UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

Report Nos.: 50-369/91-09 and 50-370/91-09

Licensee: Duke Power Company
422 South Church Street
Charlotte, NC 28242

Docket Nos.: 50-369 and 50-370 License Nos.: NPF-9 and NPF-17

Facility Name: McGuire 1 and 2

Inspection Conducted: April 22-26, May 6-10, and May 20-24, 1991

Inspector: M. Hunt (signature) 7/31/91
M. Hunt, Team Leader Date Signed

Team Members: N. Merriweather
M. Miller
R. Moore
K. VanDoorn

NRC Consultants: I. Kuperman, AECL
S. Leelananda, AECL
L. Maggio, AECL

Approved by: Caudle Julian for 7/31/91
M. Shymlock, Chief Date Signed
Plant Systems Section
Division of Reactor Safety

SUMMARY

Scope:

This special announced inspection was conducted in the areas of design of electrical systems and related engineering and maintenance activities. NRC Temporary Instruction 2515/107, "Electrical Distribution System Functional Inspection (EDSFI)," issued October 9, 1990, provided guidance for the inspection.

Results:

In the areas inspected, violations or deviations were not identified. The Electrical Distribution System (EDS) at McGuire was capable of performing its intended function under normal and postulated accident conditions. Adequate controls were in place to maintain the EDS in an operable configuration. A summary of findings is provided in Appendix A.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

A Nuclear Regulatory Commission (NRC) team conducted an Electrical Distribution System Functional Inspection (EDSFI) at the McGuire nuclear station. This inspection was performed by Region II staff and consultants from April 22 to May 24, 1991. The objective of this inspection was to assess the capability of the EDS to perform its intended functions during all plant operating and accident conditions. A secondary objective was to assess the performance of the licensee's engineering and technical support groups in activities related to the design, maintenance, and operability of the EDS.

The team's inspection addressed design, calibration, maintenance, and the "as installed" configuration of the EDS including associated mechanical systems and equipment. The areas inspected by the team were the 230 kV and 525 kV transmission system and switchyard; the 6.9 kV system; the 4.16 kV system; the 600 VAC system; the 125 VDC system; and the 120 VAC instrument buses. Mechanical systems included electrical equipment rooms' HVAC, the emergency diesel generators, and support systems. The team's conclusions and findings for the systems and areas inspected are summarized in the following paragraphs.

The team did not identify any operability problems and concluded that the 230 kV and 525 kV transmission system provided an acceptable offsite preferred power source. The design of the 4.16 kV Class 1E electrical distribution system was adequate and the equipment was properly sized. The required terminal voltages were demonstrated to be available. Protection and coordination schemes were good. A degraded grid voltage alarm is planned to be added at the end of fuel cycle 9 for each unit.

Engineering and technical support provided for EDS activities was adequate. Areas that could be enhanced include root cause analysis, documentation of design inputs in modification packages, and communication of design information between the design and site engineering organizations.

A Self Initiated Technical Audit (SITA) of the EDS was initiated by the licensee prior to this inspection. This was a comprehensive technical audit. The licensee's responses to the findings were examined. In general, responses and proposed corrective actions were appropriate. Implementation of corrective actions was limited and will be reviewed in future NRC inspections.

The following list provides a brief description of the team's findings:

- The guy wire anchors for the 230 kV and 525 kV incoming lines located near the main transformers did not have protective barriers.

- There was no inspection program established for power line anchors located on the turbine building walls.

- The cleaning of switchgear compartments was not coordinated and was incomplete.

- The fuse control program did not include the fuses in the medium voltage switchgear control compartments.

- Breaker coordination inadequacies were identified in the 125 VDC distribution system.

- Inadequate ventilation was provided for cooling the EDG rooms during the time the diesel engine is not operating (stand by mode).

- Ventilation in the battery rooms was marginal for hydrogen removal.

- Small bore non-seismically qualified steam and main feedwater lines located in the vicinity of the EDG building air intakes provide the potential for impacting EDG operability in certain accident scenarios.

Within this report FINDINGS are identified and are defined as follows: FINDINGS are facts or conclusions related to how well the electrical distribution system meets its intended function. FINDINGS may indicate a requirement or an accepted industry practice that was not fully implemented. FINDINGS may indicate discrepancies or omissions in documents where these problems could credibly result in the intended function being compromised. The licensee's working knowledge of the design as well as their control of design documents may be the subjects of FINDINGS. FINDINGS typically make statements about the need for corrective actions, or they may indicate an area where the licensee excels.

1.0 INTRODUCTION

Previous inspections of nuclear power plants by NRC teams, and various licensee event reports (LERs) have identified conditions in the electrical distribution systems (EDS) at various operating plants that could compromise the design safety margins of the plants. These deficiencies were the result of unmonitored and uncontrolled load growth on safety related electrical buses, inadequate engineering modifications, faulted design calculations and inadequate testing of EDS equipment. In addition, the NRC discovered deficiencies where the actual configuration of the EDS equipment does not always adhere to the intended design. Consequently, the NRC initiated a special inspection program to evaluate the adequacy of the EDS at each operating plant to assess the system capability to perform the intended safety function and to evaluate EDS configuration control, and engineering and technical support capabilities.

The objective of this inspection was to assess the performance capability of the McGuire EDS by reviewing the design parameters as they relate to onsite and offsite emergency power sources and associated equipment relied on during and following design basis events to support the plant's safety-related equipment. Additionally, the licensee's engineering and technical support performance and configuration control was examined.

The EDS components reviewed included the EDG and supporting systems, the offsite circuits from the 230 and 525 kV switchyard, the start-up transformers, the 6.9 kV and safety-related 4.16 kV switchgear and related equipment, the 600 VAC motor control centers, the 125 VDC batteries and distribution systems, the 120 VAC distribution systems, and protective relaying. The review included examination of:

* Short circuit analysis,
* Circuit loading calculations,
* Protective devices and their application and coordination,
* Drawings, procedures and test results for selected equipment,
* and devices which are part of the EDS.

Additionally, portions of the mechanical systems which are required to support or protect the EDG were examined. These included the air start system, lube oil system, fuel oil system, and the water cooling system. The Heating, Ventilating, and Air Conditioning (HVAC) systems for the rooms containing major EDS equipment were also evaluated.

2.0 ELECTRICAL SYSTEMS

The McGuire Nuclear Station was connected to the Duke high voltage grid transmission system through a switchyard consisting of two sections: one section at 230 kV serving Unit 1 and the other section at 525 kV serving Unit 2. The two sections were inter-tied through an autotransformer. Both switchyard sections were of the breaker-and-a-half configuration.

The 230 kV section was tied to the Duke Power network by seven double circuit overhead lines while the 525 kV section was tied to the network by four single circuit overhead lines. Power supplied from McGuire to the grid was through two 230 kV overhead lines from Unit 1 and two 525 kV overhead lines from Unit 2. These circuits receive power from each unit's main generator through two power circuit breakers feeding two half size step-up transformers. The step-up transformers also serve to supply the offsite preferred power to the Class 1E Electrical Distribution System by opening the generator output breakers and feeding back from the switchyard through the step-up transformer.

Power to the grid was supplied from two 24 kV generators each rated at 1450 MVA through two half size 750 MVA transformers per unit stepping up the voltage to 230 kV and 525 kV for Units 1 and 2, respectively. Normal auxiliary power and preferred power for the McGuire Station was derived from the low side of the step-up transformer at the 24 kV buses using two 24/6.9 kV auxiliary power transformers on each unit. Each transformer had two 6.9 kV windings each feeding one 6.9 kV switchgear bus. Each redundant 4.16 kV safety-related bus is supplied normal auxiliary power through a transformer powered from one of four of the 6.9 kV buses. Each safety bus had independent switchgear and distribution equipment to provide power to safety loads from either the offsite source or the train related emergency diesel generator. The licensee also has the capability to manually cross tie a safety-related bus on one unit to the same train related bus on the other unit.

The 4.16 kV safety-related buses for each unit supplied the accident mitigation motors and 600 VAC load centers. The load centers supplied power to the safety-related motor control centers which supplied power to the various safety-related motor operated valves, motors, and battery chargers.

The Class 1E 125 VDC Vital System is a system shared by both Units 1 and 2. This system is divided into four groups, each comprised of one battery, one battery charger, one DC distribution center, and two DC power panel boards.

The Class 1E 120 VAC Vital Instrumentation and Control Power System on each unit is supplied normal power from the shared 125 VDC Vital System. Each Unit's 120 VAC system contains four vital panel boards and four inverters.

2.1 Conclusions

The team concluded that the 230 kV and 525 kV systems provided stable off-site power to the plant 4.16 kV safety related buses.

The 6.9 kV and 4.16 kV distribution systems did not have any operability problems and were adequately designed. Cabling was adequately sized and voltages at loads were adequate. Protective relaying and relay co-ordination were satisfactory. However, the team was concerned with the available short-circuit current on the 6.9 kV buses which had only very little margin from the breaker rating. These buses supplied power to the 4.16 kV safety related buses. The generators were 99.3% loaded and no additional loading would be possible. The licensee is aware of these limitations.

One finding was identified in the 125 VDC system that involved breaker miscoordination. A short circuit in a branch circuit could cause the main 500 amp feeder circuit breaker to trip. This would result in loss of one channel of both 120 VAC and 125 VDC in each unit. This could further result in both units tripping and challenging the safety systems.

2.2 Transmission System

The expected minimum voltages on the switchyard were 221.5 kV and 512.3 kV for Units 1 and 2 respectively. During the spot checks made by the licensee, the voltages were found to be within 223-231 kV and 513-529 kV. The voltages of the switchyard were monitored by the dispatchers and the plant operators were notified of any significant variations. Due to the interconnection with 11 transmission lines (seven 230 kV connections and four 525 kV connections) the off-site power through the switchyard was very stable. Grid frequency decay due to the loss of any incoming lines to the switchyard was found to be insignificant because of the interconnected network. Future enhancements to the system are planned to include the addition of a degraded grid voltage alarm to provide the plant early warning of any operational concerns. The licensee indicated that the alarm would be added at the end of fuel cycle 9 for each unit.

2.3 Medium Voltage Systems - 6.9 kV and 4.16 kV

2.3.1 Short-Circuit Analysis

The team reviewed the short-circuit analysis documents for the 6.9 kV and 4.16 kV systems. The licensee had begun a review of the calculations using a computerized program. New calculations were completed for the 6.9 kV system incorporating the most up-to-date data. These calculations showed that the interrupting rating of the breakers was only approximately 6% higher than the available short-circuit current of the 6.9 kV bus. Furthermore, nominal system voltage of 6.9 kV was used in the calculations whereas the voltage study calculations considered a maximum steady-state voltage of 1.10 pu. [6.9 kV x 1.1]. Breaker rating would be exceeded if a fault occurred at the maximum voltage. The safety related loads were fed from these buses through the 5500 KVA, 6.9/4.16 kV transformer.

Short-circuit calculations on the 4.16 kV (MCC-1381.05-00-0011) system were not updated. These calculations were based on the assumptions made during the early design stage. The licensee was in the process of updating these calculations using the computerized program. However, the team concluded that these systems were adequately sized with ample margin and the new calculations would not challenge the present ratings of the equipment.

2.3.2 Circuit Loading Calculations

The circuit loading on 6.9 kV and 4.16 kV systems were reviewed and found to be acceptable except the EDG loading which is discussed in section 2.3.6. Large motors on the safety buses were reviewed. Proper efficiency and power factor values corresponding to the running loads had been used in the calculations.

2.3.3 Protective Relay Settings and Breaker Co-ordination

The team reviewed the relay setting calculations on the 6.9 kV and 4.16 kV buses including the diesel generator protection (MCC-1381.06-00-0023 Rev.7, and MCC-1381.05-00-0094 Rev. 10). The licensee, after performing a self initiated audit early this year, had identified certain areas where changes in the relay settings were required. As a result, actions had been taken by the licensee to revise the TS on undervoltage relay setting of the 4.16 kV bus to a setting of 3291 V.

Also, the self initiated audit, identified that the EDG neutral grounding transformer and resistor sizing was inadequate to carry continuous ground fault currents. The licensee provided a new calculation MCC-1381.05-00-0012 Rev. 2, which recommended replacement of the existing equipment with a properly sized transformer and resistor. Also the setting of the neutral overvoltage relay 59DGN would be adjusted accordingly. The licensee indicated that the new transformer and resistor will be installed on all emergency diesel generators by the end of 1992. This proposed action resolved the team's concern on this issue.

2.3.4 Cable Sizing

As a result of the self initiated audit, the licensee revised the cable selection criteria (MCC-1381.05-00-0007 Rev. 1). However, the team was concerned that the licensee still used resistance values of cables rated for 75 degrees C while the installed cables were rated for 90 degrees C in accordance with the design documents. The team raised a concern on the increased resistances that would occur at 90 degrees C, particularly on voltage drop calculations. A sample calculation using resistance values at 90 degrees C was submitted by the licensee showing a negligible effect on the voltage drop. However, the licensee agreed to incorporate the 90 degrees C resistances in the applicable design criteria and calculations.

The team was concerned with an arrangement of 1-3C250 MCM and 1-3C350 MCM cables (2EPC 506, 507) connected in parallel to feed the 5500 kVA, 6.9/4.16 kV safety related transformer 2ATD. The licensee explained that the cables were designed for 2-3C250 MCM but the above mentioned arrangement was approved for installation as the capacity was of no concern due to the increased size. This was acceptable to the team; however, concern remains on the possibility of overloading the cables and/or unproportional division of current as the load on the transformer grows. It should be noted that the transformer had been selected for continuous loading of 130 percent.

Despite the above concerns, 6.9 kV and 4.16 kV cables in general were adequately rated for use in ladder trays taking the cable spacing and ambient temperature into consideration. Cables were armored with either XLPE or EPR insulation.

2.3.5 Voltage Drop Studies

The team reviewed voltage drop and cable sizing calculations for the Nuclear Service Water pump motor and the Auxillary Feed Water pump motor. These calculations did not include as built information, i.e., motor data, cable data, and system data. The licensee agreed to update these calculations as part of the on going process of revising all calculations using the computerized program (ASDOP). Examples of recently completed updated calculations were reviewed and found to be acceptable. These calculations demonstrated the voltages to be within acceptable limits stated in the Technical Specifications.

2.3.6 Diesel Generator

The team reviewed the EDG loading, dynamic analysis and periodic test reports. The generator was originally rated at 3500 kW and later up-rated to 4000 kW. The diesel engine rated at 5575 bhp was adequate to run the generator loaded to 4000 kW. However, the team raised a concern on the exciter. The nameplate indicated an excitation current rating of 117.8 Amps while the generator required 125.2 Amps of excitation current at full load. The licensee produced drawings demonstrating the exciter was up-rated to 130 Amps and that the nameplate would be changed accordingly.

The dynamic analysis (MCC-1381.05-00-0088 Rev.1) demonstrated the generator would accept and accelerate the loads in the set sequence without dipping the voltage and frequency below unacceptable values. Also, the voltage and frequency remained below maximum allowable values during load rejection. The largest load was able to start and accelerate when the generator was loaded with the rest of the loads required to operate during a LOCA.

The total design load had reached 3951 kW with 1.23 percent margin on the generator capacity of 4000 kW, (MCC-1381.05-00-0187 Rev.1). Further calculations provided by the licensee which included cable and transformer losses, demonstrated the loading to be 3972 kW which decreased the margin to 0.7 percent.

2.3.7 Bus Transfer Schemes

The 6.9 kV buses were incorporated with fast and slow transfer schemes. During the self initiated audit, the licensee identified the inadequacy of the analysis and testing of these transfer schemes to ascertain the transients of voltages and currents. Further, the transfer durations and transfer capabilities during various loading conditions were not analyzed. The licensee had planned to perform an analysis using a computerized program. The analysis is expected to be complete by the end of 1991 (SITA-90-03 (MC) (2.1.2.2-3)).

2.3.8 Power Cable Penetrations

The reactor coolant pump motor feeders (6.9 kV) were the only medium voltage cables used with penetrations. These penetrations were acceptable to the team in terms of continuous current, short-time overload rating and short circuit current rating.

2.4 Low Voltage Power - Class 1E 600 VAC System

The configuration of the Class 1E 600 VAC Power Distribution System was comprised of two redundant trains. Each train included two load centers, each fed by a separate 1500 KVA, 4160/600 volt load center transformer connected to the 4.16 kV Essential Auxiliary Power System buses. A spare transformer was provided for the two load centers in each train.

In Train A of Unit 1, load centers 1ELXA and 1ELXC are normally fed from transformers 1ELXA and 1ELXC, respectively, with transformer 1ELXE as a spare. In Train B of Unit 1, load centers 1ELXB and 1ELXD are fed from transformers 1ELXB and 1ELXD, respectively, with transformer 1ELXF as a spare. The load centers distribute power to motor control centers and to the Pressurizer Heater Power Panels.

The team requested voltage drop, cable sizing, short circuit, and circuit breaker coordination calculations to establish the adequacy of the 600 VAC system. The team found the short circuit calculations and cable sizing to be acceptable. The team reviewed Calculations MCC-1381.05-00-0007, Cable Ampacities and Impedances to be Used in Cable Sizing for McGuire 575 Volt, 4000 Volt, and 6600 Volt Motors, and MCC-1381.05-00-0098, Auxiliary System Voltage and Transformer Tap Study for 600 volt buses and loads. The team noted in the voltage drop calculations inconsistent and nonconservative cable resistivity values of 75 degrees C conductor temperature rather than 90 degrees C which is used by the licensee in determining cable ampacity. The team selected several loads and asked the licensee to recalculate voltage drops to prove voltage level adequacy. These calculations verified adequate voltage level.

The team reviewed Calculation No. MCC 1381.05-00-0147, Maximum Allowable Cable Length for Size 1 and 2 Starters. The team expressed a concern regarding adequate voltage levels at starter contactor coils. The licensee produced manufacturer supplied documentation demonstrating the coils would pick up at 90 volts rather than the 93.5 volts used in the calculation. The licensee performed an alternate calculation using more conservative methodology and a 90 volt minimum pick-up voltage which resolved the team's concern. The licensee stated Calculation No. MCC 1391.05-00-0147 would be revised to include the manufacturer's 90 volt value.

The team reviewed Calculation No. MCC-1381.05-00-0094, Protective Relay Setting Calculation for Essential Switchgear and reviewed circuit breaker coordination curves from NSM's (Nuclear Station Modifications) MG-12255 and MG-22255. The team identified circuit breaker miscoordination with molded case circuit breakers in MCCs 1EMXG, 2EMXG, 1EMXH and 2EMXH. These MCCs are shared by two load centers and have main MCC breakers for each load center feeder. A fault on a branch circuit trips the entire MCC rather than just isolating the single faulted branch feeder. This occurs because the branch breaker is not coordinated with the main MCC feeder breaker. It occurs for fault currents over 4,000 amps. This is similiar to Finding 91-09-01 as applied to 125 VDC system in paragraph 2.6.1.

The team recommended that coordination could be achieved by means other than a main MCC molded case circuit breaker. The licensee stated that this miscoordination will be investigated further and eliminated if a suitable Class 1E device can be obtained.

2.5 Class 1E 120 VAC System

The team reviewed inverter sizing, voltage drop, short circuit and cable sizing calculations to confirm design adequacy. The 120 VAC configuration inspected included the four separate redundant instrument power channels for each unit. The 120 VAC system design was adequate.

2.6 Class 1E 125 VDC System

The Class 1E Vital 125 VDC System is a system shared by both Units 1 and 2. This system is divided into four groups, each compris of one battery, one battery charger, one DC distribution center, and two DC power panelboards. Each distribution center can be manually cross connected by a tie breaker.

The team reviewed battery and battery charger sizing, short circuit, voltage drop, cable sizing, and circuit breaker coordination calculations to establish the adequacy of the Class 1E 125 VDC System. The 125 VDC system design was adequate except for breaker coordination and short circuit ratings.

2.6.1 Circuit Breaker Miscoordination

The team reviewed short circuit calculations for the molded case circuit breakers. In the review of Calculation MCC-1381.05-00-214, the team identified 125 VDC circuit breaker miscoordination where a fault of higher than 4,500 amps on a branch feeder will open the main 600 amp feeder circuit breaker separating the battery and charger from the 125 VDC distribution panel. The result is loss of 125 VDC and Vital 120 VAC instrumentation and control power of one channel of a train for both Units 1 and 2. The licensee indicated that loss of one 125 VDC distribution center will trip both Units 1 and 2.

This miscoordination presents an unnecessary challenge to safety systems when a single short circuit fault on a branch circuit can trip both units. The licensee stated that this miscoordination will be investigated further and eliminated if a suitable Class 1E device can be obtained. This breaker miscoordination is identified as a team finding. (see Appendix A, Finding 91-09-01)

2.7 125 VDC EDG Control Power System

The 125 VDC Emergency Diesel Generator Control Power System is designed as a unit system and is comprised of the diesel generator 125 VDC battery and battery charger for each diesel. Each battery and its respective charger are housed in a metal enclosed cabinet located in their respective diesel room. Each charger battery unit supplies power to the Class 1E 125 VDC EDG fuel oil booster pump, generator field flashing, and the control loads necessary for proper diesel starting and operation during a blackout and/or LOCA conditions.

The team reviewed battery and charger sizing calculations which demonstrated adequate sizing and loading for the 125 VDC system and equipment. The team investigated the affect of higher ambient temperatures on sizing equipment and expected loss of equipment life. The team also reviewed voltage drop, cable sizing, short circuit, and circuit breaker calculations which were found acceptable.

2.8 Station Grounding Grid

To evaluate the station grounding grid, the team reviewed the calculations and documentation on the grid design. The licensee produced the grid layout drawings and stated that the guidelines established in IEEE-142 (the applicable standard at the time the design was performed) were followed when calculating grounding grid design values and these guidelines were incorporated in the ground grid design. No calculations were maintained for design verification. A letter from Harco Corporation dated May 8, 1970, was produced which summarized a soil resistivity survey and stated site resistivity measurements.

A transmission procedure entitled, "Ground Testing, Equipment Ground, Station Ground Mat and Fence Ground Soil Resistivity", was produced by the licensee. The purpose of this test was to detect radical changes in measured resistance and this test is routinely performed every six years for the Main and Auxiliary Transformers Substation, and the 525 kV and 230 kV Switching Stations. The licensee performed an informal hand calculation which showed the ground resistivity to be .919 ohms which is within recommended values stated in Standard IEEE 80, page 81 (1 ohm or less for large substations and 1 to 5 ohms for distribution substations).

The team considered that since the grounding grid was a maintenance free, passive piece of equipment with no access for visual inspection, its design should be verified. In the event of lightning strike or a serious system ground fault, it should be able to dissipate the ground current without compromising equipment operation and personnel safety.

As a result of the review of grid layout drawings, testing procedures, and informal ground resistivity hand calculations, there was no operability concern in this area. It is noted that no calculations are maintained for design verification.

3.0 MECHANICAL SYSTEMS

The team reviewed and evaluated the adequacy of selected mechanical systems to support the EDS during normal and postulated accidents. These mechanical systems included the EDG and the EDG support systems consisting of the diesel fuel oil system, the starting air system, lube oil system, diesel cooling water system, combustion air system and crank case vacuum system. In addition, the HVAC systems for the Class 1E equipment and diesel rooms were reviewed. Some portions of the chilled water and the nuclear service water systems which support the various EDG and HVAC systems were reviewed. Documents reviewed included examination of selected portions of the FSAR; engineering and vendor documentation; operating and maintenance procedures; mechanical system calculations and drawings; pump performance curves and motor data sheets; EDG manufacturer technical manuals; and system modification packages. Walkdown inspections of selected systems were conducted.

3.1 Conclusions

In general, the design and operation of the mechanical systems supporting the EDS were found to be adequate. However, a number of concerns were identified that required the licensee's prompt attention. These concerns included possible failure of the steam drain and feedwater tempering lines which could affect the operation of both diesels and inadequate ventilation flows for both the Class 1E equipment rooms and the EDG rooms. The team was concerned with the licensee's delay in implementing adequate corrective actions for the ventilation problems which had been identified as early as 1988. During the inspection,the licensee agreed to correct identified deficiencies such as overpressure protection requirements for the air starting and diesel cooling systems, and seismic failure of the eyewash stations in Class 1E battery rooms. Revisions to existing calculations or additional calculations are required for the diesel fuel oil, the EDG ventilation, the battery room ventilation and the nuclear service water systems.

Two items are under further review by NRC. These items are postulated main steam and feedwater pipe breaks over the diesel generator air intakes and the basis for maintaining the TS limit of 28,000 gallons of fuel oil for Modes 5 and 6 operation.

3.2 EDG Fuel Oil System

The licensee had submitted to the NRC a request to change the T.S. minimum volume for fuel oil from 28,000 gallons to 39,500 gallons for Modes 1 through 4 operation while maintaining the present 28,000 gallons for Modes 5 and 6. The increased fuel oil volume was chosen to provide operational flexibility. The selected volume allowed for operation of each diesel at full rated load for approximately 5 days including a 10 percent margin. The team reviewed the calculation that formed part of the basis for the 39,500 gallon value and found the calculation did not account for vortex effects when fuel is drawn out of the tank. This fact decreased the usable fuel volume in the tank. Additionally, the selected fuel consumption value at full load was not the most conservative from the various test and manufacturer data available. The licensee agreed to revise the calculation to incorporate the above factors.

The team founu no basis or calculation to justify the value of 28,000 gallons for Modes 5 and 6 operation. The licensee elected to maintain this value rather than change it to 39,500 gallons in order to have further operational flexibility. The team was concerned with this reasoning since the present TS calls for the same minimum fuel oil value for all modes of operation.

3.3 EDG Support Systems

The EDG support systems consisted of the cooling water, air starting, lubricating oil, combustion air intake and exhaust, and crank case vacuum systems.

The team identified two examples where overpressure protection was inadequate and not in agreement with ASME requirements. In both cases pressure relief valves were isolable from the protected component. The first was in the air start/control air system. The relief valve downstream of the Pressure Reducing Valve on the control air line in the air start system was not properly sized to take the full air flow should the PRV fail. Although there was another relief valve on a bypass line which could provide the required additional relieving capacity, this valve could be isolated from the main relief valve.

The second example was in the diesel cooling water system. The jacket water heater could be isolated and no overpressure protection was provided should the heater fail to shut off on high temperature. A similar water heater arrangement on the lube oil system had a relief valve. The licensee initiated a PIR implementing administrative controls to prevent isolation of these relief valves and agreed to review methods for achieving code compliance. These actions resolved the team's concerns regarding overpressure protection.

The team reviewed the design and monitoring of the control air system. Prior to this inspection the licensee had determined the need to enhance the design of this system such that a loss of control air would not result in diesel shutdown. This would avoid a condition in which possible control filter blockage could stop fuel to the engine. Present interim actions to monitor filter differential pressure were appropriate. The licensee had no process to monitor the quality of control air. Additionally, the procedure for measuring dew point did not specify corrective actions when the parameter was above specifications. The licensee agreed to address these issues by performing an air quality review and revising the applicable procedure to include appropriate actions. This resolved the team's concerns regarding control air issues.

The air start system as installed was sized in accordance with system design and appropriately verified by testing. The licensee had performed air start tests to prove the two start capability of the diesel to start after one failure had timed out at 20 seconds. In addition, the licensee had performed tests to show that each air tank has sufficient capacity for at least 5 consecutive successful starts.

3.4 Heating, Ventilation, and Air Conditioning

The team was concerned with the ventilation provided to cool electrical equipment spaces because in several cases the design ambient temperature for these spaces was closely approached by actual conditions. The licensee had previously identified these deficiencies yet had not accomplished satisfactory corrective actions.

For example, the EDG room temperatures during summer months could approach the TS limit and exceed the FSAR limit. The FSAR stated that with normal ventilation, the maximum EDG room temperature was 115 degrees F, while the TS required the temperature to be below 125 degrees F. There was no calculation demonstrating the installed system with a normal design flow of 3000 cfm and a summer outside temperature of 95 degrees F would maintain the EDG room below these limits. The team was concerned that high temperatures may lead to accelerated degradation of the electrical components and batteries in the room and also provide an adverse working environment for plant staff. (see Appendix A, Finding 91-09-02)

Review of ventilation calculations for the EDG emergency mode (diesel operating) also identified errors. The heat load from the ventilation fans was not included. The licensee revised this calculation to show the minimum air flow required to maintain EDG room temperature below 125 degrees F increased from 49,904 cfm to 52,261 cfm. Subsequently, the licensee revised the test acceptance criteria but did not address instrumentation errors. The licensee agreed to revise the test acceptance criteria to ensure that instrumentation and reading errors were conservatively accounted for when determining the acceptable air flow. This resolved the team's concern regarding acceptance testing of the emergency condition ventilation.

Ventilation of the Class 1E Battery rooms was also a team concern. The ventilation design and operation in the Class 1E battery rooms could lead to hydrogen build-up in the rooms. In one of the four rooms (room 711) air circulation was inadequate as indicated by a smoke test performed during this inspection. The combined exhaust flow from all the battery rooms, as indicated by control room instrumentation, was approximately 50 percent of the design value. Additionally, there was no control room alarm on loss of battery room exhaust flow. Considering that the battery rooms are locked closed and not on regular surveillance rounds, failure of the exhaust ventilation could lead to a significant hydrogen build-up. The licensee had previously identified battery room ventilation problems in 1988 and had not implemented corrective actions. (see Appendix A, Finding 91-09-03)

The team noted each Class 1E Battery room had an eyewash station but there was no drain in the room. The eyewash station is not seismically qualified and its failure could lead to flooding in all the battery rooms during a seismic event. The team also noted that the battery room doors were tightly sealed thus not allowing sufficient drainage from the room. The licensee initiated a PIR (0-M91-0094) and took the immediate corrective action of isolating the eyewash station by closing the supply valve outside the room. Should battery maintenance or testing be required, then the station would be valved in. For a long term solution, the licensee agreed to address this concern in its flooding evaluation of the auxiliary building (MGDS-0213/000). The licensee actions resolved the team's concerns regarding Battery room flooding.

The design of the control area ventilation system, which provided electrical equipment room ventilation, required one of the two trains be selected before the train would start (i.e., train "A" must be selected in order for it to start). In some accident scenarios, ventilation to both plants would be lost until the second train is started. The Emergency Procedure Reactor Trip or Safety Injection (for Unit 1 EP/1/A/5000/01) required the operator to verify the operation of the ventilation system as soon as possible; however, no time limit was imposed. Considering that ventilation could be lost to all the safety electrical equipment for both plants, the team felt that some time constraint, based on plant analysis, should be imposed on the operator to ensure that control area ventilation is operational. The licensee agreed to initiate a discrepancy report on this procedure to further investigate this issue. The team accepted this response.

3.5 Steam and Feedwater Line Postulated Failures

The team noted large bore, (greater than 18 inch diameter), main steam and feedwater lines located in the immediate vicinity of the intake air plenum for both diesels. This condition applied to both units. The intake plenum supplied both the diesel combustion air and the diesel room ventilation air. Although these lines are seismic and tornado qualified, the team was concerned that a random failure or a postulated break in either of these lines would result in both diesels being inoperable. The licensee reviewed their design and licensing basis regarding postulated pipe breaks and stated that these lines fulfilled all their commitments made in the FSAR and to the NRC. Although the team understood the licensee's approach, it appeared the environmental consequences of a main steam or feedwater line failure in this area had not been addressed properly considering the impact of such a failure on the emergency power source. In response to the team's concern, the licensee agreed to additional inspections for these lines. These included visual inspection of all portions of the snubber supports in the yard in conjunction with the existing program, performance of annual visual inspection on the balance of pipe supports in the yard and addition of two wall thinning detection test locations on both lines. The NRC is continuing its review of this issue.

In reviewing the above concern, the licensee identified additional small bore piping which could impact EDG operability in event of a piping failure. This piping included four 2" non seismic and non safety steam drain lines and two 4" non seismic and non safety feedwater tempering lines.

The licensee initiated a PIR and performed an operability assessment, which determined that stresses were less than the pipe rupture criteria for postulated breaks in the 4" lines. For the steam drain lines, seismic qualification could not be determined or postulated potential pipe ruptures eliminated. Therefore, the licensee initiated compensatory actions which included mechanically gagging the steam drain valves closed and establishing administrative controls to isolate the steam drain lines.

The licensee promptly developed and implemented modifications to upgrade the seismic qualifications of the steam drain lines. The licensee committed to completion of the modifications by July 1, 1991. Permanent resolutions, which may include rerouting of piping, are planned to be installed prior to the end of refueling outages 1E07 and 2E07. The licensee also initiated a PIR to address tornado impact on these lines.

The team's concerns regarding the small bore piping issues was resolved by the licensee's prompt and comprehensive actions. (see Appendix A, Finding 91-09-04)

4.0 MAINTENANCE, TESTING, CALIBRATION, AND CONFIGURATION CONTROL

The team performed walkdown inspections of the EDS to identify 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, and work orders 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 operates in accordance with design specifications. The protective relay setting drawings were reviewed to verify the calibration requirements have been addressed. The method used for fuse control configuration was examined to ensure correct sizes and types were installed.

4.1 Conclusions

The team identified several findings in addition to the items the licensee was already aware of. The licensee had engaged a contractor to perform an electrical inspection identified as a SITA. The SITA inspection included maintenance, testing, calibration, configuration control, and walkdowns to examine material conditions. The team and the SITA both determined the material condition of the electrical panels, especially for switchgear, was less than satisfactory. These panels were dirty, dusty, and contained debris. The preventive maintenance program in this area was lacking or non existent. In another area, the SITA contractor and the licensee determined that configuration control for electrical systems did not meet required standards. This included installed fuses. The licensee was in the process of taking corrective action by performing walkdown inspections to examine the as-built condition of all panels. These inspections were being performed by design teams. The team accepted this resolution.

The NRC team determined that calibration, testing, surveillance, and maintenance activities were satisfactory except for fuse control and the cleanliness inside the panels. All the protective relays were calibrated. The diesel generator sequencer timing relays were calibrated. The metal clad circuit breakers are adequately maintained. The licensee has initiated testing for molded case circuit breakers. In general the licensee's programs were satisfactory except for housekeeping, preventive maintenance, and fuse configuration control. One other finding identified by the team concerned protection for the 230 kV and 525 kV transmission line anchor guy wires.

4.2 Equipment Walkdowns

The electrical components examined during inspection walkdowns included fuses, protective relays, sequencer timing relays, motor starters, molded case circuit breakers, metal clad circuit breakers and switchgear, batteries, chargers, inverters, wiring, cables, cable trays, panels, load centers, and transformers. The associated components, equipment, and panels in the following electrical systems and areas were inspected:

- The safety-related 4.16 kV switchgear, panels, cubicles, and distribution centers.

- The 4.16 kV emergency diesel generators and panels.

- The safety-related 600 V load centers and motor control centers.

- The safety-related batteries, chargers, 120 VAC inverters, 125 VDC distributions centers and power panels.

- The EDG load sequencing panels and timing relays.

- The 230 kV and 525 kV switchyard.

- The main step-up transformers and transmission lines at the plant.

During the walkdown inspections, design drawings were used to reflect the "as installed" configuration of the EDS examined. Specific attention was paid to the protective relays for the 4.16 kV and 6.9 kV switchgear. The load sequencer timing relay settings for the emergency diesel generators were verified.

The material cleanliness of the 600 V, 4.16 kV, and 6.9 kV switchgear panels was not fully satisfactory. During walkdown inspections, the team found excessive dirt, dust, and debris inside the 600 V, 4.16 kV, and 6.9 Kv switchgear panels and distribution centers. The lack of cleanliness in the switchgear, load centers, and area terminal cabinets was identified as a finding by the licensee's SITA. Discussions with licensee personnel revealed that compartments containing the bus bars have never been cleaned. In addition, the bus bar connections have not been inspected to verify tightness.

Failure to maintain cleanliness appeared to be an interface deficiency between the plant staff IAE group and the Transmission group. IAE was responsible for the controls circuits in the switchgear panels. The Transmission group was responsible for the circuit breakers, field connections, and the bus bars. The Transmission group has performed adequate maintenance on the switchgear circuit breakers and protective relay calibration. The IAE group had not performed any preventive maintenance in these areas. (see Appendix A, finding 91-09-05).

The team observed licensee personnel performing fuse configuration control inspections in electrical panels. This was identified as a problem area by a previous NRC violation and the SITA audit. The team discussed the fuse inspections with the licensee and determined that fuses in the 600 V, 4.16 kV, and 6.9 kV switchgear compartments had not been addressed. (see Appendix A, Finding 91-09-06)

In another area, the team observed that the anchor guide lines for the 230 kV and 525 kV transmission lines off the main transformers near the turbine buildings were not protected from potential damage. The licensee agreed that vehicles could damage these anchor guy wires knocking out the offsite power. The team also learned that the transmission line connections attached to the turbine buildings are not being inspected. The lack of protection for the anchor guy wires and the connections was a finding. (see Appendix A, Finding 91-09-07)

4.3 Equipment Maintenance, Testing, and Calibration

The team inspected the maintenance program to ensure that the EDS was being properly maintained to function for the life of the plant. The calibrations, testing, and surveillances were reviewed to verify the EDS was operating within design requirements and technical specifications. The electrical maintenance program is divided between two groups. The 600 V, 4.16 kV, and 6.9 kV metal clad circuit breakers and switchgear protective relays are the responsibility of the "Transmission" group. The IAE group was responsible for all electrical equipment rated 600 V or less including the 125 VDC systems. In general both the IAE and the Transmission groups had good maintenance, calibration, and testing programs.

In the area of testing, the IAE group has implemented a program to test molded case circuit breakers. This was the result of a finding during the Maintenance Team Inspection. The team considered this testing program an adequate response to a NRC concern.

The team reviewed the most recently completed TS electrical surveillances for train 1A. The implementing test procedures effectively verified that the TS surveillances were met. One procedure enhancement was recommended by the team. The PT which verifies the EDG support system performance i.e. PT/1/A/4350/02A did not verify that the attached fuel oil pump is capable of providing full fuel requirements without the aid of the motor driven fuel oil booster pump. The licensee stated that the procedure would be revised requiring the operator to verify that the attached fuel pump was adequate for full load conditions during each performance of this test.

The team reviewed the abnormal and emergency procedures for loss of electrical power. These procedures provided no guidance to operators relative to manual loading of the EDGs. The licensee stated that appropriate caution statements would be added to the procedures.

5.0 ENGINEERING AND TECHNICAL SUPPORT

5.1 Conclusions

The team assessed the licensee's capability and performance regarding engineering and technical support associated with the electrical distribution system. The basis for this assessment was review of the technical organization and staff, problem identification and resolution, and modifications, as applied to EDS related activities. Overall, adequate engineering and technical support for EDS activities was provided. Engineering organizations providing technical support were appropriately staffed. In general, problem identification and resolution was adequate; however, root cause analysis activity could be enhanced by a more structured program and more specific training in this area. Although problem identification was generally aggressive, there were examples of a less agressive approach to correction of identified deficiencies. Design control applied to the EDS was adequate; however, documentation of design inputs in individual station modification packages was inconsistent. Temporary modification activity was adequate; however, an example was noted in which communication of supporting information from Design Engineering was not correctly interpreted by the site staff.

5.2 Organization and Staff

Adequate engineering and technical support for EDS related activities was provided by offsite and onsite engineering organizations. The team interfaced extensively with the offsite, corporate design engineering organization and noted a high knowledge level and familiarity with EDS design and design documentation. Routine technical support was provided primarily by a relatively large onsite Maintenance Engineering Support staff of approximately 50 engineers. A Projects group was involved exclusively with onsite modification administration and interface with design engineering. Overall the allocation of technical resources for engineering support was adequate for EDS activities. The McGuire implementation of the System Engineering concept was recently changed to provide a technical staff whose primary responsibilities were system trending and monitoring. Previously system engineering assignments were collateral duties of technical personnel in the various onsite engineering organizations.

5.3 Problem Identification and Resolution

A review of PIRs and corrective work requests demonstrated that identified problems were appropriately corrected. However, cause analysis performance was inconsistent. The available documentation did not demonstrate a well structured cause analysis program. Additionally, the team noted a relatively long corrective action scheduled time for correction of seismic deficiencies of diesel generator piping identified in a 1988 SITA.

In general, diesel generator start failures were comprehensively evaluated; however, there were examples of subcomponent failures and other EDS related PIRs with weak cause analysis. PIR 2-M89-0178 addressed a valid failure of 2B diesel generator and identified a subcomponent, a control voltage transformer, as the cause of the start failure. There was no documentation which indicated the root cause evaluation was extended to include the cause of the subcomponent failure, i.e., aging, environment, installation, etc. PIRs 2-M88-0152 and 2-M88-0177 addressed design change development deficiencies which resulted in inappropriate modification implementation. The associated hardware deficiencies were identified and corrected by the licensee; however, no documentation was available which demonstrated that the cause for these design deficiencies was determined.

A comprehensive SITA of the EDG support systems identified seismic qualification deficiencies with small portions of piping in the air start and lubricating oil systems in 1988. The interim action, which included a seismic walkdown and analysis was good; however, the final corrective actions to actually upgrade the piping were scheduled for 1992-93. While the audit and finding reflect favorably on the licensee problem identification initiative, the long lead time for corrective action illustrated a less aggressive approach to correction.

5.4 Modifications

A sample of EDS related modifications which had been implemented within the previous 5 years were reviewed. Although design inputs were not clearly documented in some cases, the design change process as applied to the EDS and components was acceptable.

Design inputs in the NSMs reviewed were inconsistently documented. Three examples demonstrated the importance of clearly specified and verified design inputs. The two PIRs previously discussed in paragraph 5.3 identified incorrect modifications which were installed due to exclusion of pertinent design inputs. PIR 2-M-88-0152 addressed a modification which resulted in both the normal and alternate power sources for shared buses being incorrectly supplied from the same unit. PIR 2-M-88-0177 addressed a modification which inappropriately changed the sequencer loading of containment isolation valves. NSMs MG-22173 and 22178 which installed the DG batteries did not include the appropriate industry standard as design input. This standard recommended a performance test within 2 years of battery installation. Although the period was not yet past, it was questionable whether the test would have been performed. A MES memorandum dated June 23, 1989, stated the performance test was a requirement, however, there was no procedure or schedule to accomplish the test. Appropriate documentation of the design input in this case would have facilitated entering the test in a tracking process during the NSM closeout. These examples demonstrate the necessity of specific documentation and verification of NSM design inputs.

Review of Temporary Modifications verified that this modification activity was generally adequate; however, one example demonstrated a communication deficiency between engineering organizations. To support maintenance of the EDG ventilation system, Design Engineering performed an analysis to verify appropriate flow requirements were achieved with 2 of 4 relief dampers closed. The analysis was communicated via memorandum dated January 30,1989, (MMSE-89-033). The memorandum stated that adequate flow would be maintained with 50 percent of relief damper area closed if all fans and other dampers are operating satisfactorily. The related Temporary Modifications for Work Request 88851 stated that 50 percent air flow capacity was adequate. This is a misinterpretation as air flow at 50 percent relief damper capacity is approximately 97 percent of full air flow. Air flow capacity of 50 percent is not adequate. The requirement to verify adequate operation of other dampers and fans was not addressed. Although this example was not safety significant, it demonstrated that applicable design information was not fully and correctly incorporated by the site staff.

6.0 EXIT MEETING

The team met with licensee representatives (denoted in Appendix C) at the conclusion of the inspection on May 24, 1991, at the plant site. The findings of the team were discussed at that time. There were no dissenting comments received. Proprietary information is not contained in this report.

APPENDIX A - FINDINGS

FINDING 91-09-01: 125 VDC Circuit Breaker Miscoordination (paragraph 2.6.1)

DESCRIPTION:

The 125 VDC circuit breakers have miscoordination where a fault of higher than 4,500 amps on a single branch circuit breaker will open the main 600 amp main feeder circuit breaker separating the battery and charger from the 125 VDC distribution center. A single fault on a branch circuit of the 125 VDC power panel board 1EVDA or 1EVDD will cause the 100 amp panelboard feeder breaker to fail to trip open. The 600 amp circuit breaker feeding distribution center EVDA or EVDD will open instead. The result would be a loss of the 125 VDC and vital 120 VAC instrumentation and control power of one channel for both Units 1 and 2 simultaneously. Both Units would trip due to the loss of the power to the Main Steam Isolation Valve solenoids.

Miscoordination would have a more severe result when the distribution centers are cross connected with tie breakers as during charger maintenance. In this case, both units would again trip; however, two trains of vital instrumentation and control power could be lost.

The FSAR infers coordination for the 125 VDC buses in Table 8.3.2-4, page 2, item 8, Comments and Consequences, which was not satisfied by this design. There is minor safety concern since the failure of a 125 VDC distribution center has been analyzed in the FSAR. However, the miscoordination presents an unintended and unnecessary challenge to the safety systems for both units from a single short circuit fault.

TECHNICAL REQUIREMENT:

Circuit breaker coordination not in accordance with good engineering design practices.

SAFETY SIGNIFICANCE:

A single short circuit can cause both Units to trip and unnecessarily challenge their safety systems.

FINDING 91-09-02: Ventilation Flow During Normal Diesel Operation (para. 3.4)

DESCRIPTION:

Normal diesel operation is defined when the diesel is in standby. FSAR Section 9.4.6 stated the maximum temperature should be 115 degrees F. The Technical Specification 3/4.7.12 requires the diesel room temperature to be maintained less than 125 degrees F.

There was no calculation available to show that the present design flow of 3000 cfm would maintain the temperature below the above limits with a summer design outside air temperature of 95 degrees F. The calculation available was for a proposed design modification that would increase the normal ventilation flow to 6000 cfm in order to maintain room temperature below 110 degrees F. This calculation omitted the additional heat load from the 2 hp fan motor and the 4.6 KW generator space heater. The team performed a preliminary calculation using a ventilation flow of 2788 cfm (based on the licensee's fan performance reading for Unit 1 Diesel Generator A Room) which indicated that the room temperature would exceed 130 degrees F during the summer design condition thus not meeting the requirments of the FSAR or TS.

In addition, diesel room temperatures from data logged in the computer showed that during the period from 07-16-90 to 08-30-90, the average diesel room temperature was approximately 115 degrees F during the day with an average outside day temperature of approximately 85 degrees F. If this data was extrapolated to the summer design value of 95 degrees, the diesel room temperature could reach 125 degrees F or greater. Based on the calculation results above and the historical information available, the team was concerned that a high temperature in the diesel room could lead to early degradation of the electrical equipment.

The licensee stated they were aware of this concern. A proposed design modification to raise the normal flow to 6,000 cfm had been prepared well over a year ago; however, the modifications were canceled based on a benefit/cost ratio analysis. Instead, the licensee proposed during the mid-summer months to do comprehensive tests to determine heat loads and temperatures in the EDG rooms, and review this data to arrive at a cost effective solution by September 1991.

REQUIREMENT:

10 CFR Part 50, Appendix B, Criterion III Design Control states in part "design control measures shall provide for verifying or checking the adequacy of design...".

Also Criterion XVI Corrective Action states in part "Measures shall be established to assure that conditions adverse to quality such as failures, malfunctions, deficiencies... are promptly identified and corrected.

SAFETY SIGNIFICANCE:

Inadequate ventilation flow could lead to high diesel room temperatures which could lead to early degradation of the electrical equipment and batteries located in the diesel room. The licensee current design provides a potential for these high temperature conditions.

REFERENCE:

1. FSAR Section 9.4.6.
2. Calculation MCC-1211.00-00-0004 Rev. 21, Diesel Generator Ventilation Calculation, dated 2-28-91.
3. M.A. Tartaglia, Memo to file "NSM #MG-11239, MG-20193 Diesel Generator Normal Ventilation Fans File MC-1211.00-16" dated May 8, 1991.
4. Memo M.A. Tartaglia to M.C. Robson "NSM MG-11239, MG-20193 Diesel Room HVAC Upgrade Replace VD System Normal Ventilation Fan Motors and Associated Duct Heaters" dated March 9, 1990, File MG-11239, MG-20193.

FINDING 91-09-03: Inadequate Ventilation Flow and Circulation for Class 1E Battery Room (paragraph 3.4)

DESCRIPTION:

The team was concerned that the present ventilation arrangement and actual flows did not provide for proper mixing in the battery rooms which could lead to high hydrogen concentrations in these rooms. Additionally, the team was concerned with the licensee's delay in accomplishing appropriate corrective action for these issues which were identified in 1988.

The team noted that the arrangement of the supply and exhaust registers did not promote good room air circulation, since the supply and exhaust registers were located in the ceiling near deep I beams, the supply air was directed downward in the room. In some rooms the registers were not in opposite ends of the rooms but rather one was located in the middle of the room. In addition, the exhaust air flow did not appear to be adequate. Smoke tests were done which confirmed that adequate circulation existed in three of the four rooms. In the fourth room (Room 711) the air flow was inadequate. In fact, the air seemed to flow away from the exhaust register. Control room instrumentation also confirmed that the exhaust flow was approximately 500 cfm, 50 percent of the 1000 cfm design flow.

PIR (0-M88-0321) initiated December 21, 1988, indicated that periodic verification of the exhaust flow should be done. Subsequent fan and flow calibration tests by the licensee in 1990 and 1991 confirmed that fan flows were between 500 and 600 cfm. No evaluation was done as to the effect of these low flows on battery room temperature and hydrogen concentrations. In March 1991, Design Engineering recommended that the fan flow should be increased to 1200 cfm, periodic maintenance on flow monitors and check dampers should be done, and periodic testing of exhaust flow should be performed. At the time of the inspection, the work requests had been prepared but the work was not scheduled. The team noted that well over one year had passed since the PIR was initiated and no corrective action or proper problem evaluation had been done.

The team noted that although the exhaust flow was monitored, there was no alarm to indicate loss of battery exhaust flow. Regulatory Guide 1.128, which was not adopted by McGuire, states that ventilation air flow sensors and alarms in the control room should be used. The licensee had prepared a calculation which showed that on loss of ventilation flow, it would take 172 days to reach 2 percent hydrogen concentration in the battery rooms. Therefore, sufficient time was available to discover the problem. However, this calculation had assumed that thorough mixing would occur in all six battery rooms (4 1E and 2 non 1E rooms) which is highly unlikely in the case of loss of ventilation flow (in addition to the already poor circulation). Also the hydrogen generation rate was 0.5 ft^3/hr where manufacturer data indicated during charging the rate is approximately 5 ft^3/hr. The team prepared a preliminary calculation which indicated that with loss of ventilation flow and the batteries charging, the individual room concentration would exceed 2 percent in approximately 6 to 7 hours. It takes approximately eight hours to charge the batteries. The team asked if there was any hydrogen monitoring data. The licensee stated they had no such data.

Based on the team's concern the licensee agreed to implement the following actions:

1. Implement the recommendation made in the PIR by mid August 1991;

2. Perform a flow balance test for the battery rooms;

3. Recommend to the station that a control room alarm on loss of battery exhaust fan flow be added;

4. Update design calculations for battery rooms to properly reflect the situation regarding loss of flow.

The team accepted this approach.

REQUIREMENT:

IEEE Standard 484-1975 requires that the hydrogen concentration be limited to less than 2 percent, and that the battery room be properly ventilated.

10 CFR 50 Appendix B Criterion XVI Corrective Action states in part "Measures shall be established to assure that conditions adverse to quality such as failures, malfunction, deficiencies... are promptly identified and corrected.

SAFETY SIGNIFICANCE:

High hydrogen concentration in the battery rooms could lead to explosive mixtures.

REFERENCES:

1. MCC-1211.00-00-0042, Control, Cable Battery and Switchgear HVAC Rev. 23 dated 2-12-91.

2. PIR 0-M88-0321

3. Memo K. Barrow to M.A. Tartaglia "PIR #0-M88-0321 VC System Battery Room Exhaust Fan" dated March 18, 1991.

FINDING 91-09-04: Inadequate Qualification of Feedwater Tempering and Steam Drain Lines (paragraph 3.5)

DESCRIPTION:

The team had raised concerns regarding postulated pipe break failures in the main steam and feedwater lines that passed near the diesel air intake plenums on the roof. This matter was referred to NRR for resolution.

As a result of the above concern, the licensee identified four 2" main steam drain lines and two 4" feedwater tempering lines which also passed near the diesel air intake plenums. The team was concerned that failure of any one of these lines due to a seismic/tornado event or a postulated pipe break could cause both diesels to be inoperable. The lines were classified as Duke Class G which meant they were not safety related or seismically qualified. The team noted that during construction, the steam drain lines were moved from inside the auxiliary building to the diesel roof to avoid the consequences of line failure. No such assessment was made for their present location.

The licensee initiated two PIRs, one to determine operability during a seismic event, the other to assess the licensing basis for tornado wind and/or missile impacts on these lines. The licensee's analysis concluded the tempering lines were seismically rugged and would maintain their integrity during and following a seismic event. Potential pipe ruptures were eliminated, since pipe stress levels were below the pipe rupture criteria for postulating breaks. Therefore no mechanistic pipe break was postulated. The pipe rupture criteria postulated breaks at the following locations:

a) at the terminal ends of the pipe run;
b) at locations where the stress, S, exceeded $0.8\ (1.2\ S_h + S_A)$
   where S = stresses during normal and upset condition
   S_h = allowable stress at maximum temperature
   S_A = allowable expansion stresses

For the steam drain lines, seismic integrity could not be assured or pipe rupture concerns eliminated. The licensee established compensatory actions which involved isolating the steam drain lines and if draining of the main steam line were required, a dedicated operator would open the line for a maximum of one minute. Also, urgent modifications, NSMs MG-12391 and MG-22391 were prepared which required new and revised pipe supports to be added to seismically qualify the lines and to resolve potential pipe break concerns.

In addition, more permanent resolutions were under investigation which would be implemented at the next refueling outage for each unit. Although the licensee's actions were appropriate, the team felt that the issue of pipe breaks was not properly addressed. The FSAR required that for Class G piping, breaks were postulated at each location of potential high stress or fatigue such as pipe fittings, valves, flanges, and welded attachment. In addition, Reference 1, Section 4.4, required that pipe rupture could not result in damage to an essential system.

REQUIREMENT:

10 CFR 50 Appendix A Criterion 2, in part, requires systems and components important to safety to be designed to withstand the effects of natural phenomena such as earthquakes and tornadoes. Also 10 CFR 50 Appendix A Criterion 4, in part, requires system and components important to safety shall be appropriately protected against the effects of discharging fluids that may result from equipment failures.

SAFETY SIGNIFICANCE:

Failure of either the steam drain lines or the tempering lines could cause both diesel units to be significantly damaged.

REFERENCES:

1. Report No. MDS/PDG-77-1 "Evaluation of the Effects of Postulated Pipe Failure Outside Containment for McGuire Nuclear Station" dated May 2, 1977.

2. FSAR Section 3.6.

3. PIR 0-M91-0088.

FINDING 91-09-05: Material Condition of Switchgear and Electrical Panels(paragraph 4.2)

DESCRIPTION:

During walkdown inspections, the team found excessive dirt, dust, and debris inside the 600 V, 4.16 kV, and 6.9 Kv switchgear panels and distribution centers. The lack of cleanliness in the switchgear, load centers, and area terminal cabinets was identified as a finding by the licensee's SITA. Discussions with licensee personnel revealed that compartments containing the bus bars have never been cleaned. In addition, the bus bar connections have not been inspected to verify tightness.

Failure to maintain cleanliness appeared to be an interface deficiency between the plant staff IAE group and the Transmission group. IAE was responsible for the control circuits in the switchgear panels. The Transmission group was responsible for the circuit breakers, field connections, and the bus bars. The Transmission group has performed adequate maintenance on the switchgear circuit breakers and protective relay calibration. The IAE group had not performed any preventive maintenance in these areas.

The licensee agreed to accomplish the following to enhance the preventive maintenance program for the switchgear:

1. IAE plans to develop a PM program to inspect and clean the control compartment of the switchgear panels and distribution centers. This inspection will include verifying fuses.

2. The Transmission group plans to develop and perform a PM inspection to inspect the bus bar connectors at least every six year which will also require the panels to be cleaned.

REQUIREMENT:

10 CFR 50, Appendix B, Introduction, Quality Assurance Criteria for Nuclear Power Plants, requires that all safety related equipment be maintained in a condition to ensure performance of its intended function.

SAFETY SIGNIFICANCE:

The presence of dirt, dust, and debris may cause the electrical equipment to fail. Loose connections in bus bars could cause failure to conduct electrical power, and cause hot spots.

FINDING 91-09-06: Fuse Configuration Control Program (paragraph 4.2)

DESCRIPTION:

The licensee's SITA inspection identified configuration control of wiring and fuses as a problem area with electrical panels. The licensee acknowledged this problem and was in the process of taking corrective action. The corrective action included inspection of all electrical panels except switchgear to verify "as built" compliance with design drawings. Since the units are operating at full power, it has not been possible during these inspections to pull and verify all fuses.

At the present time, the licensee's fuse control program consists of fuse sizes and types listed on a Bill of Material drawing. The BM for each electrical panel or piece of equipment lists the correct fuses by size and type. Therefore the BMs are the main fuse control documents. During discussions with maintenance personnel, the team learned no inspection or program was in place to verify the correct fuses in the 600 V, 4.16 kV, and 6.9 kV switchgear panels.

The licensee stated that fuses not verified during the panel inspections would be verified during the outage using work orders for control. Concerning switchgear panels, fuses will be verified during preventive maintenance inspections and cleaning. This will be performed by the IAE group in the Maintenance Department.

REQUIREMENT:

10 CFR 50, Appendix B, Criterion XVI, Corrective Action, states measures shall be established to assure that conditions adverse to quality ... are promptly identified and corrected.

SAFETY SIGNIFICANCE:

Incorrect fuses can cause safety related electrical equipment to fail.

FINDING 91-09-07: Transmission Line Protection (para. 4.2)

DESCRIPTION:

The guy wire anchors for the 230 Kv and 525 kV transmission lines off the main transformer near the turbine buildings are not protected. These anchor guy wires are attached in the ground and to the transmission lines. They are subject to potential damage from vehicles in the area. In addition, the transmission line connections attached to the turbine buildings are not inspected for wear.

The licensee stated appropriate corrective action would be taken. Protective barriers would be installed within one year of this inspection for the guy wire anchors. The transmission group would implement an inspection for the transmission line connections on the turbine building wall.

TECHNICAL REQUIREMENT:

10 CFR 50, Appendix A, Criterions 17 and 18, "Electrical Power Systems" and "Inspection and Testing of Electric Power Systems" addresses design, inspection and testing of the offsite electric power system.

SAFETY SIGNIFICANCE:

Damage could result in loss of the offsite electric power system creating a station blackout.

APPENDIX B

ACRONYMS AND INITIALISMS

A/E	Architect Engineer
BM	Bill of Material
EDG	Emergency Diesel Generator
EDS	Electrical Distrubtion System
EDSFI	Electrical Distribution System Functional Inspection
EPR	Ethylene-Propolene Rubber
FSAR	Final Safety Analysis Report
Hp	Horsepower
HVAC	Heating Ventilation and Air Conditioning
IAE	Instrumention and Electrical
IEEE	Institute of Electrical and Electronics Engineers
kV	Kilovolts
KVA	Kilovolt Amperes
LER	Licensee Event Report
LOCA	Loss of Coolant Accident
MCC	Motor Control Center
MCM	Million Circular Mils (cable sizing)
MES	Mechanical Engineering Section
MVA	Mega volt amperes
NSM	Nuclear Station Modification
PIR	Problem Investigation Report
PRV	Pressure Reducing Valve
PT	Performance Test
PU	Per Unit
SITA	Self Initiated Technical Audit
TS	Technical Specification
V	Volts
VAC	Volts Alternating-current
VDC	Volts Direct-current
XLPE	Cross Linked Polyethylene

APPENDIX C

PERSONS CONTACTED

Licensee Employees

*S. Adams, Director, Corporate Communications
*J. Boyle, IAE Superintendent
*R. Deese, Duke Design Representative
*E. Estep, Station Services Representative
*G. Gilbert, Superintendent Technical Services
*W. Goodman, Quality Assurance Representative
*P. Guill, Nuclear Production Department
*B. Hamilton, Superintendent of Operations
*D. Hance, Engineer, Nuclear Production Department
*J. Hawkins, Design Engineer
*C. Hendrix, Jr., Manager, Maintenance Engineering
K. Leuschner, Transmission Group Supervisor
*K. Louvin, Engineering Supervisor, Maintenance Engineering Section
*J. Lukowski, Operations Representative
*W. Matthews, Design Engineering Representative
*T. McConnel, Station Manager
*D. Murdock, Division Project Manager
*T. Pedesen, Shift Manager
*R. Pierce, Instrumentation and Electrical Section Manager
*N. Pope, Superintendent of Maintenance
*R. Roberts, Performance Representative
*R. Sharpe, Compliance Manager
*K. Singletary, Engineering Assistant, Transmission Department
*F. Tatum, Manager, Plant Maintenance
*B. Taylor, Engineering Manager
*K. Thomas, Engineering Manager
*H. Tucker, Senior Vice President, Nuclear

NRC RESIDENT INSPECTORS

*T. Cooper, Resident Inspector
*P. VanDoorn, Senior Resident Inspector