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LICENSEE: North Atlantic Energy Service Corporation
Post Office Box 300
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FACILITY NAME: Seabrook Station

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Areas Inspected: Announced team inspection by regional and contract personnel to review the functionality of the electrical distribution system.

Results: Refer to the Executive Summary.

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## EXECUTIVE SUMMARY

During the period between April 26 and May 21, 1993, a Nuclear Regulatory Commission (NRC) inspection team conducted an electrical distribution system functional inspection (EDSFI) at the North Atlantic Energy Service Corporation offices and at the Seabrook Station to determine if the electrical distribution system (EDS) was capable of performing its intended safety functions, as designed, installed and configured. A second objective of this inspection was the assessment of the licensee's engineering and technical support activities.

Based upon the sample of calculations, drawings and studies reviewed and plant equipment inspected, the team's conclusion was that the electrical distribution system at Seabrook Station was capable of performing its intended safety functions. However, the team's review identified two areas of concern. The two areas pertain to the questionable cable separation including environmental qualification of protective isolation devices and the adequacy of control air for the emergency diesel generators. The licensee performed preliminary operability reviews and found them acceptable for operation, pending further analyses.

In addition, based upon the sample of documents reviewed and of personnel interviewed, the team concluded that the engineering and technical support were adequate for the safe operation of the plant. The technical support group and corporate engineering organizations were staffed with capable and technically competent personnel. The team considered this as a strength. Communications between the various engineering and technical support organizations were found to be good. Calculations and modifications reviewed were found to be good and, in most cases, presented in a comprehensive manner. In some calculations, conservatism used to justify inadequacies should have been quantified. The self assessment and corrective actions were found to be extensive and capable of identifying areas requiring improvement. This was considered as another strength by the team. The team noted good management involvement and support for identifying and resolving issues for the plant.

The team found the procedures to operate the EDS to be generally of good quality and would assure operability under normal, abnormal and accident conditions. The physical appearance and condition of the electrical equipment were noted to be good during the plant walkdowns. The team found acceptable maintenance and surveillance testing program for EDS and support systems.

As a result of this inspection, two violations of NRC requirements were identified regarding the lack of adequate 10 CFR 50.59 review for a computer alarm modification and lack of adequate design control measures for designing control air for the emergency diesel generators. In addition, eight issues remain unresolved and several other findings were reported as observations.

Further licensee assessment and attention is required to address these unresolved issues, which include: lack of an adequate program for testing all molded case circuit breakers; establishing an adequate emergency diesel generator fuel oil quantity requirement for the seven day operation; establishing adequate heating ventilation and air conditioning calculations for the switchgear room; calculation updates to show acceptable minimum voltages at the component level; lack of adequate setpoints and testing for Elgar inverters; and lack of adequate testing or verification of the fast bus transfer scheme.

A summary of the team's findings is contained in Attachment 1. This attachment also identifies the sections of the report which address the specific issues.

## 1.0 INTRODUCTION

During recent inspections, the Nuclear Regulatory Commission (NRC) staff observed that, at several operating plants, the functionality of safety-related systems had been compromised by design modifications affecting the electrical distribution system (EDS). The observed design deficiencies were attributed, in part, to improper engineering and technical support. Examples of these deficiencies included: unmonitored and uncontrolled load growth on safety-related buses; inadequate review of design modifications; inadequate design calculations; improper testing of electrical equipment; and the use of unqualified commercial grade equipment in safety-related applications.

In view of the above, the NRC initiated electrical distribution system functional inspections (EDSFI). The objectives of these inspections were to assess: (1) the capability of the electrical distribution system power sources and equipment to adequately support the operation of safety-related components and (2) the adequacy of the engineering and technical support in this area.

To achieve the first objective of this inspection, the team reviewed calculations, design documents and test data, paying particular attention to those attributes which ensure that quality power is delivered to those systems and components that are relied upon to remain functional during and following a design basis event. The review covered portions of onsite and offsite power sources and included offsite power grids, transformers, normal and emergency buses, emergency diesel generators, safety-related unit substations and motor control centers, station batteries, battery chargers, inverters, 125 Vdc safety-related buses, 120 Vac vital distribution system and containment electrical penetrations.

The team verified the adequacy of the emergency onsite and offsite power sources for the EDS equipment and mechanical systems which interface with and support the EDS. A physical examination of selected EDS equipment verified their configuration and ratings. In addition, the team reviewed maintenance, calibration and surveillance activities for selected EDS components, and the capabilities and performance of the engineering and technical support organizations in the EDS area.

The inspection considered conformance to the General Design Criteria and other regulatory requirements and to the licensee's commitments contained in applicable portions of the plant Technical Specifications, the Update Final Safety Analysis Report (UFSAR) and the safety evaluation reports. Section 2 of this report provides a general description of the Seabrook electrical systems. The details of the specific areas reviewed, the team's findings and the applicable conclusions are described in Sections 3.1 through 6.10

## 2.0 ELECTRICAL SYSTEMS

Seabrook Station generates power at 25 kV and transmits it to the 345 kV switchyard through the generator step-up (GSU) transformer. The Seabrook Station has a generator circuit breaker which is provided between the main generator and the connections to the GSU transformer and unit auxiliary transformers (UATs). This design allows the EDS to remain energized from the 345 kV system without any bus transfers after a plant trip. There are two possible sources of offsite power for the Seabrook Station. They are: 1) From the 345 kV switchyard, via GSU transformer and UATs and, 2) From the 345 kV switchyard, via reserve auxiliary transformers (RATs).

The 4.16 kV Class 1E system consists of two 4.16 kV buses (E5 and E6). The two emergency buses supply power to the essential loads required during normal operation, abnormal operational transients and accidents. The normal and alternate power for the emergency buses are derived from the unit generator and the offsite source. In the case of a unit trip and loss of offsite power, each emergency bus is powered from its associated emergency diesel generator. The 4.16 kV buses supply the large motors and the power centers, rated at 1000/1333 kVA, which feed the smaller loads at 480 Vac.

Under normal conditions, the non-safety and the safety buses are fed in parallel from the UATs, which derives its power from the main generator. An automatic transfer is initiated in the case of loss of the normal source, by simultaneous closing of the alternate supply breaker from the RATs, through a fast transfer scheme. Restoration of the primary offsite supply is manual, with momentary paralleling of sources.

The 125 Vdc safety system consists of four batteries and chargers. Four dc supplies and a vital ac power supply are provided for the four Class 1E vital 120 Vac systems.

## 3.0 ELECTRICAL DESIGN

To assess the adequacy of Seabrook's electrical design, the team reviewed the features and components of the electrical distribution system. The design was evaluated for compliance with specifications, industry standards, and regulatory requirements and commitments. The documents were reviewed for accuracy and conformance with accepted engineering practices. The scope of the review included drawings, design calculations, and studies associated with the EDS equipment. In addition, procedures and guidelines governing the design and design change process were also reviewed.

### 3.1 Offsite Power and Grid Stability

The characteristics of the electrical grid to which the Seabrook Station is connected were reviewed to assess the adequacy of the important parameters such as the voltage regulation, short circuit contribution, protective relaying, surge protection, controls, stability, and reliability. The transmission grid reliability and availability exhibited acceptable conditions, in accordance with the data reported in the UFSAR, and verified by the team in several meetings with the licensee.

The team noted that the grid normal minimum voltage levels were 345 kV, with a normal scheduled voltage of 357 kV, and a maximum voltage of 362 kV (1.05 p.u.). The emergency low voltage was stated as 336 kV. The licensee stated that the emergency low voltage level would not occur except in improbable circumstances. This was demonstrated by calculations that showed that, under very adverse conditions, the voltage fell to only 343 kV following a unit trip, with high MW transfers. This was found acceptable.

The team verified that there were low voltage and high voltage alarms for the 345 kV system at the load dispatcher's office. The alarm setpoints corresponded with the maximum and minimum voltage levels utilized in the plant voltage regulation study. The on-line alarm points appear on the EMS Chronological Review, printed on a logger, and the paper copies are kept in the control center. The records go back three months plus the current month, but there was no easy way to search this data for a particular alarm. The team felt that retrieval and review of the maximum and minimum experienced voltage alarms at the 345 kV system would enhance the ability to determine the plant offsite source voltage variations over time, which would allow for a better verification of the chosen voltage limits for the plant. Therefore, the team considered that this area of system voltage surveillance was a potential area for improvement.

The team noted that the frequency of exercising (open/close operations) for the 345 kV, SF6 breaker was every 18 months while the manufacturer recommended 6 months to a year. The licensee stated that they will review the maintenance requirements for these breakers.

During the plant walk-down, the team observed that there were no fire walls between the transformers and all of the bus duct connections from the offsite source to the plant. While fire protection was provided, the absence of fire walls was deemed to be a design shortcoming, since multiple bus ducts could be affected by an oil fire from a single transformer fault.

The team concluded that the offsite power supply and the grid stability conditions were adequate and met the GDC 17 requirements.

### 3.2 Electrical Bus Transfer Schemes

The team reviewed the electrical bus transfer schemes to assure that they were designed to prevent failures of connected equipment due to excessive voltage and phase angle.

The team found that the licensee was not performing any periodic testing of the bus fast transfer scheme dead time. The scheme was tested only once, during the plant pre-operational tests. The only subsequent testing was breaker opening and closing time per Procedure MX 0508.01, with acceptance times of 23-35 ms opening and 50-90 ms closing, which allows for a maximum dead time of 67 ms. The maximum allowable time of 67 ms appears adequate; however, the testing of the early "b" contact that initiates the transfer was not included in the periodic testing procedure. The team was concerned that the early "b" contact may fall out of calibration with time, which may prevent the timely initiation of the bus transfer. The effects of postulated failures of the fast transfer scheme are potential damage to the Class 1E connected equipment. To address the above issue, the licensee committed to develop a periodic testing criteria for the bus transfer scheme. This issue is unresolved pending the licensee's establishing adequate test criteria for the bus fast transfer scheme and review of this information by the NRC (50-443/93-80-01).

The team found no evidence that an analysis of the bus fast transfer scheme had been performed for determining the adequacy of transferring sources under varying bus loads and under conditions of system faults. The team noted that while there was a high-speed synchrocheck relay (GE SLJ12A1A) installed to supervise the transfers, it was normally energized and would not prevent an unsuccessful transfer which exceeded the angle setting. The team's concerns relative to the bus transfer were ameliorated by the fact that the plant was provided with a generator breaker, which eliminated the need for fast transfers during a plant trip. The team noted that the probability of fast bus transfer was very small, and no occurrence of a fast bus transfer had been recorded at Seabrook since the plant started operating.

The slow transfer system operated from a 25% residual voltage relay. The team noted that there was no analysis performed to show the voltage profile for a slow transfer, the concern being related to the ability of multiple motors to re-accelerate after the reduction in speed due to the bus voltage decay. Prior to the initiation of the slow transfer scheme, the system design requires an automatic trip of the reactor coolant pumps (RCPs) to reduce the inrush produced by motor re-acceleration. The team noted that pre-operational testing and the last loss of power event had verified the successful operation of the slow transfer scheme. The team had no further questions at this time

### 3.3 Electrical Distribution System Loading

The preferred transformers were reviewed in terms of their kVA capability, their connections to the safety buses, field installation capability, protection, testing and surveillance, and voltage regulation. The 4160 Vac and the 480 Vac safety buses and connected loads were also reviewed to assess load current capabilities, voltage regulation, and the adequacy of cable connections between loads and buses.

The team found that the system loading conditions were adequate to support all plant operating modes.

### 3.4 Voltage Regulation

The team's review of the voltage regulation study showed that the limiting voltage conditions specified for the network were duly incorporated in the study. The study assumed a minimum grid voltage of 345 kV, which was utilized to set the degraded voltage relay (DVR).

The DVRs for bus E5 (worst condition) were reviewed and set as follows:

| | |
|---|---|
| Maximum Reset: | 4004 V (0.9625 p.u. on 4160 V base) |
| Maximum Drop Out: | 3964 V (0.9529 p.u. on 4160 V base) |
| Drop Out Setting: | 3933 V (0.9454 p.u. on 4160 V base) |
| Minimum Drop Out: | 3902 V (0.9380 p.u. on 4160 V base) |

The time delay relay is set to time out in 10 seconds, with an allowable value of 10.96 seconds maximum time delay. Also, the loss of voltage relay (LVR), is set to drop out at 2975 V, with an allowable value of 2908 V, or 0.699 p.u. on 4160 V base.

The licensee had analyzed equipment operation within the operating bands of the low voltage relays. The verification of equipment operation under degraded voltage conditions included a calculation (9763-3-ED-00-66) for contractor control fuse blowing time versus time at degraded voltage when a safety injection (SI) signal was present. The team found that some of the calculations showed a small margin, which would disappear when tolerances such as fuse curve tolerances and ambient temperature effects were included. Subsequent to the inspection, the licensee re-examined the calculations including the fuse tolerances, temperature effects and the conservatism included in the assumptions, and was able to show that the fuses would perform adequately.

While a verification of fuse blowing versus time at degraded voltage was performed for the case of an SI signal present, no such verification was performed for the case when an SI signal was not present. Under these conditions, it could be possible for the degraded voltage to persist for a much longer period of time, such that blowing of fuses could be a high probability. However, the licensee indicated that the justification of equipment operation under these conditions was provided in the licensing documents which showed that the standby equipment will be available for shutdown purposes. Since the equipment on standby will not be subjected to a degraded voltage, the licensee had concluded that it would not be damaged. Subsequent to the inspection, the licensee performed an additional review for the loads that could be subjected to low voltage under the absence of an SI signal and found that the safety of the plant would not be compromised.

The team found that all safety-related buses and motors receive more than 90% of rated voltage during plant full load operation, with minimum anticipated grid voltage. A slight overvoltage may occur at light load conditions, with maximum grid voltage, but it was too small to be considered important to create any concerns.

The voltage study also showed that under simultaneous motor starting conditions, when either the UAT or the RAT is the source, the minimum motor terminal voltage would be 79.1% for the worst case load situation for two motors, which is below the acceptable limit of 80%. However, the licensee verified the affected two motors would start successfully.

The team noted that the loading calculations assumed that the UATs would be the preferred source of power and would never run at light load. However, the operating procedures failed to identify the UATs as the preferred source. During the inspection, the licensee initiated a station operating procedure change (Procedure OS1046.05, Rev. 04, Change 02, dated 5-14-93) to correct this problem.

In analyzing the voltage dip at vital inverters, the team was unable to readily find the relevant voltage levels from the voltage regulation study. The licensee explained that the "DAPPER" program version utilized for Seabrook has a limitation on the number of buses that can be analyzed (maximum 300 buses), which does not allow for calculation of voltages at all bus levels. The licensee performed a separate hand calculation to respond to the team's question on the vital buses voltage. The licensee stated that the main calculation (9763-3-ED-00-02-F) will be revised to reflect this information.

## 3.5 AC Short Circuit Study

### 3.5.1 Medium Voltage System

Calculation 9763-3-ED01F, Revision 6, was reviewed to determine the short circuit currents at the 13.8 kV and 4.16 kV levels. The calculation used computer software called A-FAULT Version 3.5, developed by SKM Systems Analysis Inc. and the method of calculation was in accordance with ANSI C37.010-1979 for medium voltage switchgear. All calculated short circuit currents for momentary and symmetrical ratings for medium voltage switchgear were within the ratings of the switchgear used at the site. The lowest margins were 2.56% and 20% for the interrupting and close and latch ratings of the 13.8 kV breakers and 4.9% and 5.4% for the corresponding ratings of the 4.16 kV switchgear. The team noted that the assumptions used in the calculation were reasonable.

The team checked the coordination of relays and circuit breakers for the safety related and part of the non-safety related portion of the AC system, for which calculation 9763-3-ED23F Rev. 4 had been prepared. Motor and transformer loads supplied by the 13.8 kV bus 1 and 4.16 kV buses 3 and E5 were examined. All coordination curves proved to be satisfactory. Cables to the various loads, and between buses and transformers, were found to be adequately sized for overcurrent conditions.

Ground fault protective devices were provided for the 13.8 kV and 4.16 kV systems. For load feeders at the 13.8 kV and 4.16 kV levels, core balance transformers and relays were set to trip at ground currents of 10 and 5 amperes, respectively. For 4.16 kV bus protection, three single phase transformers connected in a star/open delta arrangement provided a high resistance grounded system. The ground detection relay in the secondary provided an alarm at a ground fault current of 8.5 amperes. The team considered these systems to be satisfactory.

### 3.5.2 480 Vac System

The values of short circuit currents in the 480 Vac system were derived by first assuming a limiting current of 25 kA r.m.s. symmetrical, and then calculating the corresponding percentage reactance of each transformer supplying the load center or MCC bus. The team reviewed Calculation 9763-3-ED9F, Revision 2, which showed the values of reactance and withstand capabilities of buses and breakers. The 480 Vac bus/structure had a withstand capability of 50 kA r.m.s. with the breakers having a minimum interrupting rating of 30 kA, whereas the corresponding figures for the MCC's were 42 kA and 25 kA rms, respectively. The team checked this calculation and found it to be satisfactory.

The team reviewed calculations 9763-3-ED31F Rev. 2 and 9763-3-ED9F Rev. 2, which contained information regarding the coordination and short circuit current levels for the safety related 480 Vac system. The type of protection for the safety loads was reviewed, and the relay and circuit breaker setpoints examined, and were found to be satisfactory. The 480 Vac system is high resistance grounded using three instrument transformers connected in a grounded star/open delta arrangement with a voltage relay at the minimum setting of 7.7%. The team found the ground detection circuits to be acceptable.

## 3.6 Emergency Diesel Generator Loading

Emergency diesel generator (EDG) loading was reviewed to ensure that load growth was adequately controlled and that the EDGs were capable of starting and carrying the required loads during normal, abnormal, and accident conditions. The Seabrook installation consists of two, 6083 kW emergency diesel generator units.

The team reviewed calculation 9763-3-ED-00-83-F, "Diesel Generator Loading," Revision 2, dated May 3, 1993. Based on a review of the loads selected, the loading was found to be within the capability of the EDGs. The licensee had demonstrated in their calculation that the EDGs can start and run the projected loads during normal, abnormal and accident conditions. The team noted that licensee verifies the results of this calculation during the eighteen-month surveillance testing.

The team also reviewed calculation 9763-3-ED-00-02-F, "Voltage Regulation," Revision 5, dated April 19, 1993, to determine the adequacy of the voltage available at the load terminal. The team noted that the licensee had demonstrated that all the loads would start and run at the calculated voltage values. The voltage regulation for the loads reviewed was found to be acceptable.

The team concluded that based on the data presented during the inspection, the rating of the EDGs was adequate for all the design basis load combinations.

## 3.7 Emergency Diesel Generator Protection

The team reviewed the EDG protection to ensure that EDGs were adequately protected during normal operation and that their availability was not compromised by the protection schemes during abnormal accident conditions.

The EDGs use a combination of protection schemes to assure protection from operational transients during both the normal testing and the expected emergency events. These schemes, except engine overspeed, generator differential current, and two out of three low lubrication oil pressure, are bypassed if a safety injection signal is present. Normal operation includes the expected trips for both the engine and the electrical part of the machine. The team reviewed the protection schemes and based on the surveillance test observed during the inspection, the team determined that the protection and protection bypass provisions for the EDGs were adequate.

### 3.8 Electrical Penetration Sizing and Protection

The sizing and protection of the containment electrical penetrations were reviewed, which were fabricated by the Westinghouse Corporation, to ensure that their thermal and mechanical force limits would not be exceeded for worst-case circuit faults. The team's review included the containment electrical specification and sizing calculation 9763-3-ED19F, Revision 5. The team concluded that the penetrations were adequate to withstand the thermal effects of a short circuit current and that the penetrations would not incur mechanical damage from the effects of short circuit currents flowing in the penetration conductors.

A sample review of the protection coordination used for the medium voltage and low voltage ac circuits and dc circuits indicated that the primary and backup protective devices had been selected and set correctly. Based upon the above review, the team concluded that the electrical penetrations had been properly sized and protected.

### 3.9 Electrical Separation and Isolation

The team reviewed the electrical separation criteria used by the licensee for safety and non safety-related cables to verify the physical independence of redundant systems and the capability of the electrical distribution system to support the required accident loads in the presence of a single failure.

The UFSAR showed that the Seabrook cable tray system used only the four safety-related cable separation groups (channels) typically found at nuclear stations. For the non safety-related circuits whether originating on the Class-1E or non-Class 1E buses the licensee opted to associate them with the safety-related Class 1E circuits, in accordance with the provisions of sections 4.5(1) and 4.6.1 of IEEE Standard 384-1974 and position C4 of Regulatory Guide (RG) 1.75, Revision 2. The licensee indicated that the design with four instead of five separation groups was adopted to ensure maximum separation between safety-related cables. The Seabrook separation criteria are described in detail in section 8.3.1.4 and Appendix 8A of the UFSAR.

IEEE Standard 384-1974 defines associated circuits as "Non-Class 1E circuits that share power supplies, enclosures, or raceways with Class 1E circuits or are not physically separated from Class 1E circuits by acceptable distance or barriers." Section 4.5(1) of the standard requires, in part, that the associated circuits "remain with or be separated the same as those Class 1E circuits with which they are associated." RG 1.97,which, clarifies the requirement states that "associated circuits installed in accordance with 4.5(1) should be subject to all requirements placed on Class 1E circuits such as cable derating, environmental qualification, flame retardance, splicing restrictions, and raceway fill unless it can be demonstrated that the absence of such requirements could not significantly reduce the availability of the Class 1E circuits."

During the plant licensing phase, the NRC reviewed the Seabrook design but expressed concerns regarding potential interaction between safety and non safety-related circuits. However, the licensee's response to specific issues confirmed the general acceptability of the design which was approved by the NRC in supplement 4 of the safety evaluation report (SER). In discussing the statements of the UFSAR, section 8.3.3.3.1 of the SER states that "the treatment of the non-Class 1E circuits as associated is interpreted by the staff to mean that the non-Class 1E circuits at Seabrook meet the requirements placed on Class 1E circuits, except for the items... for which the applicant has demonstrated that the absence of such requirements will not significantly reduce the availability of the Class 1E circuits." The NRC approval of the design was primarily based on the assumptions that: (1) given the failure of the non-Class 1E loads, the circuit protective devices would operate to remove power from the circuits; (2) the protective devices were of identical design and met equivalent requirements of Class 1E circuit protective devices; and (3) non-Class 1E protective devices would be periodically inspected approximately every five years.

The licensee's implementation of the separation criteria was found to be generally acceptable. However, because acceptability of the associated circuit concept is predicated on the capability of the protective device to perform its tripping function, the team asked the licensee whether any breakers were located in a harsh environment and for the periodic testing program of all breakers.

It was the licensee's belief that all breakers were located in mild environment. However, further evaluation determined that two panels, 1-PP-8A and 1-PP-8B, were located inside primary containment. The licensee also determined that, although the circuits were non safety-related, their post-accident availability was desirable. As a result of the discovery, the licensee initiated an operability determination of the circuit breakers involved. The evaluation concluded that there was reasonable expectation that the circuit breakers would function in the expected harsh environment. The conclusion was based on analysis of critical breaker materials and an understanding that breakers tend to operate faster in a high temperature environment. At the same time, the licensee took steps to initiate qualification of the breakers by test. The licensee also indicated that the tests would address long-term effects of the post-accident relative humidity on the breakers operation.

In conjunction with this review, the licensee also identified several non safety-related circuit protective devices which had been purchased as commercial grade components and, therefore, not identical to the Class 1E devices for which approval had been granted by the NRC SER. In addition, the licensee found a number of circuit breakers which had not undergone testing as assumed by the SER. To address these issues, the licensee initiated replacement of the commercial grade components with equivalent Class 1E ones and performed maintenance testing on all breakers for which maintenance had been missed.

The team found the licensee's preliminary analysis for the breakers inside containment acceptable and the decision to perform qualification testing reasonable. Also acceptable were the corrective actions to address the commercial grade components and the testing of the breakers. However, the licensee's use of the following requires further justification: (1) non environmentally-qualified circuit breakers inside containment; (2) commercial grade components in associated circuits without appropriate qualification or dedication; and (3) circuit breakers for which qualification was not demonstrated by periodic testing in accordance with the SER. This item is unresolved pending the licensee's review to ensure that the procurement, environmental qualification and maintenance testing of several associated circuit protective devices were in accordance with the UFSAR commitments and the SER bases to assure proper electrical separation (50-443/93-80-02).

Regarding periodic maintenance testing of circuit protective devices, the SER indicated that this would be accomplished later. Testing of safety-related components to ensure the capability and readiness to perform their safety function is required by 10 CFR50, Appendix B. At the time of the inspection, the team determined that, although the trip characteristics of circuit breakers specified in the Technical Specifications, i.e., containment electrical penetration protection and electrical isolation breakers, were periodically tested, those of the other breakers were not. Also, it was not clear what commitments had been made by the licensee regarding trip testing of the non safety-related circuit breakers. The licensee agreed that they would evaluate testing requirements for all breakers and develop a testing program which would encompass vendor recommendations as well as regulatory requirements. This item is unresolved pending completion of this effort by the licensee and review by the NRC (50-443/93-80-03).

### 3.10 Equipment Ratings

The offsite system, and the onsite ac distribution system down to the 480 V loads, were reviewed in terms of the capability of continuous loading, as well as peak loading conditions. The "DAPPER" program was utilized for load data base management. The team noted that sufficient margin existed between the equipment ratings and the maximum anticipated loading conditions.

For all medium voltage motors, the running load was determined based on brake horsepower (BHP) requirements of the load. BHP values were determined from load flow versus BHP curves. For all low voltage (460 V) motors the running load was determined on BHP, when available, or on rated HP. All loading conditions were displayed in the computer output report included in calculation 9763-3-ED-00-02-F.

No unacceptable conditions were noted during this review.

### 3.11 Load Growth Control

Load Growth Control was exercised by the completion of checklists which are required to be attached to every modification package. EDP Form 30040C, item 5, includes these requirements by requiring verification of "Bus loading including diesel generators and associated fuel oil calculation, batteries, transformers and inverters." EDP Form 30040C is required to have the preparer's and the checker's signatures.

The review of modification packages showed that the licensee had good load growth control.

### 3.12 120 Vac Class 1E System

The 120 Vac Vital system provides reliable, regulated power for essential instrumentation loads, and also for some non essential instrumentation and control of loads requiring regulated power. The system is subdivided into a train A and train B arrangement, with train A, for example, comprising two class 1E, 7.5kVA uninterruptible power supplies (UPS) (1-1A and 1-1C) each supplied normally from a separate safety-related motor control center (MCC), with back-up power from the class 1E, 125 Vdc system buses Bus-11A and Bus 11-C, respectively. The UPS output at a nominal 118 Vac, single phase, 60Hz, each form part of the channelized power supplies for vital loads. In addition, one class 1E, 25 kVA UPS per train, supplied in a similar manner from class 1E, 460 Vac, 3 phase MCC buses and Class 1E, 125 Vdc supplies, is used for other vital and non-vital instrumentation. For these UPS, the 120 Vac single phase outputs are connected to vital buses through static transfer switches, which are supplied alternatively from non class 1E, MCC buses. A static transfer switch monitors the output of the UPS and automatically transfers to the alternate source of power on failure of the UPS, provided the back-up source has the correct voltage and phase angle values. A similar set of equipment is used for the train B arrangement.

The team reviewed the Westinghouse 7.5 kVA UPS specification, noting that the input voltage range is 372.5- 496.7 Vac, and 105-140 Vdc to provide a regulated output of 118 Vac $\pm$ 2%, which is not sensitive to load current. The design is such that the transformed, rectified ac is the preferred source voltage to the inverter portion of the UPS, but the dc input source will take over instantaneously if this voltage is greater than that from the ac supply. For the Elgar 25 kVA UPS, the input voltage range is 460 Vac+10%,-20% for 5 seconds, 101-140 Vdc, to provide a regulated output of 120 Vac $\pm$ 2%, which is not sensitive to load current values. The transfer from ac to dc input voltage sources is instantaneous if the transformed, rectified ac voltage falls below the dc input voltage. In addition, a solid-state static transfer switch controls the oscillator frequency of the inverter to that of the standby supply, such that a transfer to the alternate source will be made without large disturbances.

The team reviewed calculation 9763-3-ED68F, Revision 1, which considered the short circuit currents potentially available within the 120 Vac system and the coordination between various panel circuit breakers and the UPS equipment. The coordination of circuits and trip setpoints for various components reviewed were found to be adequate. When the supplies to the vital instrument buses are switched from the UPS to the non-class 1E maintenance supplies, the potential values of current increase. The team checked that the interrupting capacity of the breakers was adequate, but noted that coordination was lost at the higher available short-circuit currents. However, since the loads are being supplied from a non safety-related supply only during maintenance and shutdown condition, the team did not have any concerns regarding this condition.

The team reviewed voltage drop calculation 9763-3-ED66F, Revision 1, for the 120 Vac system. The method of calculation used conductor temperatures of 75 C and considered circuits with the highest resistance and load currents. However, the team noted that the source voltages were not always considered at their lowest regulated values of 118 Vac-2% for the 7.5 kVA UPS and 120 Vac-2% for the 25 kVA UPS, creating doubts that there would be adequate voltage under all conditions of ac and dc input voltage.

In response to the team's concern, the licensee re-evaluated the calculation with minimum regulated output source voltages, and demonstrated that all loads could be successfully energized. The team noted that the equipment specification requirement of 105 Vdc for the 7.5 kVA UPS was inconsistent with the required minimum battery voltage of 105 Vdc, due to the voltage drop in the supply cable. The licensee performed a load test on a spare 7.5 kVA UPS in which the dc input voltage was reduced to a value of 103 Vdc, corresponding to a battery terminal voltage of 105 Vdc. At this input voltage, the UPS output voltage was within the allowable tolerance. A further concern of the team was that the 25 kVA Elgar UPS was found to have a trip setting of 104.4 Vdc, measured at an internal bus supplying the inverter portion of the UPS. This internal trip, which is adjustable, shuts down the SCR firing circuits of the inverter. There is no procedure covering the setting of this trip and the setting of the other UPS was unknown. The net result is that the UPS cannot sustain an input voltage of 103 Vdc as required. For further discussion, refer to Section 5.2.2.

The team also reviewed ground detection for the 120 Vac system. The vital buses are ungrounded, and ground faults are monitored by an ac ground detection system for each bus, comprised of two voltmeter relays, a milliammeter and resistors, and capacitors. Calculation 9763-3-ED34F provides a basis for the circuit and derives values for the components. A ground fault resistance of up to 6 kilohms is alarmed locally and by the station computer. The ground detection scheme was acceptable.

### 3.13 125 Vdc Class 1E System

The 125 Vdc, class 1E system provides a source of reliable class 1E power for all safety-related emergency control, instrumentation and power loads. The 125 Vdc system is comprised of four main battery systems numbered 11A, 11B, 11C, and 11D, separated into a train A/train B arrangement, with 11A and 11C forming train A, and 11B and 11D forming train B. Each battery system is comprised of a 125 Vdc switchgear assembly, one battery charger, and one to four DC distribution panels. A spare charger is also available to support the operation of either battery of a train, if required. A ground detection scheme is supplied with local and control room indication to detect fault conditions.

The team considered the consequences of short circuit currents in the various battery systems with the objective of determining the adequacy of protective equipment in handling this type of event from a fault interruption and a coordination point of view. In addition, the adequacy of the main board busses to withstand damage was also reviewed.

The team reviewed calculation 9763-3-ED43F, Rev. 3, to determine the short circuit levels and interrupting rating of breakers. In general, the review concluded that the available short circuit current was well within the interrupting rating of the breakers except for panel breakers in power panel PP-111B. The team noted that a short circuit at the distribution panel PP-111B would produce a calculated short circuit current of 10.5 kA, compared with an input breaker rating of 10 kA. The licensee provided a test report for this breaker tested in accordance with National Electrical Manufacturers Association (NEMA) standard AB-1 to a potential current of 15 kA. The team had no further concerns.

The team also reviewed calculation 9763-3-ED44F sh the coordination of various fuses and circuit breakers at the main buses and down to the individual distribution panels. Proper coordination was not achieved for short circuits occurring at the main switchgear bus. At the value of short circuit current potentially available at the bus, it is probable that the main battery fuse will clear the fault before the breaker on the shorted feeder will have time to operate. Thus all supply lines to the various loads will be lost for the affected train. The licensee's justification for the acceptance of this condition was that the design is still single failure proof for the Class 1E loads. A similar lack of coordination was also found for the supply to the non-class 1E load UPS-E-1-2A from DC bus 11C. In this case, the licensee's argument for the acceptance of this condition was the single failure criterion for the length of cable carried in the safety-related structure, and showed that a short circuit at the boundary point between the safety and non safety-related structures would give a smaller short circuit current, for which adequate coordination exists. The team noted that for these cases there was no safety concern.

A similar lack of coordination was apparent between the feeder breaker to the non-class 1E load UPS-E-1-2A and the main supply breaker from battery B-1A when buses 11A and 11C were both supplied from B-1A. In this case, overlap of the breaker tripping curves occurred at lower currents where the above argument cannot be used. During the inspection, the licensee issued a modification (MMOD93-0531) to change the long-time setpoint of the breaker to an intermediate time band, thus providing adequate coordination. This change was implemented on May 6, 1993, and the team considered that this change resolved the issue of coordination between the non-1E load and the 1E supply.

For the dc distribution panels PP-112A and PP-112B supplied from dc switchgear buses 11A and 11B, respectively, a short circuit close to the feeder breakers will trip the supply breaker, since both breakers have instantaneous settings. While the team considered that a lack of coordination was not desirable, the final view was that it did not represent a safety hazard.

The team checked calculation 9763-3-ED14F in which the sizing of the main plant class 1E batteries was developed. The calculation uses the method of sizing batteries described in IEEE 485-1983, and includes a temperature correction factor of 1.11 (60°F), and an aging factor of 1.25. The team checked that the load profile used for the battery surveillance test bounded the profile used in the calculation for battery sizing and that the UFSAR load profiles were consistent with those used in the calculation. The battery sizing was found to be adequate.

For the battery chargers, the method given in IEEE 946-1985 was used in calculation 9763-3-ED14F, resulting in a requirement for a 150 Amperes charger. The calculation showed that one charger was sufficient to recharge the battery in a time of less than 12 hours. The team had no concern in the sizing and selection of the battery chargers.

Calculation 9763-3-ED66F, Revision 1, determined the minimum voltages at the loads on the 125 Vdc class 1E battery systems. The calculation considered both battery systems, and used conservative assumptions such as conductor temperatures of 75°C, and full load conditions at the inverters. The calculation, however, considered minimum voltages of 105 Vdc at the distribution panels in calculating minimum load voltages. In accordance with the commitments made in the UFSAR, the voltage at the battery has a minimum voltage of 105 Vdc which made it incompatible with the assumption made in the calculation. During the inspection, the licensee recalculated load voltages assuming a voltage of 105 Vdc at the battery. The team noted that the calculation had to be updated to show the minimum voltages at the loads. This issue is unresolved pending the licensee revising the voltage profile calculation showing the acceptable voltages assuming 105 Vdc at the battery and review of this information by the NRC (50-443/93-80-05).

The team reviewed the licensee's dc ground detection system. Each class 1E battery system employs a ground detection system, comprised principally of a dc milliammeter acting as a detector, and zener diodes and resistors forming two arms of a Wheatstone bridge. The other arms of the bridge are the resistances to ground of the positive and negative poles of the battery supply. The milliammeter is set to alarm at a current of 5 milliamperes which corresponds with a ground fault resistance of approximately 3.1 Kilohms. The team found the design acceptable.

### 3.14 Conclusions

The team's review of the design attributes within the scope of this inspection concluded that, with the exception of the specific findings noted above, the EDS components were adequately sized and configured and no safety concerns existed. However, one area was of particular concern to the team. This was regarding the questionable electrical separation between 1E and non-1E systems and qualification and testing of isolation devices. The team identified other areas which needed further evaluation by the licensee. These areas include: (1) testing and validation of fast bus transfer scheme (2) update dc voltage profile calculation to show the minimum voltage requirement for components. Several observations that could improve the functionality of the EDS were also identified by the team.

## 4.0 MECHANICAL SYSTEMS

To verify the loading on the emergency diesel generators, the team reviewed the power demands of major loads (selected pumps and fans) and the translation of mechanical into electrical loads used as input into the design basis calculations. To determine the ability of the mechanical systems to support the operation of the EDGs during a postulated design basis accident, the team reviewed sample documentation and conducted walkdowns of the diesel generator fuel storage and transfer, starting air, lubrication, cooling water, combustion air intake and exhaust systems, and the service water system. The team also reviewed the heating, ventilation and air conditioning (HVAC) systems that ensure adequate operating environment for the safety related equipment in the diesel generator building, the emergency switchgear rooms, the cable spreading room, and the emergency battery rooms.

### 4.1 Power Demand for Major Loads

The team reviewed system calculations, site test data, manufacturer's pump performance curves and motor efficiencies for the major pumps and the cooling tower fans to determine the power demand on the emergency diesel generators under various accident scenarios. Motor power requirements were found to be acceptable, and the total loads were found to be well within the capabilities of the diesel generators.

### 4.2 Diesel Generator & Auxiliary Systems

The Seabrook EDG design consists of two Colt-Pielstick, PC2.3 sixteen cylinder engine-generator units rated at 6083 kW continuous and 6697 kW for seven days. Each unit consists of an engine, a generator and associate controls and support systems. The engine is a "V" type four-stroke, turbocharged, sixteen cylinder diesel engine. The generator consists of a three-phase, wye-connected, impedance-grounded, synchronous generator, and its associated voltage regulator and static, solid-state exciter.

#### 4.2.1 Emergency Diesel Generator Fuel Oil Storage and Transfer System

The team reviewed EDG fuel oil storage and transfer system documentation and calculations and conducted system walkdowns to determine whether adequate fuel oil would be available to the EDGs for the period indicated in the Technical Specification (TS).

Each EDG has a 76,000-gallon fuel oil storage tank and a transfer system consisting of a transfer pump and interconnecting piping that supplies a 1500-gallon day tank. An engine-driven (or auxiliary electric motor driven) fuel oil pump transfers fuel oil from the day tank via filters and strainers to engine driven injectors that supply a metered amount into each cylinder at the correct time.

A review of calculation C-S-1-E-0161, Revision 2, showed that the TS minimum quantity of fuel oil (60,000 gallons) in the fuel oil storage tank exceeded the seven day quantity required for diesel generator "A", the most heavily loaded by only 100 gallons. During the inspection the licensee provided a summary of revised calculations which showed that there was a larger margin, based on reduced conservatism in load calculations. However, the team had concerns regarding the specific fuel consumption rate on which the above sets of calculations were based. The rate used was 0.371 lb/bhp-hr., and was taken from the diesel engine manufacturer's (Colt) data sheet for this model of engine. This value was dependent on several parameters such as heating values of fuel, outside air temperature, coolant temperature, number of engine driven pumps running and amount of load on the engine. It was noted that the manufacturer's shop tests of the licensee's diesel engines registered higher consumption rates, perhaps due to the newness of the engines. Conversely, informal in-house tests by the licensee showed lower consumption rates. However, the licensee had not performed any controlled tests to determine the actual fuel consumption rates of diesel generators "A" and "B" at various loads to support the fuel consumption rate used in their calculations. The team noted that the licensee had not considered any fuel leakage in the system for the fuel consumption calculation. A total leakage of 0.6 gallons per minute could use up the 10% margin suggested in R.G.1.137.

The team was also concerned about existing controls to confirm the adequacy of the TS minimum fuel oil quantity if changes occur in the future. There was no system in place to detect and evaluate the impact on diesel engine fuel oil consumption rates of such things as engine overhaul, leakage rate changes, engine aging and engine performance changes. Because of the number of uncertainties in the calculation, and because of the very small margin presented in the calculation, the calculated minimum fuel oil quantity requirement may not be adequate to meet the seven-day TS requirement. This issue is unresolved pending the licensee establishing an adequate calculation to determine the minimum fuel oil quantity for seven-day operation assuming diesel fuel leakage and normal performance degradation. Also, implementing an on-going program to control and monitor future load changes and performance changes (50-443-93-80-06).

The team noted that the Seabrook Station EDGs use a dirty oil collection system that collects fuel oil leakage from the fuel injectors and lubricating oil that leaks past the tappet housing oil control rings and drains it directly back to the main fuel oil tank. The licensee found that this oil would contaminate the main fuel oil above the TS limit.

To address the above problem, the licensee installed a forty gallon tank in the return line. This tank was designed to catch the dirty oil from the normal surveillance testing. The tank was designed with an overflow system such that when it was full, it will overflow to the main tank. The team asked if the tank overflow would occur during the seven day run. The licensee stated that a regular reading of oil level in the holding tank is taken by the operator during and following an EDG operation. Appropriate actions are taken in accordance with procedure RTS -1DG-MM-794A-M1 to drain the tank if the level was above five-eighths of the tank to prevent any possible overflow. The team noted that the procedure did not have a time requirement for draining the tank to prevent any overflow to the main tank.

Furthermore, the tank installation modification did not require the level gauge to be seismically qualified and no maintenance or calibration requirements were specified for the gauge. Subsequent to the inspection, the licensee provided information which showed that the level gauge was designed specifically for use in equipment exposed to high impact loading and the gauges will function properly following a seismic event.

### 4.2.2 Emergency Diesel Generator Starting Air System

The team reviewed the EDG starting air system documentation and conducted walkdowns to evaluate the adequacy of the system. The air start subsystem provides not only the motive force to start the engine, but also supplies the air-operated coolant temperature control valves for the EDG engine. Each EDG has an independent starting air system capable of starting the EDG five times. It consists of a skid-mounted air compressor, dryer, and two air-receiver storage tanks that supply air to an engine-mounted air-over-piston starting system with separate starting air distributor for each bank of cylinders and associated power, control and instrumentation circuits.

The design of the final check valves, receiver air storage tank, and associated piping and fittings meets ASME section III requirements and was seismically qualified. The compressor motor, which is a non Class 1E load, receives its power from a Class 1E bus that uses Class 1E equipment and breakers. The team noted that the licensee was relying on the compressed air supply after the engine was running. The licensee's design of the air start subsystem does not include seismically qualified components before the isolation (code) check valve. The licensee's UFSAR, Section 9.5.6.3, states that it is acceptable for the air start system not to supply air after the engine starts. The licensee assumed that the coolant valves failing in the open direction without air would assure that the engine would receive maximum cooling and that this would not cause any damage. The team questioned this assumption. The licensee had failed to fully evaluate the impact of excess cooling on the engine. In response to the team's question, the licensee contacted the vendor to see whether this design was acceptable. The vendor stated that if the valves failed open, damage to the engine could occur.

During the inspection, the licensee was reviewing their design to see if the air start subsystem ahead of the isolation check valve could be qualified as seismic. They were also reviewing their design basis to see if the original design intended the whole subsystem to be seismically qualified. The licensee performed an operability determination and concluded that adequate assurance existed for the components to perform their safety function in the event of an accident. The licensee also stated that portable gas bottles and temporary cross-connection of the air system to operate one diesel for seven days could be considered if necessary to prevent full opening of the control valves.

The team noted that the basic EDG design does require that the air operated valves to function for the full seven day post-accident operation. The failure of the design review to identify that the control valve failure (in the event of the loss of control air) was inadequate and is a violation of 10 CFR 50, Appendix B, Criterion III, Design Control (50-443/93-80-07).

During the plant walkdown, the team noted that the air start subsystem used threaded union couplings to connect the various piping and components on the air start skid. The licensee stated that ASME code ND-3671.3, "Threaded Joints," allows threaded joints in which the sealing surface was not the thread. They based this on the statement that "Threads other than taper pipe threads may be used for piping components where the tightness of the joint depends on a seal weld or a seating surface other than the threads and when experience or test (ND-3649) has demonstrated that such threads are suitable." The team noted that ND-3671.3 (b) states that "Threaded joints shall not be used when severe erosion, crevice corrosion, shock, or vibration is expected to occur." The team asked if this installation was acceptable since the piping and joints see the running vibration loads and seismic loads associated with the skid.

The team also noted that while the tanks and fittings are seismically qualified by the vendor, the threaded couplings did not have any torque requirements associated with them. This is necessary to assure that the seismic qualification would be maintained after any maintenance action that would unfasten the couplings. This issue is unresolved pending a detailed evaluation of the acceptability of the threaded coupling used in vibration and shock area, incorporating torque requirements for threaded fittings in licensee's applicable procedures, and further review by the NRC (50-443-93/80-08).

### 4.2.3 Emergency Diesel Generator Cooling Water System

The team reviewed the EDG cooling water system documentation and conducted walkdowns to assess the adequacy of this system. Each EDG has an independent closed-circuit cooling water system which circulates demineralized cooling water to the EDG components requiring cooling. Heat is transferred to the service water system via the diesel generator component cooling water heat exchanger.

It was noted that control of the EDG cooling, particularly the jacket water cooling and intercooler cooling, would be affected on loss of supply air. The control valves would fail to their maximum cooling position, which might result in degraded diesel operation or even damage to the diesel. Hence, resolution of the air supply concerns discussed in Section 4.2.2 above is required to ensure proper EDG cooling.

### 4.2.4 Emergency Diesel Generator Lubrication System

The team reviewed the EDG lubrication system documentation and conducted walkdowns of the system to assess its adequacy.

The lubrication system recirculates the oil and maintains it at the desired temperature by an electric heating unit or by cooling via the lube oil heat exchanger, which transfers heat to the EDG cooling water system. The team did not identify any unacceptable conditions during the review.

## 4.3 Class 1E Heating Ventilation and Air Conditioning (HVAC)

The team reviewed documentation, calculations, and conducted walkdowns of the HVAC of the EDG rooms, emergency switchgear rooms and emergency battery rooms to assess their adequacy.

It was noted that calculations 6.01.47.03, Revision 0, and 6.01.42.04, Revision 0, for heating loads in Class 1E HVAC areas at extreme minimum temperature had not been kept up to date. The licensee provided marked up copies showing updates, and indicated their intention to revise these documents.

### 4.3.1 Emergency Diesel Generator Rooms

The HVAC of the main EDG rooms consists of two independent sets of supply and exhaust air fans and associated ducts and dampers for the two EDGs. The team found the system to be adequate. It was noted that Section 9.4.8.1 of the UFSAR, describing the design basis of the EDG rooms HVAC, uses the ambiguous term "nonseismic category 1" in describing its seismic qualification. The licensee had agreed to clarify the wording at the next revision of the UFSAR.

### 4.3.2 Emergency Switchgear Rooms

The emergency switchgear room HVAC consists of two sets of supply and exhaust fans, ducts and dampers for the two (train A and B) rooms. Normally, emergency switchgear room 'A' receives cooling flow from the train 'A' and train 'B' supply fans, to maintain its temperature below the 104°F Technical Specification limit. Calculation 6.01.42.01, Revision 6, did not consider the case of loss of the train 'B' supply fan following a reactor trip and possible loss of offsite power. This would eliminate cooling flow from that fan to room 'A' and could cause some of the train 'A' supply flow to be redirected from train 'A' to the train 'B' battery rooms. Based on assumed flow realignments and reductions in heating loads, preliminary calculations done by the licensee during the inspection showed that cooling of switchgear room 'A' would be adequate for this case. This issue is unresolved pending the licensee completing the calculations to show the acceptability of HVAC for switchgear rooms for a worst case loading condition and further review by the NRC (50-443/93-80-09).

### 4.3.3 Emergency Battery Rooms

HVAC for each train (A and B) of emergency battery rooms is supplied air by the associated emergency switchgear room supply fan, while exhausting is provided by dedicated battery room exhaust fans. The team's review determined that the HVAC condition of these rooms was acceptable.

### 4.4 Service Water

The team reviewed documentation and conducted walkdowns of the service water system to determine whether adequate cooling water was available to the diesel generator component cooling water heat exchangers. The system consists of two independent, normally operating, trains drawing seawater from the Atlantic Ocean, backed up by two independent, normally secured, mechanical draft cooling tower trains. The latter is used in case of a possible blockage of the non seismically-qualified seawater inlet and outlet tunnels during a seismic event. Provisions for cooling tower startup, water make-up, and de-icing were also reviewed. Both subsystems, together, were judged to be adequate to perform their intended safety function.

### 4.5 Conclusions

The team concluded that the design of the mechanical systems supporting the EDS was generally adequate. However, the team identified concerns in the areas of EDG fuel oil quantity requirement, qualification of the air start system for EDGs and switchgear HVAC conditions.

The team considered the licensee's mechanical engineering staff technically competent and knowledgeable of the mechanical supporting systems.

## 5.0 EQUIPMENT OPERATION, MAINTENANCE, AND TESTING

The scope of this inspection was to assess the effectiveness of the controls established by the licensee to ensure that the design bases for the electrical distribution system are maintained. This effort was accomplished by physical inspection of the electrical equipment that verified that the as-built configuration corresponded to that specified in the applicable documents. In addition, the maintenance and test programs developed for electrical system components were reviewed to determine their technical adequacy.

### 5.1 Equipment Walkdowns

The team inspected various areas of the plant to verify the as-built configuration of the installed equipment Areas inspected, included the emergency diesel generator rooms, switchgear rooms, 125 Vdc battery rooms, the switchyard, and the cable-spreading rooms. Transformers, inverters, battery chargers, circuit breakers, protective relays and pump motor nameplate data were recorded. This information was collected to verify the completeness and accuracy of design drawings, as this is used in system calculations.

The walkdown inspection indicated that adequate measures are in place to effectively control system configuration. Equipment inspected was found to be well kept, with surrounding areas clear of safety hazards. The inspected equipment was found to be installed in accordance with design drawings with the exception of minor discrepancies in the EDG auxiliary systems as described in Section 5.2.1.

## 5.2 Equipment Maintenance and Testing

The team reviewed various maintenance and testing procedures for such equipment as the 480 V, 4.16 kV and 13.8 kV switchgear, emergency diesel generators, batteries, battery chargers and inverters. The team's observations are described in the paragraphs below.

### 5.2.1 Emergency Diesel Generators Testing

Periodic surveillance testing of the emergency diesel generators is conducted to assure their operational availability and capacity to perform their emergency shutdown functions. The Technical Specifications require the EDGs to be tested to demonstrate their operational readiness and to verify their capability to accept and start each emergency load within the specified time limit. The inspectors witnessed two monthly surveillance tests. The licensee conducted these tests using approved procedures and the operators were knowledgeable in the EDG operation.

During the "B" EDG surveillance test, the team noted that the turbocharger and attached equipment vibrated (about several inches peak-to-peak). The turbocharger intercooler and the attached supply and return cooling water piping was also vibrating. The licensee had previously reviewed the turbocharger vibration and determined that it would not affect the operability of the EDG. However, the team found that the potential detrimental effects of an intercooler failure, as the result of the vibration, had not been assessed. An internal failure of the intercooler would result in cooling water entering the supply air to the engine and could thereby result in engine failure. The licensee subsequently reviewed this condition with the vendor and, based on these discussions and a review of the intercooler construction, concluded that the vibration levels should not result in an intercooler failure. The team noted that the licensee is continuing to monitor engine performance, including intercooler vibration, to ensure any increased vibration levels are detected before they would reach a level which would jeopardize engine operability.

In general, for the maintenance activities reviewed, the licensee used good maintenance practices and procedures. However, while witnessing monthly EDG surveillance tests, the team observed the auxiliary operator (AO) climbing and standing on the engine prior to startup to perform pre-operational inspections. The team was concerned that the lack of adequate footing and handholds may result in damage to vulnerable EDG components, and poses a safety hazard. The licensee initiated a Training Development Recommendation (TDR) to investigate this issue.

The team reviewed many piping and instrumentation drawings to verify the as-built conditions. The quality was found to be good, except for those of the EDG auxiliary systems. The team noted that errors on the manufacturer's drawings have been repeated onto these drawings. For example, on Drawing PID-1-DG-D20459, Revision 8, the two filters of duplex filter F-65A were erroneously shown in series rather than in parallel as connected in the plant. The licensee indicated that they plan to improve the accuracy of these drawings.

During the review of the licensee's actions for vendor Service Information Letters (SIL), the team noted that SIL C.4, "Generator Bearing Insulation Check Procedure," dated April 15, 1985, requires the measurement of shaft currents in the generator shaft. This is important since the current return path for any generator shaft currents would be through the engine's main bearings. To prevent this from occurring, the vendor insulates the rear generator bearing to prevent a complete circuit. The SIL describes the test method necessary to assure that the insulation system has not degraded. The SIL also specifies an inspection period of eighteen months. The licensee prepared a test procedure, MS0539.22, effective May 8, 1991, to measure the shaft currents as required by the SIL, but they never performed the test. The team questioned the fact that the test had not been performed, even though the licensee had an opportunity to do it. In response, the licensee stated that they will perform the tests to verify the information in the SIL. The team reviewed the licensee's response to other industry bulletins and found them acceptable. The team had no further questions.

The general equipment condition was very good with only a few exceptions. All bolts and fasteners were examined. Two bolts, one on each turbocharger inspection door, were missing. And, several bolts on the "A" air compressor skid belt guard cover were loose. The licensee took immediate action to correct the turbocharger bolting, and noted that they would correct the loose air compressor skid bolts.

The general cleanliness around the engine and generator was very good. There were a few fuel oil leak on the engine driven pump and several injectors during the engine's operation. The team pointed out to the licensee that the fuel consumption calculation should factor in these leakages. Refer to Section 4.2.1 for further discussions.

In summary, the surveillance tests, maintenance and upkeep of the diesel generators were satisfactory except for the deficiencies identified above.

### 5.2.2 Station Battery Testing

The team reviewed weekly tests, quarterly tests, 18-month battery discharge tests and 60-month battery capacity tests for the 125 Vdc station batteries. The review addressed acceptance criteria and conformance with the requirements of the Seabrook Station Technical Specifications and the guidelines of IEEE Standard 450, "IEEE Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Substations," 1980.

The acceptance criteria associated with procedure MX0506.04, Revision 04, "Station Battery Service Test," dated April 15, 1991, requires that the battery voltage must be greater than or equal to 105 volts during the 120 minute discharge test. A review of the battery voltage drop analysis as described in Section 3.13, revealed that 105 volts at the battery terminals was adequate for the required loads. The Seabrook Station contains six safety-related inverters, four manufactured by Westinghouse and two manufactured by Elgar. The Westinghouse inverters were designed to operate over a dc voltage range of 105 to 140 volts. However, as discussed in Section 3.12, the licensee had performed a test verifying acceptable Westinghouse inverter operations with 103 volts at the inverter input. Since the calculated voltage drop between the battery and the Westinghouse inverters was less than two volts, the licensee considers the Westinghouse inverters to be operable.

On the other hand, the Elgar inverters were designed to operate over a dc voltage range of 101 to 140 volts. However, these Elgar inverters are equipped with a dc undervoltage shutdown feature that is currently set at approximately 105 volts sensed at the DC link within the inverters. This may not be adequate for the operation of the inverters with the current acceptance criteria of 105 volts at the battery terminals with approximately three volt drop between the battery and the inverter dc link. Furthermore, the licensee had identified that a setpoint was neither specified nor periodically tested. The licensee has committed to specify a setpoint by September 30, 1993. This setpoint should be based on the worst-case voltage at the battery terminals of 105 volts and allow for the voltage drop from the battery terminals to the inverter dc link. Additionally, the licensee has committed to develop a procedure to verify dc shutdown features and continuous output regulation for the full range of dc input by October 30, 1993, and conduct maintenance department training on the procedure by December 30, 1993.

The team concluded that this was not an immediate safety concern based on the recent battery service discharge tests, which indicated that the batteries had more than sufficient voltage to supply adequately all loads including the Elgar inverters with the current dc undervoltage shutdown feature setpoint, and the licensee's commitment to verify and adjust this setpoint in the near future. Therefore, this issue is unresolved pending verification and testing of the set point for dc undervoltage shutdown feature and subsequent NRC review (50-443/93-80-04).

Based upon the above review and a sampling of the test results, the team concluded that the tests adequately verified the design function and the capacity of the Class 1E battery system.

### 5.2.3 Battery Chargers and Inverters Maintenance and Testing

The team reviewed the maintenance performed on the safety-related battery chargers and inverters and found them in accordance with the vendor's recommendation. The team also reviewed procedure LX0556.06, Revision 01, "Station Battery Charger Capacity Test," dated April 6, 1993, and found that its acceptance criteria conform with the requirements of the station's Technical Specifications. The licensee adequately tests the safety-related Westinghouse inverters. However, the licensee identified inadequacies in the testing of the Elgar inverters. This is further discussed in Section 5.2.2.

Additionally, the team reviewed procedure OX1447.01, Revision 04, "Inverter ED-1-2A 18 Month Trip Circuit Test," dated August 25, 1992, required by Technical Specification (TS) 4.8.3.3. This procedure ensures the operability of the safety-related circuit breaker that trips the dc feed from Bus #11C to non safety inverter #I-2A after fifteen minutes of battery discharge. The procedure was found to be adequate to meet the TS requirement.

The team found the licensee's program for maintaining and testing the battery chargers and inverters to be satisfactory. The team had no further concerns in this area.

### 5.2.4 Circuit Breaker Maintenance and Testing

The team evaluated the licensee's program for testing circuit breakers. The team reviewed several procedures addressing the inspection, maintenance and testing of 13.8 kV, 4160 V, 480 V and 120 V circuit breakers. In addition, the team observed the completion of procedures LX0557.01, Revision 00, "Inspection, and P.M. - 480 volt Molded Case Circuit Breakers," and LX0557.21, Revision 00, "Inspection and P.M. of Gould Motor Starters," for Portable Battery Charger Power Receptacle Breaker D69. The technicians were knowledgeable and familiar with the procedure. All steps were completed adequately and in the proper sequence.

The Seabrook Station is required by Technical Specification Surveillance 4.8.4.2 to verify the operability of each containment penetration conductor overcurrent protective device and protective devices for Class 1E power sources connected to Non-Class 1E circuits. The circuit breakers that are covered by this requirement are both Class 1E and Non-Class 1E. This surveillance requires the licensee to perform the following:

- At least once per 18 months verify that the medium voltage 13.8 kV and the 4.16 kV circuit breakers are operable by selecting at least one of the circuit breaker, on a rotating basis.

- At least once per 18 months select and functionally test a representative sample of at least 10% of each type of lower voltage circuit breakers and overload devices. Circuit breakers and overload devices selected for functional testing shall be tested on a rotational basis.

- At least once per 60 months subject each circuit breaker to an inspection and preventive maintenance in accordance with procedures prepared in conjunction with the manufacturer's recommendations.

The team verified that the licensee was completing the necessary surveillance requirements. However, it was determined that not all Class 1E and Non-Class 1E molded case circuit breakers are tested on a regular basis. For further discussion regarding breaker testing, refer to Section 3.10.

Generally, the breaker testing program was found to be adequate except for the deficiencies identified above.

### 5.2.5 Cable Testing

The team reviewed procedure LS0564.01, "Insulation Resistance/Dielectric Absorption Testing." This procedure, in part, meets the licensee's commitments stated in letter NYN-91062 to the NRC, which addresses the megger testing of cables. Furthermore, the licensee performs a polarization index test for cables that are bolted to the motors. The polarization index is more useful than the megger test as it gives the appraisal of the motor winding for dryness and for fitness for overpotential tests as stated in IEEE 43-1974, "IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery."

Even though cables are periodically tested, the team found no formal trending program of the megger test results. The licensee indicated, however, that it is common practice for the maintenance personnel to contact the system engineer when there are unusually low megger readings that approach the acceptance criteria and review work history to determine if a trendable condition exists.

Based on this review, the team found the licensee's cable testing program adequate.

### 5.2.6 Transformer Oil Analysis

The team reviewed procedure MNO510.12 "Obtaining Transformer Oil Samples," for the Generator Step-up Transformer, Reserve Auxiliary Transformers, and Unit Auxiliary Transformers. These were the only oil-filled transformers at the station. The procedure reviewed was found to be well written and thorough. The normal frequency for obtaining samples was every six months as generated by computer. The test data reviewed showed that the gas concentration and combustible levels were within the acceptable levels. The team reviewed other transformer preventative maintenance procedures, including insulator tests, power factor tests, bushing tests and sudden pressure relays and concluded that these procedures were thorough. Based on the team's review, the transformer oil analysis program was found to be adequate.

### 5.2.7 Motor Lubrication

The team reviewed the licensee's program for motor maintenance. Maintenance is scheduled using the repetitive tasks sheets (RTS), which extract information from the preventative maintenance data base to list the required actions for maintenance. The licensee keeps a record available for all motors. One preventative maintenance procedure MS0508.03 is available for 4.16 kV motors for general visual inspection and electrical resistance testing. This procedure was reviewed and found to be acceptable.

The Seabrook Station also uses non lubricated 1E motors supplied with anti-friction bearings that are lubricated for life which did not require any preventive maintenance. The team concluded that the motor lubrication program was adequate.

### 5.2.8 Switchyard Equipment Testing

The quarterly and weekly procedures for the switchyard batteries were reviewed and found to be generally adequate. The team noted that the licensee did not specify a maximum acceptable battery voltage in the weekly procedure. However, there was a high voltage alarm set at 145 volts to warn of the dc high voltage condition, but the licensee was not testing this non-safety alarm function. The team commented that if the alarm failure was undetected, a possible degradation to the battery and connected components could occur due to a high voltage condition.

Generally, the switchyard equipment testing was adequate.

### 5.3 Protective Relay Setpoint Control and Calibration

Relay setpoints at the Seabrook Station are controlled through 1-NHY-310231, "Motor Load List." In addition, the setpoints of relays requiring Technical Specification surveillance testing are controlled by the Technical Requirements Manual. Testing and calibration of protective relays are accomplished through specific procedures.

The team reviewed site procedures for various protective instruments and found them well written and containing appropriate acceptance criteria. These procedures were found to contain the recommendations provided in the vendor technical manuals and in IEEE Standard 242-1975, "IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power systems." The team also reviewed completed calibration and test documents of several protective devices, and compared a sampling of the tested points to the associated coordination curves. This review included diesel generator protective relays, impedance relays and overcurrent relays. In addition, the team verified that the as found settings identified during the plant walkdown were in conformance with the Motor Load List and the Technical Requirements Manual.

The team noted that there was no formal program established for the trending and evaluation of instrument drift. Instrument trending is desirable since it can provide information regarding the instrument setpoint reliability, between calibration checks. The licensee does provide guidelines for performing standardized trend analysis should the system engineer determine that such an analysis would be appropriate. For example, the system engineer determined that it is beneficial to trend Agastat relay drift because of the repeated calibration failures.

The team identified no protective relays or other devices outside the allowable values. The team had no further questions in this area.

### 5.4 Fuse Control

Fuse characteristics differ among manufacturers and classes. Therefore, proper evaluation, installation, and replacement are necessary to ensure appropriate circuit protection and coordination. The team reviewed the licensee's fuse control program and performed a plant walkdown to verify that the installed fuses were in conformance with as-built drawings.

As a part of the licensee's preparation for the EDSFI, the licensee performed field inspections of installed fuses. These inspections revealed discrepancies involving the fuse types and ratings. Station Information Report 92-051 was issued to initiate a root cause analysis and to determine the reportability and safety significance. Furthermore, all fuse discrepancies were evaluated by Engineering Evaluation 92-37 for safety significance and the adequacy of protection for connecting wiring and equipment. This evaluation determined that although incorrect fuses were installed, equipment performance and applicable safety related functions were not compromised. The team reviewed the licensee's evaluation and found it adequate. However, the team noted that the licensee's field inspection of installed fuses was not 100%, but the licensee was scheduled to complete the inspection of all fuses used in the Engineering Coordination Studies by OR03 refueling outage.

The team reviewed procedure LS0565.01, Revision 00, "Fuse Control," dated May 27, 1992. This procedure provides instructions for the replacement of fuses in identified motor control centers, ac and dc switchgear and other plant equipment. The procedure requires the replacement with a fuse of the same manufacturer, voltage rating, type or class, amp rating and interrupting rating as listed in 1-NHY-300230, "Wiring System - Notes and Typical Details." If a fuse is not listed, replace "like-for-like" and if identified as Class 1E, generate a Request for Engineering Services requesting the fuse be added to 1-NHY-300230. If the failed fuse is different than what is specified in the wiring notes and details, the technician's immediate supervisor is to be notified for appropriate reporting action. Prior to replacement of any blown fuse, the technician is required to investigate the cause. Also, in every case, the technician is required to record vendor and rating information for both the removed and installed fuses.

The team found the licensee's program for control of fuses to be comprehensive and well defined. The team had no further concerns in this area.

### 5.5 Conclusions

Based upon the sample of equipment and documentation reviewed, the team concluded that the licensee has an acceptable maintenance and test program for Seabrook EDS equipment. In addition, the team determined that, in general, adequate criteria had been established for surveillance testing of EDS equipment. Maintenance and test procedures were found to be acceptable and technically adequate. Similarly, the test and calibration records reviewed showed that the selected devices were operating within the applicable acceptance range. However, the team identified some areas that needed licensee's further evaluations as discussed in the above sections.

## 6.0 ENGINEERING AND TECHNICAL SUPPORT

The team assessed the capability and performance of the licensee's organization to provide engineering and technical support by examining the interfaces between the technical disciplines internal to the engineering organization and the interfaces between the engineering organization and the technical support groups responsible for plant operations.

The team also reviewed a sampling of the licensee's Station Information Reports (SIRs), Operational Information Reports (OIRs), Nonconformance Reports (NCRs), Licensee Event Reports (LERs), permanent and temporary modification programs, technical training program, root-cause analysis and corrective action programs, and self-assessment programs.

### 6.1 Organization and Key Staff

The Engineering and Technical support for the Seabrook Station are provided by the Corporate Engineering Group at the site, and the site Technical Support Group. The Corporate Engineering Department is headed by the manager of engineering. Also, the Yankee Nuclear Services Division at Bolton, MA, headed by the project manager provides additional engineering support for the station. These departments handle all engineering and design activities for the Seabrook Station. In addition, the Technical Support Group headed by the Manager of Technical Support provides additional engineering, system support and plant interface activities.

The corporate engineering support for the electrical distribution system area is provided by the electrical and mechanical group, which are headed by the respective group managers. The Technical Support Group (system engineers) is responsible for providing site engineering support to plant operations, maintenance and design installation, maintenance and surveillance tests. The licensee has used a system engineer approach to resolve technical issues in the plant. An individual systems engineer is considered the station's expert for his assigned systems or subject area. This group also handles temporary modifications in the station.

The team concluded that the engineering positions are adequately staffed with knowledgeable personnel. Throughout the inspection, the corporate and system engineering group provided timely and thorough responses to the team members. The team noted that the corporate and site technical support staff were knowledgeable and very familiar with the EDS.

### 6.2 Root Cause Analysis and Corrective Action Programs

The team reviewed several LERs, NCRs, SIRs and OIRS to assess the effectiveness of the licensee's root cause analysis and corrective action program.

The team reviewed NCRs and found them in accordance with licensee's procedure 12710, "Nonconformance Reports," Revision 8. The evaluations and dispositions of all NCRs reviewed were technically correct and demonstrated a good understanding of the applicable procedures and requirements. In addition, appropriate evaluations were made for operability and reportability.

SIRs and OIRs reviewed by the team were found to be in accordance with procedures OE 3.1 "Station Information Report," Revision 11 and OE 3.2 "Operational Information," Revision 0 to determine whether the safety concerns were properly identified and corrected. In all cases, the licensee promptly identified potential problems, made accurate operability and reportability evaluations, and performed necessary corrective actions.

The team evaluated selected LERs to assess the adequacy of the engineering organization involvement in NRC reporting requirements in accordance with 10 CFR Parts 20, 21, 50.72, 50.73, and 50.36. The selected LERs were evaluated in accordance with licensee procedure. In general, the team determined that the reports had been made in a timely manner and that the corrective actions were thorough and complete. However, the team noted that in one case, the engineering evaluation and event descriptions provided in LER 91-008 "Turbine trip with reactor trip due to an inadvertent actuation of switchyard circuit breakers" did not provide sufficient details of bus transfers and protective relay interactions for this event.

Root cause analyses are performed by the Operating Experience Group in accordance with procedure OE 4.3 "Root Cause Analysis," Revision 0. This procedure describes the techniques used to evaluate the causes of problems or conditions related to the operation of Seabrook Station. The licensee's procedure 12700 "Corrective Action System," Revision 5, also described the methods that are used to identify, document and correct conditions adverse to quality. The root cause evaluations and corrective actions reviewed were found to be comprehensive and to contain adequate information and guidance for addressing the causes and take appropriate corrective actions. The team noted that the licensee was trending the station operating performances on a routine basis and generated a quarterly trend report for the managers to disseminate this information.

The team concluded that the licensee's root cause analyses and corrective action programs were effective in achieving their objectives.

### 6.3 Self Assessment Programs

The team reviewed the licensee's self assessment programs to assure that problem areas are identified and corrected before they become violations of regulatory requirements. The team noted that the licensee had performed a review of their EDS by reviewing generic questions and concerns identified in previous NRC EDSFIs. The licensee had generated about 400 questions during this process. A review of the licensee's responses to some of these questions revealed that the technical review and documentation were adequate to determine its acceptability. The team considered the licensee's efforts to be commendable in identifying discrepancies in the electrical systems.

Another self-assessment program reviewed was the licensee's self assessments of design changes and engineering self-assessment reports. A review of several reports indicated that the assessment was thorough in identifying and improving the quality of engineering prepared design documents.

The quality assurance (QA) area was also reviewed by the team to evaluate the involvement of QA personnel in assessing the quality of engineering services. QA audits in design control, test control, refueling outage, modification process and design change authorizations were performed. The team determined that the findings and observations identified in the above audits were resolved in a timely manner. Therefore, it concluded that QA audits and QA involvement in monitoring engineering effectiveness were adequate.

The team also reviewed Independent Review Team assessment of electrical testing and configuration control. These reports identified several recommendations to improve the performance in this area. The licensee was taking appropriate actions to address the Independent Review Team's recommendations.

In summary, the licensee has a commendable self-assessment program. The reports reviewed by the team indicate high quality reviews are being performed. The overall quality of plant operation should improve due to the established quality self-assessment activity.

### 6.4 Technical Staff Training

The licensee's training program was reviewed to evaluate the adequacy of training given to the corporate and technical support personnel. The team discussed the program with the training supervisor and reviewed the training procedures and records. Licensee's procedures 30120 "Training," Revision 0 and 18700 "Training program", Revision 3, provide the requirements and instructions to implement the training for engineering and technical support staff. A review of the above procedures concluded that it contained the necessary elements for a successful training program. The team noted that the licensee's engineers participate in industry groups and programs, regularly contact industry counterparts, and are aware of the technical issues. The team concluded that the technical staff does receive the training required for performing engineering and design functions and for providing technical support for the plant's operational activities.

### 6.5 Temporary Modification Program

Temporary modifications are administered and controlled by procedure MA 4.3 "Temporary Modifications," Revision 11. This procedure identifies the process used for request, review, approval, installation, restoration, and periodic reviews of temporary modifications to evaluate their continued use. The team's evaluation of selected temporary modifications revealed that they contained proper review and approval by the Operations Department and appropriate safety evaluations/review were performed in accordance with 10 CFR 50.59 requirements. The team noted that the number of open temporary modifications was acceptable and that the Technical Support Group oversees the modifications program. The open temporary modifications are reviewed periodically and a log is kept in the control room for tracking. The team reviewed this log and interviewed control room supervisors and determined that the licensee has a good program for controlling temporary modifications.

### 6.6 Engineering Support/Interface

The team reviewed the involvement and effectiveness of the engineering staff to support design functions, operations, maintenance and other organizations at the site. The team observed that adequate support to the station was provided by the system engineers and corporate engineers. A review of the open modifications and engineering service request indicated that engineering backlog was reduced since last year. An engineering corporate goal was established for 1993 to reduce the engineering backlog to 500 by the end of this year. The interface between station and engineering personnel was found to be effective, as evidenced by the presence of corporate staff and technical support staff at the site, to support the engineering/technical needs of the plant. To improve communications between the engineering staff and the support organizations, the licensee has established various meetings such as station manager's meeting at 8 a.m., plan of the day meeting at 1 p.m. and bi-weekly engineering interface meeting during which engineering, maintenance and operations action items are discussed. The active participation of management representatives from different organizations for these meetings is indicative that effective communications exist between engineering and plant organizations.

### 6.7 Design Changes and Modifications

The team reviewed this area to ascertain that design changes and modifications were performed in conformance with the requirements of the Technical Specifications, 10 CFR, UFSAR and applicable procedures.

The licensee implements design changes and modifications in accordance with licensee's procedure MA 4.13, " Design Change Implementation and Post Modification Testing, " Revision 1 and design control manual, NYDC, Revision 8. Seabrook's modification process is categorized into minor modifications and major modifications. Major modifications are prepared, documented and implemented using design coordination reports (DCRs). DCRs are generally multidiscipline or complex in nature and costs more than $10,000. The minor modifications are projects with a cost of less than $10,000 and require only minor design changes. The team noted that in both cases the licensee performed the minimum required reviews in accordance with NRC regulations. A review of the licensee's prioritization of modifications indicated that they had the right safety perspective.

Several modification packages were reviewed to verify the implementation and adequacy of the design and the procedures. The modifications reviewed were found to be well organized, complete and in accordance with the applicable procedures. Materials, parts and equipment were identified properly and were suitable for the application. The applicable design inputs were correctly incorporated into the design. The design verification and independent review were found to be adequate. The team performed field verification of some of the design changes, examined post modification test data and verified several drawing and documentation updated information. No unacceptable conditions were noted during this review. Generally, the changes were evaluated for plant safety impact under 10 CFR 50.59 in accordance with licensee's procedure NYMA 11210, "10 CFR 50.59 ", Revision 12. However, in one case the team noted that the licensee performed a design change without a design change package. This discrepancy is discussed in detail in the following section.

The team concluded that the licensee had an acceptable plant modification and design change control program.

#### 6.7.1 Input/Output List Alarm Modification

During the plant walkdown, the team noticed "charging amps low" alarm condition at the battery charger " D" and asked the licensee to justify this operating condition. The licensee's UFSAR section 8.3.2.1.f(2) states that the "Battery charger output current (ammeter) - an ammeter is located at the charger. In addition, a loss-of-current relay (Device No. 37/62) is provided which senses loss-of-charger output current. This relay provides an alarm locally at the charger and a computer alarm. These, plus the loss-of-charger input ac voltage computer alarm, provide sufficient indication that the battery charger is capable of performing its intended function."

In response, the licensee stated that the above alarm was valid because battery charger components that provide the alarms are not sufficiently sensitive to sense the low trickle charge for Batteries C and D. The normal charging current for Batteries A and B is significantly larger than the current for Batteries C and D. So while the devices for Batteries C and D are normally in the alarm state, that is not the case for Batteries A and B. Battery current digital ammeters with alarm units and time delays were installed during startup to provide alarm in the control room when the trickle charge is not maintained.

Further inquiries by the team revealed that in March 1991, all four "Battery Charger Charging Amps Low" control room alarms were deleted, and the computer points redirected to a logger function only by Work Request 91W001726 without the completion of the appropriate 10 CFR 50.59 applicability review. The team also noted that the licensee described the "Battery Charger Charging Amps Low" alarms as functional in their response to Generic Letter (GL) 91-06, "Resolution of Generic Issue A-30, Adequacy of Safety-Related DC Power Supplies." The team questioned the discrepancy in their GL 91-06 response and also the licensee's practice of modifying computer alarm points without a 10 CFR 50.59 review. In response, the licensee initiated Station Information Report 93-042 to address the above deficiencies. The licensee indicated that they would revise their response to GL 91-06.

The team noted that even though the Battery Charger Charging Amps Low Alarms that were referenced in the UFSAR could not alarm, the same information could be received from the battery current digital ammeters and the alarm units. Therefore, the operator had the information that was necessary to take the corrective actions for a loss of charging current to the batteries. However, additional investigation identified that the deletion of the Battery Charger Charging Amps Low control room alarms were completed in accordance with the Station Operating Procedure PN 1851, Revision 01, "Main Plant Computer System Computer Input/Output List Revisions," which allowed changes to the priority and destination of computer points with only Operations Department review, and without the completion of a 10 CFR 50.59 applicability review.

The main plant Computer is used to provide the vast majority of the alarms to the operator. This is done through the video alarm system (VAS). The computer input/output (I/O) list documents the points in the computer. The priority field is used to describe how the point is presented to the operator. The destination identifies on which CRT monitor the point is displayed or if the point is printed on the logger or if the point is not displayed at all. Only points that go to a CRT monitor can be considered alarms since the operator does not respond to, or review on a periodic basis the points on the logger. The team noted that in the current revision of PN 1851, which added additional guidance which stated that "Changes that affect plant design must be authorized by Document Revision Request (DRR), Minor Modifications (MMOD) or Design Coordination Report as appropriate," still only requires Operation Department's review for modifications/changes to the priority and destination of computer points. There is no direct reference made to the need for 10 CFR 50.59

applicability reviews. Additionally, since alarms are important for the detectability of component failures, it is necessary that engineering evaluation be performed when deleting any installed alarm functions.

It should also be noted that the licensee was previously issued a non-cited violation when the resident inspector identified that the alarm points for the containment enclosure to outside air differential pressure had been disabled in May 1988. This violation was documented in Inspection Report 90-05. The disabling of these alarm points was performed through a temporary modification. As a result of this violation, the licensee directed their corrective actions towards the temporary modification process and failed to identify the deficiency in the procedure controlling the computer I/O list.

Subsequent to the inspection the licensee provided additional information to the team which showed that the licensee has committed to do the following corrective actions to resolve the issue:

- Evaluate digital points that are priority 0, destination 0 (archive) or 5 (logger only) for technical correctness with respect to design.
- Perform a 10 CFR 50.59 applicability review for changes of priority and destination (made to points identified above) since receipt of the zero power license.
- Station procedures will be revised to ensure that modifications to the I/O list that could affect station design will require that a 10 CFR 50.59 applicability be performed.
- Revise station procedure PN 1851 Revision 2 to require priority and destination to be reviewed by engineering. Also revise-cross reference between PN 1851 and Engineering Procedures as necessary.
- Revise UFSAR 8.3.2.1.f to correctly reflect the current battery charger alarms.
- Update the response to Generic Letter 91-06 to revise the reference to the alarm which has been deleted.

The deletion of the Battery Charger Charging Amps Low Alarms described above is an example of the licensee's failure to perform and document 10 CFR 50.59 safety evaluations and constitutes a violation of 10 CFR 50.59 requirements (50-443/93-80-10).

### 6.8 Operation Procedures

The team reviewed operating procedures to confirm that the operating instructions and administrative controls were adequate to ensure operability of the EDS under all plant operating conditions. The Seabrook Station plant operators were interviewed to determine their familiarity with the selected procedures and knowledge of plant equipment. The team also performed a walkdown of the control room and applicable plant areas with the plant operating staff to determine whether the procedures could be implemented as written.

The team concluded that the procedures contained a sufficient level of detail to ensure that the procedure could be implemented satisfactorily. The operating staff interviewed were found to be familiar with the procedures and with the equipment, instruments, and controls involved.

### 6.9 Operational Events and Industry Experience

The team reviewed the procedures and programs used by the licensee to evaluate both in-house and industry operating experience.

Procedure 12910, "Operating Experience Review Program," Revision 6, provides the details for processing, evaluating and screening the information received by the Operational Experiences Review Program (OERP) group. This group reviews NRC correspondence, vendor information letters, plant operating event reports and industry event reports. A sample review of licensee's evaluations of EDS related NRC Information Notices indicated that appropriate reviews were performed and pertinent information were disseminated to the appropriate station staff.

Based upon its limited review, the team concluded that the licensee's procedure provided a satisfactory method for addressing nuclear plant experiences and the licensee's review of operational events and industry experience were found to be adequate.

### 6.10 Conclusions

Based upon the sample of documents reviewed and of personnel interviewed, the team concluded that the technical support group and corporate engineering organizations were staffed with capable and technically competent personnel. The team considered this as a strength. Effective interfaces exist between station and engineering personnel. Communications between the various Engineering and Technical Support organizations were found to be good. Calculations and modifications reviewed were found to be good and, in most cases, presented in a comprehensive manner. In some calculations, conservatism used to justify inadequacies should have been quantified. The team found an example where the licensee failed to recognize performing a design change without any engineering review and 10 CFR 50.59 evaluations. The root cause analysis and corrective action programs were considered adequate and the temporary modification program was properly controlled and implemented.

The self assessment and corrective actions were found to be extensive and capable of identifying areas requiring improvement. This was considered as another strength by the team. The team noted good management involvement and support for identifying and resolving issues for the plant.

In summary, the team concluded that the engineering and technical support available to the Seabrook Station was adequate for the safe operation of the plant.

## 7.0 UNRESOLVED ITEMS AND OBSERVATIONS

Unresolved items are matters about which more information is required to ascertain whether they are acceptable items or violations. Unresolved item(s) identified during this inspection are discussed in Sections 3.2, 3.9, 3.13, 4.2.1, 4.2.2, 4.3.2. and 5.2.2.

Observations are conditions that do not constitute regulatory requirements and are presented to the licensee for their consideration.

## 8.0 EXIT MEETING

The inspectors met with licensee personnel, denoted in Attachment 2, at the conclusion of the inspection on May 21, 1993, and summarized the scope of the inspection and the inspection findings.

ATTACHMENT 1

SUMMARY OF INSPECTION FINDINGS

| A. Violations | Section | 50-443 |
|---|---|---|
| 1. Failure to perform evaluation in accordance with 10 CFR 50.59 | 6.7.1 | 93-80-10 |
| 2. Failure to incorporate design requirements for qualified control air for EDGs. | 4.2.2 | 93-80-07 |
| B. Unresolved Items | Section | 50-443 |
| 1. Periodic test/verification for bus transfer scheme | 3.2 | 93-80-01 |
| 2. Electrical separation requirements | 3.9 | 93-80-02 |
| 3. Testing program for breakers | 3.9 | 93-80-03 |
| 4. Verify setpoint for the UV trips for Elgar inverters | 5.2.2 | 93-80-04 |
| 5. Revise voltage profile calculation for DC system | 3.13 | 93-80-05 |
| 6. Establish minimum fuel oil quantity for EDGs | 4.2.1 | 93-80-06 |
| 7. Acceptability of threaded coupling used in vibration and shock area for EDGs | 4.2.2 | 93-80-08 |
| 8. Acceptability of HVAC for switchgear rooms | 4.3.2 | 93-80-09 |

| C. Observation | Section |
|---|---|
| 1. Grid voltage data not easily retrievable | 3.1 |
| 2. SF6 breakers are exercised only every 18 months | 3.1 |
| 3. Absence of fire walls for multiple bus ducts | 3.1 |
| 4. No analysis of fast bus transfer scheme | 3.2 |
| 5. No voltage analysis addressing effects of faults from non-1E buses on 1E buses. | 3.9 |
| 6. Lack of adequate coordination for some of DC circuits | 3.1.3 |

## ATTACHMENT 2

## PERSONS CONTACTED

### NORTH ATLANTIC ENERGY SERVICE CORPORATION

*B. Beachel,I & C Engineering Supervisor
D. Bergeron, Electrical Engineering Manager
N. Bhowmic, Electrical Engineer
*B. Brown, Mechanical Engineering Supervisor
S. Buchwald, QA Supervisor
A. Callendrello, Licensing Manager
R. Deloach, Exec. Director of Engineering & Licensing
*E. Desmarais, IRT Manager
W. Dickson, BOP Systems Engineering Supervisor
W. DiProfio, Station Manager
B. Drawbridge, Exec. Dir. of Nuclear Prod.
R. Faix, Mechanical Engineering Manager
*T. Feigenbaum, Sr. Vice President
J. Gilmartin, MRD Analyst
R. Goodridge, Electrical Engineer
T. Harpster, Director, Licensing Services
M. Harrington, MRD Supervisor
J. Hickman, Project Services
J. W. Hill, OPS Technical Supervisor
G. Kline, Tech. Support Manager
G. Kotkowski, Electrical Engineering Supervisor
*A. Legendre, Regulatory Compliance - Lead Engineer
K. Letourneau, Principle Electrical Engineer
N. Levesque, Electrical Maintenance Department Supervisor
K. Mahler, Senior Electrical Analyst
J. Marchi, A & E Group
J. Martin, Director of Communications
K. Mullen, System Engineer
J. Peschel, Regulatory Compliance Manager
J. Peterson, Maintenance Manager
R. Savage, Electrical Support Supervisor
J. Sobotka, NRC Coordinator
P. Tutinas, Engineering Programs Supervisor
J. Vargas, Manager of Engineering
L. Walsh, OPS Support Manager
J. Warnock, NS & A M
B. Fadden, Lead I & C Engineer, YEAC
T. Glowacky, Sr. Electrical Engineer, YAEC
R. Jamizam, Lead Electrical Engineer, YAEC
G. Tsouderos, Project Manager, YAEC
R. White, Engineering Manager, YAEC

Attachment 2

U.S. Nuclear Regulatory Commission

A. DeAgazio, Project Manager, NRR
N. Dudley, Senior Resident Inspector
E. Imbro, Deputy Director, Division of Reactor Safety
*W. Ruland, Chief, Electrical Section
R. Laura, Resident Inspector

* Indicates those **not** present at the Exit Meeting

## ATTACHMENT 3

## ABBREVIATIONS

| | |
|---|---|
| A or Amp | Amperes |
| AC or ac | Alternating Current |
| ANSI | American National Standards Institute |
| ASME | American Society of Mechanical Engineers |
| BHP or Bhp | Brake Horsepower |
| BIL | Basic Insulation Level |
| CRF | Containment Recirculation Fan |
| CB | Circuit Breaker |
| CFR | Code of Federal Regulations |
| CONED | Consolidated Edison |
| CRT | Cathode-Ray Tube |
| CS | Core Spray |
| CVT | Constant Voltage Transformer |
| DBA | Design Basis Accident |
| DBE | Design Basis Event |
| DC or dc | Direct Current |
| DEMA | Diesel Engine Manufacturers Association |
| EAT | Emergency Auxiliary Transformer |
| ECCS | Emergency Core Cooling System |
| EDG | Emergency Diesel Generator |
| EDS | Electrical Distribution System |
| FLA | Full Load Amps |
| FSAR | Final Safety Analysis Report |
| FTOL | Full Term Operating License |
| GDC | General Design Criteria |
| GE | General Electric |
| GM | General Motors |
| GPM or gpm | Gallons per Minute |
| HV | High Voltage |
| HVAC | Heating Ventilation and Air Conditioning |
| IEEE | Institute of Electrical and Electronics Engineers |
| kV | kilovolts |
| kVA | kilovolt-amperes |
| kW | kilowatts |
| LC | Load Center |
| LOCA | Loss of Coolant Accident |
| LOOP | Loss of Off-site Power |
| LTC | Load Top Changer |
| LV | Low Voltage |
| MCC | Motor Control Center |
| MOV | Motor Operated Valve |
| MS or ms | Milliseconds |
| MVA | Mega Volt-Amperes |
| NCR | Non Conformance Report |

| | |
|---|---|
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| PR | Protective Relay(s) |
| PSI or psi | Pounds per Square Inch |
| RCP | Reactor Coolant Pump |
| RG | USNRC Regulatory Guide |
| RHR | Residual Heat Removal |
| SCR | Silicon Controlled Rectifier |
| SEP | Self Evaluation Program |
| SF | Service Factor |
| SI | Safety Injection |
| STD or Std | Standard |
| SUT | Startup Transformer |
| TS | Technical Specification |
| UAT | Unit Auxiliary Transformer |
| UL | Underwriters Laboratories |
| UPS | Uninterruptible Power Supply |
| USNRC | United States Nuclear Regulatory Commission |
| UST | Unit Service Transformer(s) |
| UV | Undervoltage |
| V | volt(s) |
| Vac | volts alternating current |
| Vdc | volts direct current |
| W | Westinghouse |

ATTACHMENT 4

SEABROOK STATION ELECTRICAL DISTRIBUTION SYSTEM