During the inspection of various panels including switchgear, the team noted that the taping used on spare lead ends would not last for the life of the plant. The electrical maintenance department immediately corrected this condition by placing "tie wraps" over the tape.

4.3 Equipment Maintenance, Testing, and Calibration

The team reviewed the maintenance program to ensure that the EDS was properly maintained to function for the life of the plant. The completed work requests for calibrations, surveillances and testing were reviewed to determine if the EDS was operating within design and TS requirements. The Preventive Maintenance

(PM) program was examined to determine if the equipment was being serviced on a scheduled basis. Specific attention was directed to the switchyard batteries and they were verified to be in the PM program. The team reviewed the EDG surveillance test activities and determined that the TS requirements and design criteria were met.

4.3.1 Calibration

The team examined the calibration program for the protective relays and the timing relays used in the EDS including the switchyards. The calibration procedures for the various types of relays were reviewed. The data sheets and/or calibration lists for completed calibration of the protective relays for the 7.2 kV, the 115 kV, and 230 kV switchgear were reviewed and found satisfactory. The calibration of the metal clad breakers in the 480 V load centers was satisfactory. During the review of calibration procedures, the team noted that the "as found" and "as left" acceptance criteria were specified as a band. This is acceptable, except that if the setpoint is not left in the center of the band it could drift out of calibration during the next time period. The team did not identify any relays out of calibration. Licensee personnel agreed and stated they would enhance the calibration procedures by requiring the "as left" value to be readjusted to the setpoint (center of band). Overall, the team found the calibrations satisfactory.

4.3.2 Battery Service Test

Technical Specification Surveillance Requirement 4.8.2.1.d requires service testing to verify that "the battery capacity is adequate to supply and maintain in operable status all of the actual or simulated emergency loads for the design duty cycle". The battery service test procedure used to comply with this TS, procedure STP-501.003, requires the battery voltage at the end of the first minute under simulated load be recorded and compared with a specified acceptance value. The team's review of the battery service test performed on the train A battery on April 28, 1990, found that the voltage was not properly recorded at the end of the first minute, such that the wrong voltage was compared to the one minute acceptance criterion. This was apparent because the recorded voltage after one minute under a 500 A load, had dropped only about one volt from the original unloaded battery voltage measurement. A larger drop would be expected. Licensee personnel agreed that a comparison of data indicated the voltage had been taken after the load had been removed. Further review revealed there was sufficient data to verify the battery was satisfactory, even though the test data was not recorded and used as intended. The failure to record the appropriate voltage appears to be a violation of TS 6.8.1, in that the service test procedure or its implementation did not ensure the service test data was properly recorded. The recorded error appears to have limited safety significance and the licensee initiated a correction to the procedure to assure it would not recur. This violation is not being cited because the criteria specified in Section VII.B the NRC Enforcement Policy were satisfied. This item will be identified as Non-Cited Violation 395/92-04-02, Incorrectly Taken Battery Test Results.

4.3.3 Preventive Maintenance for Electric Equipment

Based on a review of PM for MCCs, protective relays, and switchgear, the team considered the licensee's PM program generally satisfactory. The licensee had a good program to trip test molded case circuit breakers in the 480 V MCCs. However, a weakness was noted in that overcurrent trip testing was not performed on the important molded case circuit breakers used as feeders for the 125 VDC load center busses. A PM program was in place for 125 VDC breakers but it only required these breakers to be exercised. The breakers were manually exercised by toggling the "on-off" switch or handle. In some cases the breakers were manually tripped using the "test trip" button. The team considered the exercising of the DC breakers to be a positive step toward assuring the breakers trip when intended. However, the team did not consider this sufficient for the life of the plant. Overcurrent trip tests, similar to tests the licensee performed on 480 V molded case circuit breakers, would provide an appropriate verification. The team's principal concern was that, in aging, lubricant in the breaker will dry out or other degradation will occur and affect the trip calibration. The team observed that overcurrent trip testing would be most important for the main feeder breakers on the 125 VDC load distribution centers (from the batteries). The failure of these breakers to carry the required full load current would result in the loss of power to safety related equipment, such as the instrumentation and 7.2 kV switchgear. This matter was identified as Inspector Followup Item 395/92-04-09, Preventive Maintenance Trip Testing of Important DC Molded Case Circuit Breakers to Verify Their Settings. The team was informed that these circuit breakers would be added to the PM program. Also, licensee personnel stated that the molded case circuit breakers in the 7.2 kV switchgear would be exercised during switchgear maintenance. These latter breakers are used in lieu of fuses for short-circuit protection only.

The team found that insulated 7.2 kV bus bars were not periodically inspected as recommended by the vendor in General Electric Manual GEH-1802, Metal Clad Switchgear. The "MAINTENANCE SECTION" of GEH-1802 specifically states "The switchgear structure and connections should be given the following overall maintenance ... Inspect the busses and connections carefully for evidence of overheating or weakening of the insulation." This inspection was specified because the purpose of the insulation is to limit the likelihood of arcing and short circuits between phases or to other equipment. The continued integrity of the insulation must be maintained to assure this is accomplished. The use of insulated busses permitted the busses to be placed closer together and to other equipment, such that a more compact arrangement could be provided.

The lack of the specified inspection was considered a weakness in the licensee's PM program. This will be identified as Inspector Followup Item 395/92-04-08, Preventive Maintenance Inspections for 7.2 kV Switchgear. Licensee personnel stated the 7.2 kV switchgear PM program would be revised to include the inspection of the bus bars' connections and insulation.

In addition to the above, the inspectors questioned the apparent lack of any preventive maintenance inspections for motor starter contactors. Licensee personnel indicated agreement that these inspections would be beneficial and stated that inspections of the contacts would be incorporated into their program and performed during the period when the molded case circuit breakers are tested.

5.0 ENGINEERING AND TECHNICAL SUPPORT

The team assessed the adequacy of the engineering and technical support provided to maintain the Electrical Distribution System. The assessment was based on examination of the following areas: technical organizations and interfaces, problem identification and resolution, modifications, and engineering involvement in routine plant EDS activities.

5.1 Conclusions

Overall, engineering and technical support to maintain the operability of the EDS was considered adequate. Staff levels were appropriate to support EDS-related activities. The knowledge of EDS design demonstrated by the engineering organizations was good. Support for identification and resolution of problems was satisfactory, although weaknesses were noted in a few of the examples reviewed. Involvement in and support of routine plant activities was considered adequate. The modifications reviewed by the team demonstrated adequate design controls were implemented on EDS modifications. The team noted improvement in specification of post modification testing requirements in the more recently prepared modification packages.

The licensee's determination that a diesel test failure was invalid was questioned and is to be resolved later.

5.2 Organization and Staff

All of the licensee engineering organizations for the Summer plant were located onsite and this was viewed as positive by the team. An association had continued with the plant's Architect/Engineer, Gilbert Commonwealth, in providing contract engineering support for various projects. Additional support was obtained from various other contractors. Of five modification packages reviewed by the team, the three largest were developed by Gilbert. Several of the support functions previously provided by Gilbert (e.g., control of drawings and design calculations) were found to have been recently transferred to the licensee engineering organization.

Overall, the team considered the engineering and technical support staff and organization adequate to support EDS activities. Although some problems did appear to have been neglected, they were generally not of major significance and had been neglected more because of management priority than unavailability of engineering and technical support. The most significant example of neglect observed by the team was with regard to the cathodic protection system, as described in Section 3 of this report. The licensee neglected this system for some years but more recently initiated actions intended to assure that it will function properly. In contrast, the team noted the more prompt and extensive support provided to address EDS weaknesses revealed by an event in 1989 (Licensee Event Report 89-12). This event indicated degraded grid weaknesses that were far more important and immediate than the cathodic protection system deficiencies. The team observed various changes in equipment and practices that had been instituted as a result of this event (e.g., addition of a voltage regulator downstream of the 115 to 7.2 kV transformer and limits on generated reactive power).

From their review of documents and discussions with engineering personnel during the inspection, the team concluded that the knowledge level of EDS design demonstrated by the engineering organizations was good. Effective controls were implemented through formalized procedures for training and qualification of engineers and for their job performance.

5.3 Problem Identification and Resolution

Engineering and technical support for problem identification and resolution was considered generally satisfactory by the team, though weaknesses were noted in a few instances. Documented examples of the licensee's implementation of problem identification and resolution were reviewed as a basis for this assessment. The examples reviewed included 49 Nonconformance Notices (NCNs), 10 Off-Normal Occurrence reports, and 6 Request for Engineering Evaluations (REEs). Several Special Reports concerning EDG-identified problems were also reviewed. From the reviews and related discussions with licensee personnel, the team determined that most of the examples reflected proper engineering performance. However, as stated previously, some weaknesses were noted. Problem resolution weaknesses found by the team were as follows:

NCN 4352 addressed a failure of an EDG voltage regulator during testing. The defective component was replaced but no analysis of the failure cause was documented. The licensee stated that failure analysis was performed; however, the effectiveness of this analysis could not be evaluated without documentation.

NCN 3621 identified a small cooling water leak into the EDG rocker arm lubrication system. The accept-as-is evaluation, which allowed operation until the following outage, was incomplete in that it did not address the effect of long term water leakage into this lubricating system.

REE 21593 recommended changes to the Fire Emergency Procedure in 1989. However, the team noted that the changes had not been fully implemented, indicating there had been no follow-up by the engineering organization. The recommended changes would improve personnel safety during local 7.2 kV breaker operation and eliminate procedural steps which removed fault protection for 7.2 kV breakers when operated locally. Following identification by the team the recommended changes were implemented.

The team noted that System Engineering involvement in NCN resolution varied. It was evident that, for the EDG, the responsible system engineer was involved. However, the majority of electrical NCNs were resolved by Design Engineering with no System Engineering involvement. The team questioned the limited involvement of system engineers. It appeared desireable that they be fully aware of the impact of nonconformances related to their systems and of the resolution of these nonconformances. Licensee personnel stated that impending program changes would result in increased System Engineering involvement in the NCN process.

5.4 EDG Failure Classification

In reviewing the Special Reports referred to in the previous section, the team observed that the criteria being used by the licensee to identify valid diesel generator failures appeared incorrect. It differed from the criteria mandated by Technical Specification Table 4.8-1, through reference to NRC Regulatory Guide 1.108, Rev. 1. Proper classification of diesel generator failures is required for determining the reliability of the diesels and as a basis for instituting actions, such as increased testing, if necessary, to ensure that appropriate reliability is maintained.

Special Report 91-089 addressed an EDG "B" failure on October 27, 1991, which occurred on a start following periodic maintenance on the diesel engine. The cause of failure was an automatic voltage regulator potentiometer malfunction which was unrelated to the EDG maintenance. This failure would have prevented the EDG from meeting its design function in the emergency mode. As documented in the Special Report, the failure was classified as invalid based on the fact that the failure did not occur during a test run or a bona fide emergency start signal. The team noted a similar failure in 1986 (Special Report 86-015) during maintenance was classified as a valid failure.

Regulatory Guide 1.108, Rev. 1, specifies that all diesel start attempts that result in a failure to start should be considered valid tests and failures with the exception of those that can definitely be attributed to:

- Operating error
- Spurious operation of a trip signal that is bypassed in the emergency operating mode
- Malfunction of equipment that is not operative in the emergency operating mode or is not part of the defined diesel generator unit design

It then states, as an additional exception, that tests performed in the process of troubleshooting should not be considered valid tests but that tests performed to verify correction of the problem should be considered successful tests or failures, as appropriate.

The team noted that the basis given in the licensee's Special Report for classifying the failure as invalid was not in accordance with the above exceptions. In response, licensee personnel stated the position that the start had been initiated while the diesel was out of service for maintenance and, therefore, it could be classified as troubleshooting. The team found no indication that the start was initiated for troubleshooting. Rather, it appeared to be a test to verify satisfactory diesel operation following completion of the maintenance. The team determined that the failure described in Special Report 91-089 and the bases given for not considering the failure valid did not meet any of the exceptions stated in RG 1.108 and, therefore, the licensee's classification of it as invalid appeared to be a violation of the Technical Specification requirement.

It is the team's understanding that the definition of validity used by the licensee may be authorized in a RG revision now under consideration by the NRC. This matter will be reviewed further by the NRC to establish the acceptability of the licensee's valid failure definition and the need for any enforcement action. Pending completion of this review, the matter is identified as Unresolved Item 395/92-04-06, Interpretation of Valid Emergency Diesel Generator Start Failure.

5.5 Routine Plant Activities

The team reviewed engineering involvement in routine plant activities such as maintenance and testing. System Engineering provided the primary daily technical support for plant activities such as maintenance. Operations shift engineers provided technical support for routine surveillance testing. The Design Engineering plant support group was the primary interface for deficiency resolution. Review of EDG periodic maintenance activity with the responsible system engineer demonstrated his knowledge of equipment status and involvement in routine maintenance activities. In examining TS surveillance testing the team found that the shift engineers' knowledge of specific surveillance test results and resolution of test deficiencies indicated their involvement in these activities. Involvement of the design group in deficiency resolution was observed through review of problem identification and resolution as discussed in Section 5.3 above.

5.6 Modifications

The team reviewed several electrical and mechanical modifications associated with EDS and support systems. This was accomplished by examining completed documentation packages for the modifications, which were identified by licensee assigned Modification Request Form (MRF) numbers. The following MRF's were reviewed:

MRF 21989	Ventilation System Setpoint Change for the EDG Exciter Cabinet Room
MRF 21659	Degraded Voltage Relay Replacement

MRF 22109	Physical Restraints for 7.2 kV Switch-gear Breakers
MRF 21372	DC Voltage Drop Margin Improvements
MRF 21369	Train "A" Voltage Boost to Main Control Board

The MRF's demonstrated appropriate implementation of design controls. The team noted improvements in the quality and overall package development for recent MRF's as compared to the earlier MRF's. Post modification testing at Summer had historically been a weakness of the modification process, as noted in previous SALP reports. The two older MRF's, 21372 and 21369 (developed in 1988) contained post modification requirements, but only provided limited instructions for accomplishing the testing. MRF 21659, which was completed in 1990, was an improvement in both the specification of the post modification testing requirements and the method for performing the testing. A maintenance special instruction procedure was developed specifically for replacement and functional testing of these relays. The licensee's effort to identify and resolve problems during their EDSFI preparation was demonstrated by MRF 22109. A lack of seismic restraint for 7.2 kV breakers was identified during a previous EDSFI. The licensee confirmed a similar problem existed at Summer and initiated a MRF to provide seismic restraints. Actual work per the MRF was being performed during the EDSFI. Also, the licensee identified on a walkdown inspection that permanently installed hoists near EDS equipment were not properly secured. Instructions were provided to secure the hoist; the work was completed prior to the start of the EDSFI.

6.0 ACTION ON PREVIOUS INSPECTION FINDINGS

6.1 (Closed) Unresolved Item 395/91-24-03, Failure to Evaluate the Cause of 15 Safety Related Circuit Breaker Failures.

This unresolved item identified a concern that the licensee was not performing even a cursory evaluation of the cause of failures of certain safety related molded case circuit breakers. The failed breakers were being replaced in accordance with the licensee's Pre-Approved Disposition (PAD) 12, which treated the failures as expected occurrences like normal wear-out or aging and required no definitive assessment of cause.

The EDSFI team further evaluated this issue. The licensee's program for dispositioning nonconformances, such as component failures, was found described in Station Administrative Procedure (SAP)-1141. In accordance with this SAP, a Nonconformance Notice (NCN) would be issued for most component failures. This requires consideration of the failure for cause, 10CFR50.72/73 or 10CFR21 reportability, and for possible generic concerns. However, certain components could be replaced without consideration of these factors through utilization of a PAD, such as the PAD 12 whose application is of issue in this unresolved item. PAD 12 is a standard engineering services pre-approved disposition intended for expected type failures due to normal wear or aging. Some examples of equipment which were handled under PAD 12 included bearings, gears, valve packing, molded case circuit breakers, relays and fuses.

The team reviewed application of PAD 12 to examples of circuit breaker failures mentioned in the original identification of the unresolved item. There were four examples (e.g., Class 1E breakers XMC1DB2X 03EH and XMC1DA2X 05EH) where, due to safety related application and mode of failure, simple examination for the possibility of a cause other than normal wear or aging appeared appropriate. The team found that PAD 12 did not adequately prescribe the criteria to be used to assure that a failure was due to "normal wear and aging", such that use of PAD 12 would be applicable. The team's concern regarding PAD 12 is not limited to molded case circuit breakers. There are other safety related equipment under this program where certain failure scenarios would require evaluations for cause, reportability, etc. These evaluations would not have to be performed if a PAD 12 disposition was utilized. The failure to provide written criteria to assure that PAD 12 was only applied to equipment or components which failed due to normal wear or aging is considered a violation of 10CFR50, Appendix B, Criteria V. This is identified as Violation 395/92-04-04, Inadequate Instructions for Application of Pre-Approved Disposition (PAD) 12. The team did not identify any significant hardware deficiencies that had gone undetected because of the lack of controls on application of PAD 12.

6.2 (Closed) Violation 395/91-23-02, Failure to Promptly Correct an Id ntified Deficiency with the EDG Indicating Lights.

The team reviewed the basis for this violation, which had been disputed by the licensee in its response letter of February 5, 1992. Based on the findings of the review, the team concurred with the original violation.

In this violation the licensee was cited for having failed to correct a condition adverse to quality involving a deficiency associated with the control panel indicating lights for each Emergency Diesel Generator (EDG). This was a deficiency which could lead, and in one instance had led, to temporary disabling of EDG. The lights in question provide EDG indication status for "Emergency Start", "Ready for Auto Start", and "Ready for

Load". The violation was issued in response to an Emergency Start light bulb failure on the B EDG panel and a related blown fuse in the associated EDG control circuit in December 1991. The EDG was rendered inoperable by the blown fuse. This failure had been preceded by a number of other light bulb failures on both of the licensee's EDGs.

The licensee denied the violation on the basis that the recurring indicating light failures did not represent a condition adverse to quality. It stated that the failure cause for the blown fuse was considered random and the failure mode unique, as there had been no previous instances where bulb/socket problems had resulted in the circuit being disabled. The licensee's 1989 investigation of the repeated EDG indicating light failures, documented in Nonconformance Notice (NCN) 3349, was referenced. This NCN reported the failure cause as improper bulb installation, stemming from difficulties in installing the bulbs in the spring coil type holder used in the particular socket design. The planned corrective action involved changing to a different socket design which would facilitate better seating of the bulbs. The NCN indicated that the change would be made in 1991 but it was subsequently delayed.

The team reviewed the licensee's denial and related information and determined that the violation was valid. The team found that the failures did indicate a condition adverse to quality and that the blown fuse was not a wholly random or unique failure in that:

(1) The susceptibility of the sockets to damage or actions which could blow a fuse and disable a EDG control circuit was demonstrated during the removal of a broken "Ready for Auto Start" bulb for the licensee's B EDG in November 1990. Accidental grounding of the socket during removal of a broken bulb resulted in a blown fuse, disabling the EDG control circuit and causing the EDG to be inoperable.

(2) A review of information recorded in the licensee's work history database indicated potential for shorting the circuit, such that a fuse failure should not be considered so unlikely as to be termed random or unique. Examples of entries included: "lamp socket defective emits sparks", "socket arced and disintegrated light bulb when attempt was made to change out bulb", "ready for auto start light explodes when screwed into socket", and "ready for auto start lamp exploded during alarm test".

In addition to the above, the team found that a recent notification to the NRC regarding a light socket-related failure may further dispel the contention that the coincident bulb/socket problem and blown fuse represented a random or unique failure mechanism. The notification involved a March 12, 1992 problem at the Oyster Creek nuclear facility. Undervoltage devices for the degraded voltage protection became inoperable due to a blown control and indicating fuse, resulting in a plant shutdown. The fuse blew when one of the indicating light sockets shorted and failed. The apparent cause of this failure was reported to be a short within the socket that may have resulted during installation of the light bulb. It was postulated that the spring coil bulb holder was pushed near another power supply lead during installation. This permitted an arc to develop, resulting in the excessive current that caused the fuse to blow. The team noted the apparent similarity of the spring coil bulb holder, the susceptibility of control circuitry to indication light socket problems, and the actual disabling of the circuit through the blown fuse.

The team reviewed the corrective action that was taken by the licensee for the EDG indicating lights. Initial actions included the installation of placards on the EDG control panel containing instructions and cautions for replacement of light bulbs. Also, the task of replacing the light bulbs received additional attention due to the potential impact on the EDG. During the EDSFI final corrective action was completed. This involved changing the light socket to a standard design that is less susceptible to light bulb failures. The new style light socket also has a resistor in series with the light bulb which will reduce the likelihood of a fuse failure. Based on review of the licensee's completed actions, the team concluded appropriate corrective action has been performed to correct this violation.

7.0 Exit Interview

The inspection scope and findings were summarized on March 13, 1992, with those persons indicated in Appendix C. The team leader described the areas inspected and discussed the inspection findings. The licensee questioned the identification of a deviation for the lack of cathodic protection for underground fuel oil tanks and piping, as the problem had been previously identified by the licensee and corrective action had been initiated. The team leader stated the deviation was identified for two reasons: (1) the extent of time the system would have been inoperable, and (2) that no plans had previously been documented for inspections of the tanks or piping for deterioration.

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. Two previously identified items were closed as a result of this inspection:

Item Number	Description and Reference
395/91-24-03	Unresolved Item, Failure to evaluate the cause of 15 safety-related circuit breaker failures. (Section 6.1)
395/91-23-02	Violation, Failure to promptly correct an identified deficiency with the EDG indicating lights. (Section 6.2)

APPENDIX A - ACRONYMS AND ABBREVIATIONS

A	Amps
AC	Alternating Current
AECL	Atomic Energy Commission of Canada, Limited
CFR	Code of Federal Regulations
DBD	Design Basis Document
DC	Direct Curren
EDG	Emergency Diesel Generator
EDS	Electrical Distribution System
EDSFI	Electrical Distribution System Functional Inspection
ESF	Engineered Safety Feature
F	Farenheit
FSAR	Final Safety Analysis Report
HP	Horse Power
HVAC	Heating Ventilation and Air Conditioning
kA	Kiloamp
kV	Kilovolt
kW	Kilowatt
LOCA	Loss of Coolant Accident
MCC	Motor Control Center
MOV	Motor Operated Valve
MRF	Modification Request Form
NCN	Noncompliance Notice
NRC	Nuclear Regulatory Commission
OL	Overload
PAD	Pre-Approved Disposition
PM	Preventive Maintenance
REE	Request for Engineering Evaluation
RG	Regulatory Guide
SALP	Systematic Assessment of Licensee Performance
SAP	Station Administrative Procedure
TS	Technical Specifications
V	Volts
VAC	Volts Alternating Current
VDC	Volts Direct Current

APPENDIX B - PERSONS CONTACTED

Licensee Employees

R. Brown, Supervisor, Design Engineering
*M. Browne, Manager, Design Engineering
*S. Carroll, Engineer, Design Engineering
*J. Derrick, Supervisor, Systems Engineering
*H. Donnelly, Senior Engineer, Nuclear Licensing
*R. Fowlkes, Associate Manager, Shift Engineering
*J. Graham, Assistant Engineer, Nuclear Licensing
*S. Hunt, Acting General Manager, Nuclear Safety
P. Justice, Engineer, Design Engineering
*A. Koon, Manager, Nuclear Licensing
D. Lengel, Systems Engineer, Systems Engineering
*A. Lyons, Engineer, Design Engineering
*G. Meyer, Senior Mechanical Engineer, Design Engineering
J. Mundy, Engineer, Design Engineering
C. Osier, Acting Manager, Systems & Performance Engineering
M. Quinton, General Manager, Engineering Services
*J. Skolds, Vice President Nuclear Operations
*R. Slone, Systems Engineer, Systems Engineering
*W. Stuart, Supervisor, Systems Engineering
A. Torres, Associate Manager, Quality Control
*A. Wactor, Senior Electrical Engineer, Design Engineering
*B. Williams, Manager, Operations

Licensee Contractors

R. Brady, Engineer, Gilbert Commonwealth
J. Jancauskas, Engineer, Gilbert Commonwealth
D. Kelly, Engineer, Gilbert Commonwealth

NRC Employees

*G. Wunder, Project Manager, Office of Nuclear Reactor Regulation

*Attended exit meeting