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Licensee: Portland General Electric Company

Facility Name: Trojan Nuclear Plant

Inspection at: Trojan Nuclear Plant, Rainier, Oregon

Inspection Conducted: July 23-26, August 6-10 and 27-31, 1990

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EXECUTIVE SUMMARY

A U.S. Nuclear Regulatory Commission (NRC) team conducted an electrical distribution system functional inspection (EDSFI) at the Trojan Nuclear Plant. The team, which consisted of members of the Special Inspection Branch (RSIB) of the Office of Nuclear Reactor Regulation (NRR) and consultants, conducted the EDSFI from July 23 through August 31, 1990.

The NRC inspection team reviewed the design and implementation of the plant electrical distribution system (EDS) and the adequacy of associated engineering and technical support. To accomplish this, the team reviewed the design of the electrical and mechanical systems and equipment affecting the EDS, examined installed EDS equipment, reviewed test programs and procedures and results affecting the EDS, and determined the adequacy of technical disciplines and functions by interviewing licensee personnel. The team concentrated its review on equipment samples chosen from the B safety-related train.

The team found, in general, that the EDS was adequate in performing its intended functions under the various design-required conditions. The team also found, in general, that the Nuclear Plant Engineering (NPE) group provided adequate engineering and technical support to the other plant organizations. However, some weaknesses existed in the implementation of the design and control of the design for the EDS and in the engineering support efforts that the team reviewed. The team also identified several strengths in the licensee's programs at Trojan.

The identified weaknesses in the engineering support for the EDS were (1) a lack of attention to detail in engineering work, and (2) a lack of rigor in fully evaluating technical issues and problems. In addition, the team felt that the increasing numbers of unresolved open items from various plant programs required additional attention by the licensee.

Some of the more significant inspection findings that brought the team to its conclusions regarding engineering support weaknesses are discussed briefly below.

Cable Raceway Overfill

On the basis of a previous NRC finding at another plant, the NPE group evaluated the site's cable tray schedule. Although it noted the overfilled tray identified in the schedule, the group failed to properly evaluate the condition and to review a comparable schedule for cable conduit. The team noted that the conduit schedule also identified conduits as overfilled and that the schedule contained errors. Because the NPE group was unaware that the plant design called for the routing of low-voltage power cables in control cable raceway, it failed to fully resolve the overfilled cable tray condition until it was questioned by the inspection team.

Emergency Diesel Generator Room Temperature

The design requirements for the emergency diesel generators (EDGs) and EDG support equipment were based on a maximum ambient temperature in the EDG rooms of 104°F without the EDGs running and 116°F with the EDGs running. The design for the ventilation system to the EDG rooms did not permit automatic operation of the system unless the EDGs were running. The team found that (1) while the EDGs were not running, the temperature in the rooms had exceeded 104°F, (2) several support components had design capacities based on 80°F and 90°F, and (3) calculations and testing performed by Bechtel and the NPE group did not fully support 116°F as the maximum room temperature.

In addition, the licensee could not show that the temperatures in the west EDG room can be maintained within design limits if the ventilating system traversing the east EDG room was not working as a result of fire damper closure or other common mode damage mechanism.

Equipment Cable Sizing

A calculation performed by the NPE group to determine the current carrying capacity of equipment power cables that had been protected from the effects of external fires indicated that the power cable for the B train hydrogen recombiner in the containment was significantly undersized. The team found that the engineering justification for the acceptability of the undersized cable was not adequately supported. The first re-analysis and justification performed because of the team's concerns also were not adequately supported. Subsequent analysis showed that the hydrogen recombiner can perform its safety function.

A second calculation performed by the NPE group to determine the satisfactory operation of dc-powered motor-operated valves included improper values for criteria required by the vendor of the valve operators. Had the proper values been used, the calculation would have shown that the steam supply valve to the steam-driven auxiliary feedwater pump would not operate under certain conditions. The NPE group performed a preliminary reevaluation of the valve operator and determined the valve would operate but with only a small margin of assurance.

Document Errors, Omissions, and Inconsistencies

In addition to the problems with cable sizing calculations discussed above, the team found other examples of calculations that were incomplete, inaccurate, or not adequately supported.

Maintenance procedures for motor and transformer polarization testing did not contain acceptance criteria, and the data obtained were not reviewed, evaluated, or trended. A declining trend existed in the polarization data for several safety-related pump motors that had not been identified and, therefore, had not been evaluated.

The replacement of safety-related fuses was not controlled by procedure or other documented instructions and the fuse data drawing contained an omission. In addition, the licensee had recorded eight separate problems regarding fuses on corrective action documents during the current year.

Several weaknesses in PGE's temporary modification program existed, including temporary modifications installed over two years, no time limit on obtaining the plant safety board review, and no indication to plant operations on the review's outcome. The weaknesses in the temporary modification program supported similar findings previously identified by NRC Region V.

Although several of the design-basis documents reviewed contained a number of omissions, inconsistencies and errors, the problems were mostly minor in nature. Overall, the design-basis documents will become good engineering tools for future modifications to the plant and its systems.

Strengths

Several engineering criteria developed by the NPE group were well written, comprehensive, and complete. The criteria included those for sizing thermal overloads and circuit breakers used on safety-related motor-operated valves, for establishing overload device settings for ac motors, and for establishing electrical separation requirements.

The team also found that the plant was being maintained in a clean and orderly condition.

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1.0 INTRODUCTION

During previous inspections of nuclear power plants, NRC teams observed that the required functional capability of certain safety-related systems was compromised by inadequate engineering and technical support. As a result of this lack of support, various design deficiencies had been introduced during design modifications, particularly of the station electrical distribution system. In response to the observed design deficiencies, the Special Inspection Branch (RSIB) of NRC's Office of Nuclear Reactor Regulation (NRR) developed a draft temporary instruction for the NRC Inspection Manual. This temporary instruction describes how teams from the NRC regions are to conduct electrical distribution system functional inspections (EDSFIs).

The EDSFI performed by RSIB at the Trojan Nuclear Plant was the last of five pilot inspections to be conducted before the NRC issues the temporary instruction. A team consisting of NRC staff and consultants conducted the EDSFI at Portland General Electric (PGE) Company's facilities at the plant site on July 23-27 and August 6-10 and 27-31, 1990.

The objectives of this inspection were to assess (1) the functional capability of the electrical distribution system (EDS) at Trojan and (2) how well PGE's Nuclear Power Engineering (NPE) organization provided engineering and technical support to site organizations. The team consisted of electrical and mechanical design engineers who reviewed the original design and changes to that design, and installation engineers who verified the configuration, condition, and test results of installed equipment. The methodology used included reviewing calculations, analyses, drawings, procedures, and tests for selected equipment, devices, and components of the EDS. The team also performed walkdown inspections of plant electrical wiring and components and mechanical systems and components. The mechanical systems inspected by the team were those that are required to support operation of the EDS. The team reviewed load paths within the B train of the safety-related EDS, including the east emergency diesel generator (EDG), and the offsite and auxiliary power supply paths to the safety-related system.

The areas reviewed and the safety significance of identified deficiencies are described in Sections 2, 3, 4, and 5 of this report. Conclusions are given at the end of each section. General conclusions are summarized in Section 6. Unresolved items addressed in the report are summarized in Appendix A. Personnel contacted during the inspection and persons attending the exit meeting on August 31, 1990, are identified in Appendix B.

2.0 ELECTRICAL DESIGN REVIEW

The team's review of the EDS extended from the station's unit and startup transformers' low voltage terminals to the terminals of electrical power utilization devices, such as motors and motor-operated valves. The team's review emphasized, but was not limited to, the safety-related or Class 1E electrical power system, which included the 4160-Vac power system, the 480-Vac power system, the 120-Vac preferred instrument system, the 125-Vdc system, and the emergency diesel generator system.

The team verified conformance of the Class 1E electrical distribution system to General Design Criteria 17 and 18 of Appendix A and Criterion III of Appendix B to 10 CFR Part 50 as well as to design commitments in the updated Final Safety

Analysis Report (UFSAR) and the amended Technical Specifications (TS). The team examined the licensee's design documentation including design-basis documents (DBDs), design criteria documents, design calculations, procedures, specifications, electrical diagrams, setpoint lists, and corrective action reports.

The normal power supply for the station's electrical distribution system was from the plant's main generator through the 22-12.47-kV unit auxiliary transformer and the alternate preferred power source was the licensee's offsite 230-kV transmission system via two 233-12.47-kV startup transformers. Standby (emergency) ac power was provided by two redundant 4418-kW emergency diesel generator units. Two redundant 12.47-kV system buses served the station's major nonsafety-related electrical loads and the redundant Class 1E 4160-Vac buses through two 11.85-4.16-kV unit substation transformers. Each unit substation transformer served one Class 1E 4160-V bus and one non-Class 1E 4160-V bus. Each Class 1E 4160-V bus, in turn, supplied power to one redundant train of larger safety-related pump motors and two Class 1E 480-V load centers. The two redundant Class 1E 480-V load centers served the safety-related motors in their respective trains, various nonsafety-related motors, and safety-related and nonsafety-related motor control centers.

Each of the two redundant Class 1E 125-Vdc systems included a 60-cell lead-acid battery and two full-capacity battery chargers. The present batteries were installed under a design change and were sized to meet projected station blackout requirements [i.e., 4-hour duty cycle with a minimum acceptable terminal voltage of 105 V (1.75 V per cell)].

Four Class 1E 120-Vac, 7 1/2-kVA, 60-Hz, single-phase inverters supplied closely regulated (voltage and frequency) power to the four preferred instrument buses. Two inverters were served by each of the redundant Class 1E 125-Vdc systems and by each of the redundant Class 1E 480-Vac systems.

Many design calculations provided to the team were based on assumed information, a practice usually followed during the design phase of a project. However, Criterion III of Appendix B to 10 CFR Part 50 requires that the licensee establish design controls for verifying or checking the adequacy of the design. The licensee was in the process of verifying the assumptions using information on as-built equipment and systems. The licensee intended to input this information into three recently acquired computer programs: "Load Tab," "Volt Drop," and "Short Ckt." These computer programs will provide the loading on all buses down through 480 volt panelboards for various station operating conditions, determine steady state and transient conditions on the buses and motor terminals for various supply voltage conditions, and determine momentary and interrupting 3-phase fault levels on the various buses from the 12.47 kV system through the 480 volt system. The licensee anticipated operation of the three programs by mid-1991. The team felt that these computer programs will enhance the design control program.

2.1 Equipment Ratings

2.1.1 Transformers

The station design included four Class 1E 4160-480/277-V, 742-kVA load center transformers arranged in two redundant trains (i.e., two units per train). The licensee had performed Calculations TE-185, "Engineered Safety Features (ESF)

Load Center Buses and Transformer Load Calculations," Revision 1, July 16, 1990, and TE-186, "ESF Transformer Overload Studies for B01, B02, B03, and B04," Revision 0, February 13, 1990, to evaluate the effect of worst-case loading on the usable life of the transformers and to confirm that the units were sized to handle the demand loading under all postulated conditions, including a design-basis accident. The calculations established that long-term loading of the units should not exceed 699 kVA and short-term loading (8 hours) should not exceed 761 kVA in order to ensure that there would be no decrease in the life expectancy. The calculations also established that, for an assumed loading of 804 kVA, life expectancy would be reduced to 0.6 year.

The calculations indicated that only one (B01) of the four Class 1E load center transformers would have a loading that exceeded the short-term rating, but the duration of the overload would be only 1 hour. Under accident conditions, that unit was determined to have a 1-hour loading of 802.67 kVA before the load is reduced to a level below the short-term limit of 761 kVA. The licensee, therefore, concluded that the loading on the load center transformers was acceptable because the 1-hour overload would not significantly reduce the life expectancy of the transformer. The team agreed.

2.1.2 Switchgear and Motor Control Centers

The team reviewed the following calculations that demonstrated fault duty withstand capability of the Class 1E equipment including 4160-V switchgear, and 480-V load centers and motor control centers: Bechtel Calculation III, "3 Phase Faults," Revision 1, May 23, 1973, which had been performed during the station's design phase, and Bechtel Calculation E-16, "480 V Class 1E Short Circuit Current for Appendix R Associated Circuits," Revision 2, February 24, 1984. The fault duty levels for the 4160-V and 480-V systems determined in Bechtel Calculation III were approximately 80 to 90 percent of the momentary and interrupting ratings of equipment. Bechtel Calculation E-16 determined the 480 volt system fault duty level to be approximately 96 percent of the reported motor control center equipment rating. The team was concerned that, with the small margins in the calculations, the as-built system and equipment characteristics had not been evaluated for their effect on the calculated fault duty levels to ensure that equipment ratings had not been exceeded. As a result of the team's concern, the licensee performed an informal calculation using as-built equipment characteristics that indicated that the fault duty withstand and interrupting capabilities of equipment were not exceeded.

2.1.3 Cable

To determine if the station cabling system would be functional under all postulated normal and abnormal operating conditions, the team evaluated various design criteria prepared by the licensee that were used by PGE engineers involved in the design of cabling systems for new or modified loads. These criteria were NPE Electrical Branch Criteria 3.4, "Cable Sizing Criteria," Revision 0, June 3, 1989; NPE Electrical Branch Criteria 3.1, "Independence Criteria for Electrical Circuits," Revision 2, May 30, 1989; Electrical Numbering System Description E-12, Revision 6, February 6, 1986; and Installation Standard E-2, "Cable Installation and Identification," Revision 7, April 17, 1990. The team assessed these documents against applicable cable industry and nuclear industry standards, the UFSAR, and the TS and found that the criteria were comprehensive, technically accurate, and generally well prepared.

The team reviewed cable lists and cable tray and conduit arrangement drawings to evaluate the cable routes for two safety-related loads (service water pump motor and safety injection pump motor). The cable routes met the independence criteria for safety-related loads.

Procurement specifications prepared by the licensee for electric cables and containment electric penetrations included all pertinent requirements for these type of components, and the abnormal environmental conditions following a design-basis accident had been adequately addressed. The documents reviewed were Specification for Electrical Penetration Assemblies No. TE-031, Revision 1, October 23, 1989, and Electrical Equipment Environmental Qualification Component Summary Sheet, No. E-2-PT960.

The team had two concerns with regard to Calculation TE-147, "Thermal Wrap Cable Ampacity Derating," Revision 0, September 2, 1988, which the licensee had performed to determine the derating (reduction in current) of cable because of the application of thermal wrapping and to ensure that full-load currents in thermal-wrapped cables did not exceed the derated ampacities. The first concern was that the calculation used input from superseded calculations. Nuclear Division Procedure (NDP) 200-4, "Quality Related Calculations," Revision 3, dated July 28, 1989, required that referenced calculations shall be checked for applicability of assumptions. The licensee initiated Corrective Action Request (CAR) C90-5263 to resolve this problem.

The second concern was a lack of support for the licensee's conclusion in the calculation although NDP 200-04 required calculations to be complete and use adequate assumptions. In its conclusion, the licensee accepted the condition wherein the feeder cables for the B-train hydrogen recombiner were derated to 76 amperes whereas the full-load current was 90 amperes. Further analysis by the licensee showed that full-load current would be 80 amperes and reduced cable life under these conditions would not prevent the hydrogen recombiner from performing its safety function.

The team considered these two deficiencies with regard to Calculation TE-147 to be examples of the licensee's failure to follow established design control measures and adequately justify a cable installation outside design parameters. (See Appendix A to this report, Unresolved Item 90-200-01.)

Calculation TE-126, "Cable Sizing, RDC 84-128, DCP-4," Revision 1, August 1, 1990, which had been performed to support a design change, evaluated the application of the three-conductor 480-Vac power cable that provided power to a fuel transfer cart motor. The team questioned the motor's operating current and the cable length assumed in the calculation. The licensee's preliminary review of the calculation indicated that the cable length and the motor's full-load current rating might be inaccurate and would require additional review. The team also questioned whether the cable was completely protected as shown on the time-current protection device curves attached to the calculation. The team considered the potential errors in Calculation TE-126 to be another example of the licensee's failure to adequately control the design of the plant. (See Appendix A to this report, Unresolved Item 90-200-01.)

Calculation TE-174, "DC Motor-Operated Valve Failure To Develop Sufficient Torque Due to Improper Cable Sizing," Revision 0, October 11, 1989, analyzed cable sizing and voltage drop in cables to demonstrate that 125-Vdc motors for motor-operated valves developed sufficient torque to perform their safety functions under degraded voltage conditions. The calculation used a less conservative value for stem coefficient of friction than that recommended by the vendor of the 125-Vdc valve operators. The calculation also used a higher value of pullout efficiency for motor-operated valve MO-3071 (auxiliary feedwater trip/throttle valve) than that specified by the vendor. Furthermore, even though control circuits for MO-3071 are served by the same cable as the motor, this additional load was not considered in the calculation. The team determined that when considering the more conservative values of stem coefficient of friction and of pullout efficiency, this calculation showed insufficient torque was available to operate valve MO-3071 under degraded voltage conditions.

The licensee agreed with the team's observation concerning errors and omissions in the calculation and performed a preliminary recalculation that reevaluated several assumptions used in the original calculation. The recalculation showed that for all 125-Vdc valve motor operators, except MO-3071, large margins of torque were available. It also showed that the cable to MO-3071 was adequately sized for degraded voltage conditions, but the margin was only 2.6 percent. The team reviewed the recalculation and found the methods used were satisfactory. The team considered the incorrect values used in TE-174 to be another example of the licensee's failure to adequately control the design of the plant. (See Appendix A to this report, Unresolved Item 90-200-01.)

2.1.4 Circuit Breakers

The circuit breakers used in the 4160-Vac, 250-MVA switchgear were the 1200-ampere drawout type. The breakers had a momentary (close and latch) rating of 58 kA asymmetrical and an interrupting rating of 33.2 kA at 4160-Vac, which was greater than the fault duty calculated in Bechtel Calculation III, Revision 1.

The circuit breakers used in the 480-Vac load centers were the drawout type with 225-ampere, 600-ampere, or 1600-ampere frames, depending on their load currents. On the basis of the 225-ampere breakers, which were limiting, the 480-Vac load centers had an interrupting rating of 22 kA, which was greater than the fault duty of the load calculated in Bechtel Calculation III, Revision 1.

The Class 1E motor control centers had 480-Vac molded-case feeder circuit breakers. In the design, 100-ampere frame circuit breakers were used, except for the 100-hp service water booster pump motors. For these motors, 225-ampere frame circuit breakers were used. Bechtel Calculation E-16, Revision 2, showed that the circuit breakers had an 18-kA interrupting rating and that the maximum calculated fault was 17.2 kA.

The licensee had issued Calculation TE-188, "Molded Case Circuit Breaker Test Points," Revision 0, May 4, 1990, to provide engineering acceptance criteria for maintenance testing of molded-case circuit breakers. Before the NPE group issued this calculation, maintenance personnel determined the acceptance criteria independently using values obtained from the data shown on Drawing Series E-56, "Protective Device Coordination Setpoints," and E-57, "Protective

Device Coordination Curves." Previously, NRC Inspection Report 50-344/89-09, August 29, 1989, indicated that a number of errors had been found in the acceptance criteria that had been determined by maintenance personnel and the licensee's response was to issue TE-188.

Despite the documented problems with acceptance criteria provided by maintenance personnel that resulted in Calculation TE-188, the licensee had taken no apparent corrective action to ensure that data on molded-case circuit breakers obtained before Calculation TE-188 was issued were within the engineering required values. The team reviewed existing data for seven 125-Vdc safety-related breakers to the acceptance criteria within Calculation TE-188. Two breakers, numbers D1002 and D1007, had trip values outside the criteria of Calculation TE-188. The licensee initiated CAR 90-3330 to evaluate the nonconforming trip values and to consider engineering review of the data for the remaining safety-related molded-case circuit breakers. The licensee concluded that the nonconforming trip values were not a concern since breakers D1002 and D1007 did trip when tested, demonstrating their capability to perform their safety function. The team considered this observation an example of a weakness in engineering support of plant maintenance in that there was a failure to completely respond to and fully evaluate a previously identified problem.

2.1.5 Motors

The team reviewed two original motor specifications prepared by the Bechtel Corporation: "Technical Requirements and Specification for Large Induction Motors," Revision 2, March 30, 1970, and "Technical Requirements and Specification for Fractional and Integral Horsepower Induction Motors," Revision 1, December 30, 1969. In particular, it noted the special requirement that motors required to operate under emergency conditions should be capable of accelerating to full-load speed within 4 seconds at 70 percent of rated terminal voltage. This requirement is of particular importance when the loads are supplied power by the emergency diesel generators.

Motor data sheets for seven engineered safety features (ESF) pumps and one ESF air cooler were reviewed by the team and complied with the Bechtel motor specifications.

The team performed a walkdown inspection of the service water pump motor and safety injection pump motor to verify that the actual motor nameplate data were identical to the information on the motor data sheet. No discrepancies were observed.

Electrical data for many fractional horsepower and small integral horsepower motors had not been recorded in the plant records, and assumed inrush (locked-rotor) currents had to be used to establish transient load conditions for the emergency diesel generators (Calculation TE-124). The team indicated that a station load list would be beneficial. A station load list that provides, on an individual load basis, all relevant electrical data for the load, has many uses and is a standard document at many nuclear stations.

The team noted that the licensee has taken an active role in industry initiatives pertaining to motor-operated valves (MOVs) and that engineering personnel possessed expertise in this area.

2.1.6 Batteries

The team reviewed Calculations TE-119, "125-V Station Batteries," Revision 4, April 6, 1990, dealing with the Class 1E battery capacity and battery charger sizing, and TE-145, "125-Vdc Fault Currents," Revision 4, July 5, 1990. Calculation TE-119 indicated an acceptable capacity for batteries that was based on a 2-hour duty cycle for battery D11 and a 30-minute duty cycle for battery D12. These duty cycle times were in accord with commitments implied in UFSAR Table 8.3-8. However, both batteries had been replaced, and their capacities had been increased to meet 4-hour duty cycles that were based on the licensee's projected station blackout requirements. Calculation TE-119 was being revised on the basis of the 4-hour duty cycles. The replacement battery characteristics were considered in both calculations, TE-119, Revision 4 and TE-145, Revision 4.

In Calculation TE-145, the licensee had not considered all possible fault current contributions when determining the fault level on the load side of the battery bus circuit breakers. The calculation did not include the potential for fault current contribution from the charger connected to the opposite dc motor control center bus. In response to this finding, the licensee issued CAR C90-5259 to revise the calculation. The team considered the omission in Calculation TE-145 to be another example of the licensee's failure to adequately control the design of the plant. (See Appendix A to this report, Unresolved Item 90-200-01.)

The licensee's design-basis document DBD-02, "125-Volt DC System," Revision 1, December 29, 1989, stated a battery aging factor of 1.20 for battery capacity evaluation. This value conflicted with the 1.25 value recommended in Institute of Electrical and Electronics Engineers (IEEE) Standard 485-1983, "Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations." However, 1.25 was used in Calculation TE-119, "125-V Station Batteries," Revision 4, April 6, 1990. As a result of this observation, the licensee issued a memorandum on August 10, 1990, which requested a correction to DBD-02 to indicate an aging factor of 1.25.

2.1.7 Emergency Diesel Generators

Each emergency diesel generator (EDG) unit at Trojan consisted of two diesel engines connected in tandem to a single alternator and had a steady-state annual continuous rating of 4418 kW and a continuous (200-hr) rating of 4920 kW. The team reviewed the licensee's recent calculation, TE-124, "Emergency Diesel Loading Calculation," Revision 3, August 28, 1990, which established the steady-state and transient load requirements for various operating conditions. The latest draft revision of this calculation met the industry standards and complied with the criteria in Appendix A to IEEE Standard 387-1984, "IEEE Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Stations." The calculation showed that the worst-case steady-state load was 4077 kW, which is 341 kW below the EDG annual continuous rating of 4418 kW. The peak transient load during load sequencing was 4679 kW, which is 241 kW below the EDG continuous rating of 4920 kW.

Calculation TE-124 showed that the reactive kilovolt-ampere (kvar) rating of the EDG associated with train A was exceeded when the first sequenced load was connected to the bus. The maximum EDG rating of 3751 kvar was shown to be exceeded by 390 kvar. The EDG kvar rating was also exceeded when certain other sequence loads were connected. The licensee stated that this was a transient condition that would result in a voltage dip, but the voltage would not fall below stipulated values and the voltage regulator would restore the voltage before the next sequenced load was connected to the bus. The licensee also indicated that an EDG load capability study to be performed by the diesel generator manufacturer will provide further assurance on this point. The team accepted the licensee's position because the power (kW) rating of the EDGs was not exceeded when any of the sequenced loads were connected.

Transformer magnetizing currents had not been considered in Calculation TE-124. The initial load connected to the EDGs consists of small loads supplied through motor control centers and load centers (which also have other large loads connected to them) from the 4160-Vac ESF buses through stepdown transformers. These transformers will draw a transient magnetizing current that may affect the bus voltage regulation when power is restored to the 4160-Vac buses by the EDGs. However, after referring to various technical sources (text books and consultants), the licensee concluded that the effects could be ignored because the transient will have decayed before the first sequenced load is applied. The licensee also noted that no problems as a result of this transient have been reported during load tests. The team accepted the licensee's response.

The team noted the following concerns with regard to the licensee's Design-Basis Document (DBD) 24 for the emergency diesel generator system:

- As stated in DBD-24, Bechtel Specification G478-M-16 requires that the EDG have the capability of starting a 750-hp motor when operating under a 4182-kW base load. (Actual maximum load would not exceed 4077 kW). Because a 750-hp motor would require approximately 1060 kW on starting, making the total power requirement 5242 kW, the maximum 30-minute rating of the EDG of 5003 kW would be exceeded by 239 kW.

  The licensee stated that it would contact Bechtel Corporation for a position on the above requirement and determine its applicability to the Trojan plant. This item will remain unresolved until the licensee completes its review. (See Appendix A to this report, Unresolved Item 90-200-02.)

- DBD-24 stated that the system voltage must not fall below 72 percent of rated value when starting sequenced loads. However, NRC Regulatory Guide (RG) 1.9 (1971), "Selection of Diesel Generator Set Capacity for Standby Power Sources," states that the voltage must not fall below 75 percent and the frequency must not fall below 95 percent. Section 8.3.1.2.6 of the UFSAR stated that the standby power supply system was designed to meet RG 1.9. The UFSAR also stated that preoperational tests were performed by the diesel generator manufacturer to verify that the variations in frequency were in accordance with RG 1.9. In addition, the licensee had issued a purchase order (July 1990) to the EDG manufacturer (Morrison-Knudsen) to evaluate the load-starting capability of the EDG on the basis of the licensee's loading calculation (TE-124) and to verify that the voltage and frequency regulation requirements in RG 1.9 are met. The licensee also indicated that all motor loads required to operate during an emergency are specified to function at 70 percent of rated terminal voltage.

O Section 8.3.1.2.6 of the UFSAR stated that the EDG system was designed to meet RG 1.6 (1971), "Independence Between Redundant (On-Site) Power Sources and Between Their Distribution Systems." This regulatory guide indicates that when two or more prime movers operate a single generator, the licensee should demonstrate that the arrangement has a reliability equivalent to that of a single engine driving a single generator. However, no analysis was referenced in DBD-24.

The licensee provided evidence that Bechtel Corporation had assessed the reliability of the tandem unit and NRC safety evaluation reports that had judged the reliability to be acceptable. The licensee also noted that similar units were installed at other nuclear stations.

2.2 Protection and Coordination

2.2.1 Protection

The licensee had issued several documents for the selection of devices for equipment protection and settings for the devices. The documents were Design Criteria 3.2, "Criteria for New/Replacement Fuse Selection, Fuse Numbering and Fuse Tag Color-Coding," Revision 1, July 17, 1989; Design Criteria 3.3, "Criteria for Sizing Thermal Overloads and Circuit Breakers Used in Safety-Related Motor Operated Valves," Revision 1, June 26, 1989; and Design Criteria 3.5, "Criteria for Establishing the Overload Device Settings for Continuous-Duty AC Motors Used in Safety-Related Application," Revision 1, May 21, 1990. These documents were well-written, complete, and comprehensive.

Fuse types and ratings are documented in the licensee's Drawing Series E-22, "Electrical Fuse Schedule," and protective device selections and settings are documented in Drawing Series E-56, "Protective Device Coordination Setpoints." Many of the protective device selections and settings, as documented in these drawings, were based on Bechtel Calculations XII B, "Protective Relay Calculations," Revision 3, August 31, 1973, and XII C, "Relay Coordination," Revision 0, August 9, 1973, which had been performed during the station's design phase. The methodology in the calculations was acceptable and proper coordination had been achieved. However, input data on protected equipment, in many cases, were based on assumed data. In addition, the licensee was in the process of verifying the protection device selections and settings. The team noted that future changes to correct improper equipment protection can change coordination requirements.

The team also found that the licensee had no formal program to control the replacement of fuses. (See Section 4.3 and Appendix A to this report, Unresolved Item 90-200-16).

2.2.2 Protection Coordination

The licensee's Drawing Series E-57, "Protective Device Coordination Curve," presented time-current operating curves for the various protective devices. The curves were based on protective device characteristics and settings established in Drawing Series E-22 and E-56. Acceptable coordination between protective devices existed; however, coordination could be affected by any setting changes resulting from the licensee's verification program mentioned in Section 2.2.1.

2.2.3 Emergency Diesel Generator Load Sequencing

As determined from the 4.16 kV Electrical Distribution System Operating Manual, 02-C-04-5D, two load sequencing systems are provided for each train. One system serves loads that are to be started following a design-basis accident (DBA), operates on receipt of a safety injection signal (SIS), and consists of 10 Agastat timers, which connect the large safety-related loads to the bus at intervals of 4.5 seconds. The second system, consisting of 4 Agastat timers, reconnects large loads required to operate during a normal shutdown. The Agastat timers used in both sequencing systems are type ETR, which have been environmentally qualified in accordance with IEEE Standard 323-1974, "Qualifying Class 1E Equipment for Nuclear Power Plants," and seismically qualified in accordance with IEEE Standard 344-1975, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Plants." The timing relay coils are rated at 120 Vac and are connected via a circuit breaker to the 120-Vac preferred instrument bus, which ensures availability of power at all times.

System Operating Manual 02-C-04-5D indicated that, following the receipt of an SIS, the ESF loads are connected in sequence by the DBA sequencer regardless of whether there had been a bus undervoltage. Because the team noted that this requirement was not addressed in DBD-24, the licensee indicated it would revise the DBD.

The team reviewed electrical schematic drawings that showed the connections of the Agastat timers to the 120-Vac preferred instrument bus and how the sequencer contacts operate the circuit breaker closing coils for the individual large loads. The team identified no inconsistencies. Trace records that were taken when the sequencing system connected loads to the EDGs showed that the required 4.5 second intervals between load applications were met.

The load sequencing system met the design requirements on the basis of evidence provided in the documentation submitted by the licensee and the team's assessment of the operation of the systems.

2.3 Class 1E 120-VAC System

PGE replaced the original Westinghouse inverters with Elgar Ltd. inverters of similar ratings (7.5 kVa) in 1987-1988. The new inverters were qualified for Class 1E service in accordance with IEEE Standards 323-1974, 344-1975, and 650-1979, "Standard for Qualification of Class 1E Static Battery Chargers and Inverters for Nuclear Power Plants." In the original scheme, the 480-Vac Class 1E buses supplied power through stepdown transformers to the preferred instrument ac buses. If this normal power source failed, a switch would automatically transfer the preferred instrument ac buses to the inverter output for power. With the new arrangement, the inverter provides the normal supply of power. If the inverter fails or the dc input to the inverter is lost, a static switch transfers the preferred instrument ac buses to the 480-Vac Class 1E buses. The team believes the new arrangement does not reduce the reliability of the preferred 120-Vac system and, in fact, improves the voltage regulation of the preferred ac buses.

After the team reviewed the UFSAR and DBD-57 for the 120-Vac preferred instrument system, several observations were satisfactorily resolved during the inspection:

- During the inverter qualification tests conducted by Elgar, various parameters were monitored continuously. However, the DBD did not include output frequency as a parameter that had been monitored. The licensee provided a copy of the qualification test that showed that output frequency was monitored and initiated a change to the DBD to reflect this fact.

- The team was concerned about voltage regulation from the stepdown transformer provided in the Elgar inverter equipment for the bypass supply. The licensee stated that it was a high isolation type transformer, but was nonregulating, and that in the event of a transfer to the bypass supply on any inverter, the plant would go into an 8-hour action statement in accordance with TS Section 3.8.2.1 because the bus was considered to be in a degraded condition. This response satisfied the team's concern regarding a nonregulated bypass supply.

The team reviewed the following three calculations, which covered the 120-Vac preferred instrument system, and identified concerns with licensee corrective actions for previously identified problems.

- Calculation TE-176, "Input Specification for Loads Connected to the Preferred Instrument AC Buses," evaluated all loads connected to these buses in terms of their susceptibility to frequency transients ranging from 56 Hz to 68 Hz. This calculation was prepared as a response to concerns about inverter output voltages raised in NRC Inspection Report (IR) 344-50/89-09. The purpose of the calculation was to evaluate the manufacturer's stated frequency and voltage tolerance for each type of connected device and to assess the internal circuitry of the instrumentation devices in order to further consider the effects of frequency and voltage transients. The calculation showed that all devices could tolerate the above frequency transients. It also showed that most instruments connected to the buses could tolerate voltages ranging from 108 to 121 Vac. Only two devices could not tolerate this voltage range. The licensee had initiated Request for Design Change (RDC) 88-16 to replace these devices. The team found that the calculation was technically accurate and covered all requirements; however, the question of voltage drops between the buses and the individual instruments had not been addressed.

  The licensee agreed to add voltage losses to the calculation it had committed to perform by November 1, 1990, in response to the issues in IR 50-344/89-09. In addition, the licensee committed to determine the setpoints for and set the high- and low-voltage level alarms for the inverter outputs by May 31, 1991. The team concluded that the licensee's actions were not timely, given the importance of the affected equipment. (See Appendix A to this report, Unresolved Item 90-200-03.) Following the inspection, the licensee met with representatives from NRC Region V and committed to complete all actions regarding the inverter output calculations and setpoint changes before the restart after the next planned refueling outage.

- Calculation TE-183, "Accuracy of 120 V Preferred Instrument AC Inverter Output Voltmeters," Revision 0, February 22, 1990, also was prepared in response to NRC IR 344-50/89-09. This calculation showed that the accuracy of the inverter output voltmeters was within plus or minus 4.5 Vac, which is equivalent to plus or minus 3.75 percent of the inverter output at 120 Vac. The team noted that it would be difficult to confirm the manufacturer's stated output voltage regulation for the inverters of plus or minus 2 percent with meters of this accuracy. The licensee has used the voltmeters in Periodic Operations Test (POT) 21-2, "ESF and Offsite Power Availability," to determine the operability of the 120-Vac preferred buses as specified in the TS. The team was concerned that important loads on the preferred 120-Vac buses could be supplied with power that was outside their design parameters and the licensee would be unaware of the condition. The licensee also initiated RDC 90-24 on July 8, 1990, to evaluate the replacement of the voltmeters with meters of higher accuracy. Following the inspection, the licensee committed to NRC Region V personnel to provide a commitment date for final resolution of the use of the existing voltmeters and POT 21-2 to determine operability of the inverters.

- Calculation TE-125, "Fault Current Analysis and Fuse Breaker Coordination Associated With Inverter Replacement," stated that the highest fault conditions occurred when the inverter output was unavailable and the system was operating in the bypass mode. The calculation showed that the fault currents did not exceed equipment ratings and that proper coordination was achieved between the various devices. The team found that the calculation was performed in accordance with accepted procedures and was technically accurate.

The team noted that circuit breakers had been installed in two separate panels for each bus and that fast-acting fuses had been added in series with the breakers. However, details of these arrangements were not shown on the system single-line drawings for the system or UFSAR Figure 8.3-32 and were not detailed in the DBD for the system. The licensee stated that the breaker panels had been added to serve new loads and were qualified Class 1E panels rated at 50,000-amperes. The licensee initiated a licensing document change request on June 28, 1990, to update the UFSAR to show the actual two-panel arrangement. The licensee also indicated that new drawings are being produced in the E-1100 series which will show, for each circuit breaker in the panels, the fuse arrangement and the connected loads. These drawings are scheduled to be completed by the end of 1991. Although the team considers the actions appropriate, it considers this to be an excessively long schedule in view of the importance of this system.

The 120-Vac system design allows for the connection of two preferred 120-Vac instrument buses to a single 120-Vac instrument bus by means of separate circuit breakers. The instrument ac bus is supplied by a single regulating transformer rated at 22.5 kVA. The licensee informed the team that the transformer was not rated to carry two preferred instrument ac buses when supplying its normal load. However, the licensee stated that administrative controls prevent the simultaneous closing of both breakers. Basically the instrument ac bus serves only as a backup for maintenance purposes (e.g., an out-of-service inverter), and in this situation the station would be an 8-hour action statement. Because the team could not identify any potential actions that would simultaneously close both circuit breakers, it accepted the licensee's position.

2.4 Conclusions

The design of the the Class 1E electrical distribution system provided sufficient capacity and capability to ensure that quality electrical power was provided to safety-related equipment in the event of a design-basis accident. However, deficiencies existed in the licensee's design control measures for calculations. In addition, in several instances, the licensee had failed to fully resolve previously identified problems in a timely manner.

3.0 MECHANICAL DESIGN REVIEW

The team reviewed the capability of the mechanical systems to support the function of the emergency diesel generators (EDGs) during normal and postulated accidents. This review included selected sample documentation such as design-basis documents (DBDs), updated Final Safety Analysis Report (UFSAR), piping and instrument diagrams (P&IDs), drawings, and calculations and walkdown inspections of the diesel fuel oil, air start, cooling, and lubricating oil systems. The team also reviewed the design associated with the ventilation of the diesel generator rooms located in the turbine building; the heating, ventilation, and air conditioning (HVAC) systems of the battery rooms and switchgear rooms located in the control building; and the HVAC system in the reactor auxiliary building where the component cooling water and service water booster pumps are located. The team reviewed selected portions of the service water and component cooling water system along with the DBD for hazards external to the site.

From its review of the design documents, the team identified concerns related to the mechanical design. In many instances the team found that the licensee had identified these concerns as open items, but had yet to resolve them. This report does not discuss these concerns; however, the number of open items and the lack of a timely resolution are discussed in Section 5.2.

3.1 Emergency Diesel Generator Air Start System

The team reviewed DBD-24, Revision 0, for the emergency diesel generator system, the UFSAR, and the P&ID associated with the diesel generator air start system. The A and B train air tanks were interconnected by two locked-closed valves on the supply and return lines. The team was concerned that these valves could be left open inadvertently and, if one relief valve on either train failed, both systems could become inoperable. The licensee showed that the operation of the valves was properly controlled through station procedures (MP-12-7 and POT 24-3) to prevent such a situation.

DBD-24 stated that the aftercooler located downstream from the air compressor was capable of cooling compressed air from 350°F to 100°F assuming an ambient air temperature of 80°F. However, since the design ambient air temperature in the EDG room was 104°F, the team was concerned whether both the aftercooler and the air dryer (which was also located in the room and was air cooled) were properly sized to meet the design dew point of 35°F. An improperly sized aftercooler and air dryer could cause more moisture to enter the air tank system leading to corrosion or dirt, which could affect the air start motors on the EDGs. Bechtel Corporation had identified this concern in letter BP-5195 dated August 15, 1974, as a significant problem for air start systems. The licensee stated that Procedures POT 24-3 and MP 12-7 were used regularly (weekly) to drain water from the air tanks to prevent problems caused by moisture with the air start motors. However, the licensee stated it would review the design of the equipment to ensure that the equipment could meet the dew point requirement assuming a higher ambient air temperature. This concern is part of a more general concern regarding the EDG room temperatures that is discussed in Section 3.4.

3.2 Emergency Diesel Generator Fuel Oil System

The team reviewed the UFSAR; DBD-23, "Diesel Fuel Oil System" (draft); the P&ID; and calculations related to the sizing of the fuel oil storage and day tanks and the transfer pumps. The EDG diesel fuel oil system consists of two trains. Each train consists of a storage tank, a transfer pump, a day tank, and the associated instrumentation. The transfer pumps supply fuel oil from the storage tanks to the day tanks for both the auxiliary feedwater pump and the fire pump in addition to EDG day tanks.

The team found the seismic analysis for the support of the diesel fuel oil transfer pumps acceptable. However, it was concerned about a lack of indication for potential blockage of the inlet strainer to the transfer pumps. The licensee showed that, by using Procedure POT 13-1, "Diesel Fuel Oil Transfer Pumps Flow Test," it was able to ascertain if the inlet strainer was blocked. The team found the licensee's response acceptable.

The team verified that sufficient net positive suction head (NPSH) was provided by the day tank to the fuel pumps mounted on the engines. The operating data sheet for the diesel engines showed that the pump had a maximum suction lift of 12 feet. A calculation prepared by the licensee showed that the required NPSH was 21.9 feet and the available NPSH was 30.5 feet. Thus, the team had no concern regarding pump cavitation and found the calculation to be acceptable. The team also found that the level control logic for the diesel transfer pump, storage tanks, and day tanks was acceptable.

3.2.1 Fuel Oil Capacities

The team reviewed the capability of the EDG fuel oil system to maintain 1370 gallons of fuel in each of the day tanks and 33,000 gallons of fuel in each of the storage tanks as required by the TS. The original fuel oil capacity calculations, which were done by Bechtel Corporation in 1971, contained no references or basis for the numbers used in the calculations. During the inspection, the licensee had Bechtel perform a new calculation to verify the sizing of the diesel fuel oil storage tanks in terms of the varying specific gravity of the fuel and the fuel consumption rates of the EDGs. Although Bechtel Calculation 12-31, "Diesel Fuel Oil Storage Tank Sizing," Revision 1, August 23, 1990, contained a few mathematical errors and wrong assumptions, the results appeared to still be valid. The team used this calculation as the basis for the evaluation of the EDG diesel fuel oil system.

The calculation indicated that the specific gravity of number 2 diesel fuel oil ranged from 0.82 to 0.95; a minimum value of 0.825 with a maximum theoretical EDG consumption rate of 338.14 gallons per hour was used for the conditions resulting in the maximum volume of fuel capacity required to meet the plant's design-basis requirements. The calculation determined that this theoretical maximum volume of fuel oil to be 33,823 gallons, which exceeded the TS limit by 823 gallons. The calculation also determined that, to meet the design-basis requirements with the TS required limit of 33,000 gallons, the specific gravity of the fuel oil could be be no less than approximately 0.850 (assuming maximum consumption rate for the EDGs). The team reviewed a sample of data sheets from 1988 to July 1990 for fuel oil analysis performed by PGE Analytical Services. The data sheets indicated a range of 0.8676 to 0.8581, corrected to 60°F, for the specific gravity of diesel fuel oil used in the storage tanks and the day tanks. Although the use of a fuel oil with a specific gravity of 0.825 appeared to be unlikely, the licensee did not have any restriction on the use of fuel oil with a low specific gravity.

The fuel oil specific gravity, which was used to obtain the fuel density, played a pivotal role in determining the fuel capacity requirements and maintaining the TS required volume. The pivotal role was evident in Revision 3 of Calculation 87-04, "Diesel Fuel Oil Storage Tank CROCTRM [Control Room Operating Curve and Table Reference Manual] Curve." To maintain the TS required capacity, the calculation directed the plant operations group to increase the minimum indicated level of the storage tanks from 81 percent to 83 percent. This restriction on operations was required because the displacer-type level transmitters were calibrated for a fuel oil with a specific gravity of 0.85 and the actual specific gravity of the fuel oil was 0.865. The higher specific gravity caused the level transmitters to indicate a higher level for the same volume of fuel oil.

The fuel oil specific gravity was a vital parameter in the capacity and calibration calculations and, although the licensee had no documented requirement to test the specific gravity, the onsite chemistry department had been testing for specific gravity for a number of years because of a request from the engineering department. The team found, however, that the data was not being evaluated for potential effects on the EDG fuel oil system.

The team found the following discrepancies in Bechtel Calculation 12-31.

- The calculation, in sizing the diesel fuel oil storage tank, assumed that the transfer pump suction was 6 inches above the bottom of the tank. However, vendor Drawing 6478-M30-3-3 showed that the centerline of the suction strainer was 7.5 inches from the inside bottom of the tank. More importantly, the transfer pump, as shown on the level setting diagram, M537-34, Revision 2, would stop pumping when the fuel level was approximately 12 inches from the bottom of the tank. Even though the actual configuration of the tanks was not considered in the calculation, the 40,000-gallon capacity of the storage tanks appeared to be adequate and compensated for the these discrepancies.

- The calculation assumed that diesel fuel oil was not strongly temperature dependent. However, the team felt that temperature dependence was a factor for a volume of 33,000 gallons. The volumes of fuel oil being displaced by the submerged fuel pump and level transmitter also were not considered in the calculation.

The TS require that each EDG day tank have a capacity of 1370 gallons to ensure that the fuel oil needed for 4 hours of EDG operation at full rated load is available. Using the minimum fuel oil specific gravity and maximum EDG consumption rate from Bechtel Calculation 12-31, the team calculated that approximately 1353 gallons are needed for 4 hours of EDG operation. The team, therefore, had no concerns about the required day tank capacity.

The team found that the level instruments for the EDG day tanks were calibrated for a fuel oil specific gravity (0.85) that was less than the actual specific gravity (0.865). However, the licensee was able to show that the difference in specific gravities was appropriate to compensate for the differences in ambient temperatures between the storage tanks (buried outdoors) and the day tanks (in the EDG rooms).

The team identified the following concern regarding the expected drift for the level instruments. Installed in each of the EDG fuel oil day tanks were two pressure switches, LS-4905 and LS-4911, to monitor the level and to start the transfer pump at a low level in either day tank. According to licensee Calculation TE-166, "Setpoint and Accuracy Calculation for ITT Barton 288A Switches LS-4905 A/B and LS-4911 A/B," the setpoint to start the transfer pump could drift below the level required to maintain the TS limit. The licensee identified the problem in 1989 and initiated a justification for continuing operation (JCO) for review by the Plant Review Board (PRB). The PRB cancelled the JCO concluding that normal sensor drift had caused a single switch to be below the TS required minimum gallons, but there was no case where both switches on the same tank had been below the TS required minimum. However, the PRB did not consider that the setpoints for both switches could drift below the TS limit, as was shown by calculation TE-166. Both level switches were the same type and model. Maintenance records for the level switches showed that all four switches had been out of calibration numerous times. For example, LS-4911B had failed while it was in service on April 26, 1990, and the setpoints for LS-4911A had drifted below the TS limit on October 12, 1989. In addition, level transmitters (LT-4904A and B), that were seismically qualified but were not safety-related, provided the low-level alarm for the operators. The licensee stated that Commitment Tracking List (CTL) Item 30952 showed that the level switches were to be replaced and that they were being tracked under the 5-year plan. However, the licensee had set no date for replacing them. The licensee indicated it would reevaluate the level instrument drift concern.

The diesel fuel oil storage system appeared to be able to meet its design intent and to maintain 1370 gallons of fuel in each of the day tanks and 33,000 gallons of fuel in each of the storage tanks as required by the Technical Specifications, assuming the specific gravity of the diesel fuel oil was equal to or greater than the industry average of 0.85.

3.2.2 External Hazards

Section 3.3 of DBD-C2, "Site External Hazards," Revision 0, stated that the diesel fuel storage and supply system was required for safe shutdown after a tornado. However, the diesel storage tank vent lines with flame arrestors were not qualified to withstand a tornado. Each vent line and its flame arrestor were located outdoors and extended above ground by approximately 7 feet and were seismically qualified. A tornado-generated missile (such as a 4000-lb passenger car traveling at 40 mph, as stipulated in the UFSAR) could either sever or crush both the vent lines.

During its walkdown of this system, the team identified two potential tornado-generated missiles within 20 to 30 feet of the vent lines. If the lines were severed, each tank would be exposed to the ambient atmosphere and a fire or an explosion could occur because the flame arrestor would no longer be available. In addition, dirt and debris could enter the tanks and cause the transfer pumps to be clogged or damaged. If the vent lines were crushed, the diesel transfer pumps could draw a vacuum in the tanks that would lead to pump cavitation, damage to the pumps, and possible crushing of the storage tanks. In both cases, the possibility existed that after a tornado both storage tanks could be damaged and operation of the diesel fuel oil system could be impaired. However, documents related to the original licensing of Trojan indicated that only tornado effects on structures (buildings) were addressed. This item remains unresolved until NRC's Office of Nuclear Reactor Regulation performs a review to determine if such effects on components are applicable to the plant's design. (See Appendix A to this report, Unresolved Item 90-200-04.)

3.3 Diesel Generator Cooling Systems

3.3.1 Combustion Air Cooling

Inconsistencies in the combustion air cooler design air temperatures existed. Page 4-2 of DBD-24 indicated that the combustion air intake system was designed to operate at a maximum intake air temperature of 104°F and a minimum air temperature of 40°F minimum. UFSAR Section 9.4.3 stated that the combustion air coolers were designed to operate if incoming air reached 92°F. However, the UFSAR stated that the design temperature for the EDG rooms was 104°F when the diesels are not in operation and 116°F when the diesels are in operation. Therefore, the team believed the coolers should have been designed for the maximum temperature of 116°F. In response to the team's concern, the licensee stated that outside air was brought into the EDG room and exhausted very close to the combustion air cooler, making the intake to the combustion air cooler a mixture of outside air and EDG room air. Since the maximum outside summer air temperature was 91°F and the EDG room temperature was 116°F, then the 104°F design value was reasonable for the combustion air cooler design.

When the team applied the same approach of mixing outside winter air with EDG room air to the minimum air cooler design temperature, it determined that the temperature of the incoming air would be approximately 37°F, which was less than the design minimum temperature of 40°F. The licensee was unable to produce calculations to support the design of the combustion air cooler. Although the team felt that these temperature differences for the air cooler would not significantly affect diesel performance, documents such as the DBD and UFSAR were not consistent. The licensee agreed to review the documentation and to ensure consistent design temperature values are used.

3.3.2 EDG Room Ventilation and Cooling

The EDG rooms and supporting systems, including the ventilating systems, are located in the turbine building. The team identified deficiencies and concerns with regard to the operation and design of the ventilating system for the EDGs.

- The ventilating systems for EDG rooms were designed such that they did not operate unless the EDGs were operating. Considering the heat sources in the rooms, the temperatures in the EDG rooms when the diesels were not in operation could exceed 104°F, the maximum design temperature for this condition. The licensee had no documentation to confirm that the temperature in the EDG rooms would not exceed 104°F, and during a visit to the west EDG room when the EDGs were not in operation, the team found the room temperature was 106°F.

As a result of the team's finding, the licensee issued CAR C90-1042, dated August 10, 1990, to determine if the EDG ventilating system could maintain the room temperature below 116°F if the initial room temperature was more than 104°F. However, this CAR failed to address some additional issues, including (1) the maximum temperature that could occur in the EDG room when the EDGs and ventilating system were not in operation; (2) the immediate effects of an ambient temperature higher than the design temperature on the electrical and mechanical equipment in the room, such as control and exciter panels and the air start system; and (3) the long-term effect on the equipment in the room of room temperatures exceeding 104°F. As an interim measure, the licensee began monitoring the EDG room temperatures and manually starting the ventilating system when the temperatures neared 104°F.

The licensee had failed to maintain the EDG room ambient temperatures within design limits and to support the validity of the established design maximum temperature. (See Appendix A to this report, Unresolved Item 90-200-05).

- The licensee stated that two calculations could substantiate that the EDG room temperature would not exceed 116°F, the maximum design temperature for the rooms when the diesels are in operation. However, the team had major concerns about both calculations. The original calculation, "Emergency Diesel Generator Room H & V calculations," December 1, 1973, which had been performed by Bechtel, showed that, without using any additional margins for the room heat loads, the maximum room temperature would slightly exceed the 116°F design value with the current ventilating system supply and exhaust air flows. When the calculation added an additional margin of 10 percent to the heat load, the maximum room temperature was 119°F. The team believed that this calculation indicated that the wrong design values had been used for the EDG ventilation system, and the calculation was another example of an unverified design parameter. (See Appendix A to this report, Unresolved Item 90-200-01.)

  The other calculation, licensee Calculation TM-123, "EDG Ventilation Heat Load," Revision 0, November 31, 1984, concluded that the room temperature would be 115°F during summer design conditions. However, the calculation method had several weaknesses. The calculation method, a heat balance for the EDG rooms, was justified on the basis of readings taken during an EDG operational test. The heat rejected by the EDG was calculated and found to be within 5 percent of published values. However, no error margins were associated with the test readings. If margins for measurement error were considered, the heat reject value may have been outside published values, thereby invalidating this calculation method. In addition, incorrect design values had been selected; for example (1) a combustion air temperature of 102°F instead of the design temperature of 104°F was used; (2) the supply air was assumed to be outside air at a temperature of 91°F, whereas the supply air was taken from inside the turbine building corridor, where the temperature could be higher; and (3) the combustion air flow was assumed to be 18,080 cubic feet per minute (cfm) whereas the design value was 19,300 cfm. The team felt that these weaknesses and inconsistencies made the validity of this calculation questionable, and that the calculation was another example of the licensee's failure to adequately verify design. (See Appendix A to this report, Unresolved Item 90-200-01.)

Because of the team's concern, the licensee issued CAR C90-1049, dated August 25, 1990, to fully review the EDG room HVAC calculations.

- In accordance with the design, the normal air supply duct to the west EDG room passes through the east EDG room. If a failure (such as a fire) in the east EDG room reduced or eliminated the air flow to the west EDG room, then an adjustable louvre on the south wall of the west EDG room would be opened by a damper to provide air to the room. However, no design calculations were available to prove that sufficient air for both diesel combustion and room cooling would enter through this adjustable louvre. The physical arrangement of equipment made the air path and amount of air available for cooling the electrical equipment uncertain. The adjustable louvre was located in the south wall, most of the electrical equipment was located on the north wall, and the EDG with its tandem diesel engines was located in the middle of the room. Should insufficient air be provided for cooling, the ambient temperature for the electrical equipment would not be maintained within design parameters. The licensee issued CAR C90-1054 to address this concern. This item will remain unresolved until the licensee completes its evaluation. (See Appendix A to this report, Unresolved Item 90-200-06.)

3.3.3 External Hazards

DBD C-2, "Site External Hazards," Revision 0, September 28, 1988, stated that the ventilating system for the EDG room was required for safe shutdown after a tornado. The design tornado, applicable for this system and defined by the DBD and the UFSAR, was a 200-mph tornado with a tornado-induced pressure differential of 1.5 psi occurring in 1.5 seconds. DBD C-2 indicated that the structures were designed for the pressure differential but did not indicate if the EDG room ventilation ducting or diesel exhaust ducting were similarly qualified. The licensee stated that the ducting had not been analyzed for this pressure differential. If this ducting was not capable of withstanding the pressure differential, it could be crushed under the design-basis tornado. Damage to the ducting could greatly limit the amount of cooling to the EDG rooms so that design temperatures could be exceeded, or could impair the release of combustion gases, thereby rendering the diesel engines inoperable. Documents related to the original licensing of Trojan indicated that only tornado effects on structures were addressed. Therefore, this item will remain unresolved until NRC's Office of Nuclear Reactor Regulation performs additional review to determine if such tornado effects on components are applicable to the plant's design. (See Appendix A to this report, Unresolved Item 90-200-07.)

3.4 Class 1E HVAC Systems

Several Bechtel calculations for room cooler operability in the turbine building switchgear room and the electrical auxiliary room were satisfactory. However, the team identified one inconsistency in that different design margins were used for the heat load determination. The team did not review the problems with the HVAC system for the switchgear and the electrical auxiliary room, which the licensee had previously identified and made commitments to correct.

Bechtel Calculations 28-1 and 28-5 for the Class 1E switchgear cooling system, TB-8, showed that the system, with only one operating fan-coil cooling unit, could not maintain the switchgear room temperature at or below the summer design temperature of 104°F if the engineered safety features (ESF) switchgear was energized. Section 9.4.3 of the UFSAR, however, stated that the temperatures were maintained at or below 104°F with one fan unit available. Bechtel indicated that the original design intent was to require that two units be available. When the team raised this concern with the licensee, the licensee stated it had previously reviewed this question and had initiated Licensing Document Change Request (LDCR) MNH-0968-90M. The LDCR will change the UFSAR description from one available fan unit to two available fan units. The team found the licensee's response acceptable.

3.5 Service Water System

The team reviewed the UFSAR and DBD-11 for the service water system (SWS) because of the importance of the system to the cooling requirements for the electrical distribution system (EDS). In addition, it reviewed calculations related to the NPSH for the service water pumps and booster pumps. The team found no significant errors in its cursory review of the calculations. However, it identified several aspects of the system that apparently were not considered in the system's original design.

O No minimum design temperature for the service water system was specified in DBD-11 or the UFSAR, although a maximum design temperature of 75°F was specified as the summer condition. Only the maximum service water system temperature was considered in all of the SWS-related analyses the team reviewed for the EDS. None of the analyses considered the effects of a minimum service water system temperature. The DBD showed that, over a 3-year period (1987-1989), the service water system temperatures were near the freezing point. The team was concerned that the effects of cold SWS water had not been considered for ESF equipment such as the centrifugal charging pump, the SI pumps and the CCW heat exchangers. The licensee confirmed that there was no minimum service water system design temperature and stated that it would review the effect of cold service water on the ESF equipment.

O The evaluation of the maximum expected effects of pressure transients (waterhammer) discussed in DBD-11, Section 3.1, did not consider a partially drained system. The licensee agreed with the team that it was possible to partially drain the piping between the service water pumps and the service water booster pumps and also to partially drain the piping downstream of the service water booster pumps. If a service water pump was automatically started after a partial drain, a waterhammer could occur in the system. The waterhammer would effect both the system equipment and piping. Although the licensee was not aware of any past occurrences of waterhammer during plant operation, it would review the effects of pressure transients on the system.

The issues of no minimum design temperature and potential pressure transients for the service water system remain unresolved pending completion of the licensee's review. (See Appendix A to this report, Unresolved Item 90-200-08.)

The team also identified a problem with one of the many drawing change notices (DCNs) it reviewed during the inspection. DCN-74 for Revision 44 of the service water P&ID, M-218 sheet 1, was on a version of M-218 that was significantly different from the original drawing. When the licensee reviewed this anomaly, it discovered that the operator for the computerized drawing system had rearranged the P&ID in addition to incorporating the DCN. Although the licensee stated that such a change appeared to be an isolated situation, it agreed to investigate the matter further to ensure that extensive changes to approved drawings would be monitored more closely.

3.6 Reactor Auxiliary Building HVAC System

The team performed a limited review of the reactor auxiliary building HVAC system (AB-1) that services the component cooling water (CCW) pumps. Section 9.4.2.1 of the UFSAR stated that the fan cooling units would maintain ambient temperatures at each CCW pump motor at or below 104°F. During normal plant operation, both CCW pumps and their respective coolers, V256A and B, would operate. The UFSAR and the electrical schematics showed that the fan cooling unit would not control the CCW pump operation and the pumps would continue running if the fans stopped.

The temperature in the CCW pump room could exceed 104°F if one cooling unit failed because both CCW pumps would continue to operate and were major heat sources in the room. The situation could go unnoticed for some time because the room temperature was only indicated locally and in the control room only on operator demand, and there was no alarm to alert the plant operators. A high room temperature could lead to failure of both CCW pumps and might affect electrical cables. Bechtel had recently completed a heat load and operability analysis for all the ESF pumps located in the reactor auxiliary building. The calculations showed that, for the CCW pump room the difference between the cooler capacity and the room heat load was a marginal 100 Btu/hr. Coolers V256 A and B had a cooling capacity of approximately 138,000 Btu/hr at design conditions. From these calculations, the team determined that failure of one cooling unit would certainly result in a room temperature that was higher than the UFSAR limit of 104°F. It also determined that, because of the small margin between cooling capacity and room heat load, any changes in the design variables, such as reduced cooling coil surface area or increased service water temperature, also would result in a room temperature higher than 104°F.

The licensee stated that it was still reviewing these Bechtel calculations, including their possible safety implications. It also stated that a high CCW room temperature would be detected because the CCW room temperature was primarily monitored by an operator during rounds made at least once a shift. The team noted, however, that check sheets for operator rounds, which could be used to record room temperatures, do not exist at Trojan. The licensee stated that its review of the Bechtel calculations would include the effect of losing one cooling unit while both CCW pumps continued to operate. This item will remain an unresolved issue until the licensee completes its review. (See Appendix A of this report, Unresolved Item 90-200-09.)

3.7 Conclusions

The appropriate technical staff was knowledgeable of the mechanical systems, sufficient information was available to review and assess the operability of the mechanical systems, and the design-basis documents were a valuable resource for the plant. However, the team identified a number of findings that indicated additional calculations and reviews were required to ensure proper design of the EDG systems and their support systems, the service water system, and the reactor auxiliary building HVAC system.

4.0 ELECTRICAL DISTRIBUTION SYSTEM EQUIPMENT CONFIGURATION AND TESTING

The intent of this portion of the inspection was to determine on a random basis whether the equipment installed in the Trojan nuclear plant was the same as that required by design documents and to review the programs that may affect these systems or components, that is the surveillance test program, the maintenance program, and the modifications programs.

4.1 Equipment Walkdown Inspections

4.1.1 Transformers, Switchgear, and Motor Control Centers

The components included in the inspection of the transformers, switchgear, and motor control centers selected for review conformed to the design requirements documented in the UFSAR and in applicable plant drawings. The team verified conformance by comparing nameplate data with information from the UFSAR and the plant electrical drawings. Proper physical separation existed in the field for those components observed during the walkdown inspection. Equipment condition appeared good, transformer and oil circuit breakers were clean, no debris was evident in the switchyard, and transformers and oil circuit breaker tanks free of leaks.

Switchgear and motor control centers were clean and externally appeared in good condition. However, the team observed evidence of burned contacts in relay E-593A in panel C-165. The function of this relay was to automatically open the containment vent sample valve when the hydrogen fan is started. The licensee immediately initiated a maintenance request to replace the relay. Since other circuits were available to open the valve, this issue was of minor safety significance.

The team visually inspected four compartments of safety-related 480-Vac motor control center (MCC) B26. The compartment internals were clean. Wire harnesses were properly secured and maintained away from moving parts and door hinges. System drawings of a random sample of breakers, contactors, and overload relays correctly reflected the installed equipment. However, the team noted a gap of approximately one-eighth of an inch between two bus pieces providing power to the contactor for motor-operated valve MO-8802B (hot leg safety injection). The two bus pieces were required to be installed face to face and tightened with a screw. The team found that electrical continuity between the two bus pieces was maintained only through the screw.

The licensee determined that the electrical continuity provided by the screw was insufficient to ensure continued operability of valve MO-8802B, even though a previous operational test of the valve had been satisfactory, and declared the valve inoperable. The licensee investigated the gap and determined that although the screw was not loose, it was cross threaded in one of the two bus pieces. The licensee replaced the screw, tightened the bus pieces, and verified valve operation. Although the licensee had inspected MCC B26 in May 1988 in accordance with Procedure MP 1-7, "480 Volt Motor Control Center and Molded Case Circuit Breakers," Revision 0, March 10, 1988, it could not determine when the deficiency occurred. Paragraph III.A.5 of MP 1-7 required that accessible bus joints be inspected for tightness.

The licensee initiated maintenance requests to inspect other safety-related MCCs for similar problems.

4.1.2 Motors

The team inspected a selection of large pump motors and valve operator motors in the selected load path and found they were correctly reflected in the system drawings and component manuals. All areas inspected were clean and no defective conditions were noted.

4.1.3 Batteries, Battery Chargers, and Inverters

The team inspected both safety-related batteries and battery rooms, and found them to be clean. The team observed that all the spacers placed between several cells of 125-Vdc battery D12 did not appear to be made of the same type of material. The team questioned the acceptability of the seismic and flame-retardant characteristics of the materials used for this Class 1E battery. The licensee determined that all the spacers had been provided by the battery manufacturer and evaluated the fire loading in the battery room on Combustible Loading Worksheet (CLW) 90-004. The licensee determined the questionable spacer material had a negligible effect (2.5 seconds) on the postulated fire.

The team inspected the battery chargers and inverters and noted no unacceptable conditions when one inverter cubicle was opened. All areas inspected were clean. However, the output voltage for inverter Y17 was approximately 115 Vac, at the edge of an acceptable green band marked on the voltmeter by the licensee. See Section 2.3 of this report for a further discussion of inverter output voltage.

4.1.4 Circuit Breakers

A comparison of the nameplate data with the design drawings for 12.47-kV, 4.16-kV, and 480-V drawout type circuit breakers and molded-case circuit breakers in the 480-Vac and 120-Vac systems and 125-Vdc system showed that the installed circuit breakers conformed to the design requirements for loads, voltage, and interrupting capacities. Visual inspection of accessible circuit breakers showed that the breakers were clean and in good condition and that the electrical and mechanical connections were tight. In addition, the licensee was performing scheduled periodic testing to verify that each breaker was functional. See Section 2.1.4 for further discussion of a concern regarding test criteria for 125-Vdc circuit breakers.

4.1.5 Emergency Diesel Generators (EDGs)

During its walkdown inspections of portions of the B train EDG and support systems, including the air start system, diesel fuel oil system, service water system, and diesel room ventilation system, the team noted the following minor discrepancies:

- Isometric drawing HBD-72-6, Revision 12, incorrectly showed (1) the exit point from the diesel room for the diesel fuel oil day tank flame arrestor pipe, and (2) the location of pipe support HBD-72-6-SR-38 in relation to the diesel room ceiling.

- Valves D0028 and D0030 as shown on isometric drawing HBD-72-60, Revision 12, were not in the same position as the installed and labeled valves in the plant; that is, they were reversed.

- The diesel fuel oil day tank flame arrestor pipe in the turbine building was incorrectly painted red, a color reserved for fire protection systems.

Other than these minor deficiencies, the team noted no other concerns.

4.1.6 Cable and Raceway

The team found cable train separation in trays and conduits in the cable spreading room and switchgear rooms to be maintained in accordance with the UFSAR. In addition, fire barriers in the above areas appeared well maintained and were in accordance with UFSAR requirements.

After its inspection of cable trays and conduits and its review of the licensee's computerized cable tray and conduit raceway schedules and of the UFSAR, the team identified the following concerns:

- More than 145 conduits were designated as overfilled in the conduit raceway schedule. Section 8.3 of the UFSAR stated that conduit-fill limits were based on the 1971 National Electric Code and that any exceptions to the fill limits would be justified. However, the licensee was unable to locate any supporting analysis to justify overfilled conduits for either originally installed conduits or for recent plant modifications. The team, therefore, concluded that the unjustified overfill conditions deviated from the UFSAR requirements. (See Appendix A to this report, Unresolved Item 90-200-10.)

- The team noted a number of errors in the licensee's cable tray and conduit raceway schedules. The schedules were controlled documents and were used regularly for design modifications to determine cable routing. As a result, the team was concerned that incorrect design input documents could have an adverse effect on the outcome of design modifications and could affect a safety system design. The team concluded that the licensee had failed to control these design documents. (See Appendix A to this report, Unresolved Item 90-200-11.)

- The licensee had recently identified 150 overfilled control and instrumentation cable trays after reviewing findings from a previous NRC inspection at another plant. However, after its review of the raceway schedule and the licensee's corrective actions, the team found that the licensee had not realized that power and control cables were mixed in trays and conduits labeled as "control" raceway. Consequently, the licensee had failed to consider the cable derating concerns in its operability determination for the overfilled trays it had identified. In addition, the licensee had not identified the overfilled conduits that were identified by the team. The team concluded that the licensee failed to recognize the design implications of a known deficiency. (See Appendix A to this report, Unresolved Item 90-200-12.)

- Cable derating and seismic concerns had not been fully analyzed or justified in design modifications involving overfilled cable trays and conduits. (See Appendix A, Unresolved Item 90-200-13).

The licensee issued CARs to address the above concerns and performed an analyses to address immediate operability concerns. By the end of the inspection, the licensee's response to the team's concerns appeared adequate. With the resolution of the initiated CARs, the licensee stated that all of the team's concerns would be addressed.

4.1.7 HVAC and Service Water Systems

The team noted the following minor discrepancies during its walkdown inspections of portions of the service water system and the area room coolers for the electrical equipment rooms and the cable spreading room.

O Grouting was missing from the base plate of combined pipe support HKD-1-59-SKH-512/514, and the base plate bolts were partially pulled away from the wall. The licensee issued CAR C90-5272 and determined that the existing condition did not result in the support being inoperable. The team reviewed the evaluation in the CAR and agreed with this determination based on the information presented.

O Isometric drawing HKD-1-60, Revision 15, showed pipe support HKD-1-60-SR-325 on the outlet of area cooler V-143D, but the pipe support was actually located on the inlet line to pressure relief valve PSV-3729D.

O A pipe support had been installed between pipe supports HKD-1-60-H154 and HKD-1-60-SR-320 but did not appear on isometric drawing HKD-1-60, Revision 15.

O Approximately 23 feet of insulation had been removed from a section of the discharge piping from area room cooler V-143D. A maintenance tag (number 18323) that was dated November 28, 1987, was attached to this portion of the piping. The team asked why this maintenance item was still open. The licensee determined that a work request had been issued to replace the insulation but had been incorrectly closed without the work being completed. By the end of the inspection, the licensee had not completed the work or determined how the item had been inadvertently closed. This item appeared to be similar to an issue recently identified by the NRC Region V office and documented in NRC Inspection Report 50-344/90-06.

4.1.8 Relays and Setpoint Control

The team inspected the relay settings for a sample of devices within the selected load path, but only verified the settings that were accessible without disturbing plant operations. A comparison of the device settings with relay test records and engineering requirements on Drawing E-56, "Protective Device Coordination Setpoints," showed there were no deficiencies.

The method used in the plant to control setpoints was found to be in transition. A centralized setpoint document did not exist, but multiple, overlapping series of drawings were used instead. The drawings and calculation used were Drawings E-56, "Protective Device Coordination Setpoints;" E-57, "Protective Coordination Curve;" and E-26, "Electrical Device Index;" and Calculation XIIC, "Relay Coordination." To control changes in setpoints, an interim procedure was being used until Nuclear Division Procedure 200-15 is issued in December 1990, as currently planned. Although the licensee was in the process of establishing a centralized computer data base to control setpoints of instruments throughout the plant, it had no plans for a similiar data base for electrical devices. The team felt that such a document for electrical setpoints would be a valuable engineering tool for the site.

4.2 Surveillance Testing

Although the team did not perform an in-depth review of the overall surveillance program, it did review EDG surveillance testing. The team observed Periodic Operating Test (POT) 12-1, "Monthly Idle-Start and Loading of Emergency Diesel Generators," Revision 28. It also reviewed the procedure and previous test data for Periodic Engineering Test (PET) 12-2, "Emergency Diesel Generator Performance, Loss of Offsite Power, Diesel Automatic Start, and Auxiliary Feed Valve Actuation Test," Revision 5. The procedures, prerequisites, and warnings of both POT 12-1 and PET 12-2 were comprehensive and met Technical Specification requirements.

The team observed POT 12-1, which was performed on the west EDG, and monitored the in-progress test activities from the control room and at the EDG. The team noted that the station operators had properly reviewed and verified the test prerequisites; they were familiar with the EDG test requirements, EDG operation, and expected EDG performance; they were attentive to the EDG and its support equipment; and they were thorough in their implementation of the EDG test requirements. However, before the performance of the POT, the temperature in the west EDG room was in excess of 104°F as read on a local room temperature indicator. See Section 3.3.2 for a further discussion of problems with EDG room temperatures.

The team reviewed the surveillance data and strip charts for the 18-month EDG test, PET 12-2. On the basis of the available data and test results, the EDG appeared to meet the Technical Specification requirements.

4.3 Maintenance and Fuse Control

Although the electrical system and component maintenance program was generally adequate, weaknesses existed in the electrical maintenance procedures. Some of the procedures examined by the team did not contain acceptance criteria. For example, Procedures MP 1-2, "Transformers," Revision 13, November 17, 1988, and MP 1-16, "Motor Maintenance," Revision 11, August 2, 1990, required the maintenance worker to calculate and record the polarization index (PI) for the motor or transformer. However, neither procedure provided a minimum acceptable value nor instructions for reporting questionable values. The licensee stated that procedures were being revised and updated and that acceptance criteria in the procedures would be addressed during this update. (See Appendix A to this report, Unresolved Item 90-200-14.)

Maintenance records for the motors on safety injection pump B, residual heat removal pump B, containment spray pump B, and the centrifugal charging pump indicated a 5-year decreasing trend in the PI values for each motor. The PI values recorded during the last preventive maintenance for each motor were below the minimum value recommended in IEEE Standard 43, "IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery." Although the licensee was not committed to IEEE Standard 43, the standard provides the criteria recognized by the industry. The licensee could not provide evidence that it had evaluated the decreasing PI trend to determine if the trend reflected actual motor conditions or if the low PI values were the result of errors in measurement instrumentation or measuring techniques. In addition, it had initiated no action at the time of the inspection to correct the low values. (See Appendix A to this report, Unresolved Item 90-200-15).

Interviews with plant personnel indicated that no documented fuse control program existed and that personnel responsible for fuse replacement were supposed to use Drawing E-22, "Electrical Fuse Schedule," Revision 14, when replacing fuses. This document listed fuse numbers, sizes, locations, and types. However, plant electrical personnel considered this listing to be incomplete. During the inspection the licensee found a discrepancy on this drawing in the identification of the Shawmut 800-ampere "Amptrap" fuses associated with the dc motor control center main feeder breakers. The manufacturer's designation (reported by the licensee to be A4BY) was missing on the drawings; this lack could have caused difficulties during any replacement of these fuses. The licensee issued Drawing Change Notice (DCN) 128 on August 28, 1990, to add the missing data to the drawing. Computer printouts provided by the licensee showed that eight corrective action requests pertaining to fuse labeling, size, and voltage and duplicate fuse identification numbers had been issued in 1990. As a result of these findings, the licensee committed to develop and implement a fuse control program, which had not existed previously. (See Appendix A to this report, Unresolved Item 90-200-16).

The electrical maintenance department generally appeared to be staffed with qualified, experienced personnel. The training of electricians appeared to be adequate. However, interviews with workers indicated that job analysts (maintenance planners) had received no training in the performance of their duties. The licensee had relied on the assignment of experienced plant maintenance personnel to these positions; however, increased staffing and the recent hiring of job analysts without extensive Trojan experience created a need for a training program for these analysts.

All routine maintenance on motor-operated valves was done by contract personnel. The team considered the use of only contract personnel to be a potential weakness in the maintenance program because of the lack of continuing expertise provided by the use of permanent employees.

4.4 Modifications

The team reviewed the procedures and process for implementing permanent and temporary modifications, as well as the program for replacing components when a like-for-like replacement part was not available. The review showed that the modification program and the spare parts equivalency program were adequate; however, the following weaknesses existed in the temporary modification program.

- During its review of the temporary modification process in early 1990 (as documented in Inspection Report 50-344/90-02), the NRC Region V staff had noted numerous problems. One problem was the long length of time temporary modifications remained in effect. The report indicated that at the end of January 1990, there were 79 temporary modifications that had been open an average of one and a half years. At the time of this inspection there were still 68 open temporary modifications. Of these 68, 24 had been installed for more than 2 years, 20 others for more than 1 year, and another 10 for more than 6 months. The procedure that governed the temporary modification process did not contain any provision for ensuring that temporary modifications were restored or removed within any timeframe, and the team felt that the system was being used to bypass the more complex process for completing a permanent modification. The licensee acknowledged this finding and stated that a task force had been formed to examine this issue, along with other problems known to exist, in the temporary modification process.

- Section 4.3 of Administrative Order (AO) 5-8, "Temporary Modifications (TM)," Revision 5, required that certain TMs be reviewed by the Plant Review Board (PRB). Personnel approving the TM indicate on the TM form if this PRB review must take place and if it must take place before or after the TM is installed. The team noted two weaknesses with the procedure as written. First, although the TM form did contain an appropriate place to indicate whether a PRB review was required, it did not provide for any indication to show that the review had been completed as required. The operators, therefore, did not know if the required reviews were ever completed. Second, there was no time limit in the procedure for PRB review for those TMs that were required to be reviewed by PRB after they were installed. The team randomly selected four TMs that indicated that PRB review was required and requested confirmation of the PRB review. Of these four, one TM (TM 88-102 installed on October 20, 1989) had not been reviewed by PRB as required by the procedure. The licensee issued CAR C90-5264 to document this discrepancy. Part of the evaluation specified in the CAR will be to review all other installed TMs to ensure all required PRB reviews have been completed. The team found that the TMs requiring management review and approval before installation had been reviewed and approved before being installed.

4.5 Conclusions

The components and systems inspected were installed in accordance with the design requirements. However, deficiencies and weaknesses existed in the following areas: fuse control, isometric drawings, temporary modification program, maintenance procedure acceptance criteria, cable tray and conduit overfill, and specific components. Weaknesses in the licensee's corrective actions regarding cable tray and conduit fill and deficiencies in the engineering design process also existed. Of particular concern were the Nuclear Plant Engineering group's failure to recognize that the plant design and configuration included certain power cables that were mixed with control cables, and plant modifications that were implemented on already overfilled cable trays without analyzing the effects of overfill on the modification. The cleanliness of the plant was a strength and an indication of the positive attitude of plant management toward the plant.

5.0 ENGINEERING AND TECHNICAL SUPPORT

The team evaluated the engineering and technical support functions as they related to the electrical distribution system mostly on the basis of its daily interactions with the licensee's engineering and technical support personnel.

5.1 Organization and Key Staff

The plant modification engineers, the nuclear plant engineers, and the safety analysis engineers were under the General Manager of Technical Functions. At the time of this inspection, the Technical Functions Department had approximately 210 engineers. These engineers were mainly responsible for the long-term permanent modification engineering work and the longer term engineering projects, such as the design-basis reconstitution that was under way. This organization had been moved to the site from Portland, Oregon about 1 year ago to provide stronger engineering support of Trojan operations. The plant system engineers, the maintenance engineers, the surveillance and test engineers, and the reactor engineers were under the General Manager Trojan Plant. These engineers were responsible for the day-to-day engineering workload. Of the approximately 50 engineers in this department, 30 were system engineers. The coordination between and the responsibilities of the two major departments with engineering functions were still evolving, and there were some apparent confusion about organizational boundaries. Although the turnover rate in the Technical Functions Department had been high during the transition to the site, the licensee appeared to have slowed the attrition rate of this organization.

5.2 Root Cause Analysis and Corrective Action Process

The licensee's corrective action program was still evolving at the time of the inspection. The present corrective action program had been implemented in February 1990 by the issuance of NPD 100-21, "Operability Determinations," and NPD 600-0, "Corrective Action Program (CAP)." The team noted numerous examples under both the current and previous programs that (1) operational determinations either had not been formally documented or had been documented a long time after the original problem had been identified, and (2) design-basis document open items were still open long past their original closure due date. The licensee stated that it had the same concerns and that it had issued CAR C90-5099 on April 20, 1990, to address these types of problems. The team's review of this CAR showed that the licensee had formed a detailed action plan and that it planned to revise the applicable program procedures to clarify the process.

The team's review of six CARs to determine if sufficiently detailed evaluations and root cause analysis had been completed showed that one (CAR C90-3312) had been reopened by plant management to perform a more detailed investigation of the event discussed in the CAR. The team felt that CAR C90-3312 was an example of prudent management involvement in the corrective action process. However, one evaluation for CAR C90-5192 did not appear to be adequate. This CAR was initiated on June 16, 1990, for a failure to incorporate the maintenance requirements from the vendor's manual into the plant's preventive maintenance program for ITT Grinnell diaphragm valves. Although the evaluation appeared to adequately address the specific problem with the ITT Grinnell manual, it did not discuss the generic problem of ensuring that maintenance actions that are required or recommended in vendors' manuals are properly evaluated by the licensee for incorporation into its preventive maintenance program. The licensee stated that this evaluation was still undergoing quality assurance (QA) review and that the team's concerns would be incorporated as part of the QA review.

The number of open corrective action items had increased steadily since the program was implemented. The number of open items from the design-basis reconstitution program also had increased since the beginning of the verification process for each system. The team observed that this increasing number of open items, coupled with the amount of time it took to resolve them, as discussed above, was an area that required increased licensee management attention.

5.3 Engineering Involvement in Operations

Many of the interfacing programs such as the temporary modification program, the surveillance program, and the maintenance program are discussed in Section 4.0. In addition to these programs, the team reviewed selected operations and maintenance procedures to ensure that maintenance activities recommended in vendor manuals were incorporated into the procedures. Engineering organizations under the Technical Functions General Manager and the Plant General Manager had responsibilities for reviewing vendor technical manuals and for incorporating relevant information into plant procedures. For example, the team compared several of the maintenance activities recommended in vendor manual M16-90, "Emergency Diesel Generators and Accessories," Revision 14, with the maintenance procedure for the diesel generator, MP 12.7, "Emergency Diesel Generator Plant," Revision 21, and found that all the selected maintenance activities recommended in the vendor manual were in the maintenance procedure. Many of the maintenance intervals in the maintenance procedure were different from those suggested in the vendor manual; however, the manual specifically stated that the intervals were only recommended and could be adjusted by the owner on the basis of the plant experience. None of the intervals reviewed by the team appeared to be excessive.

Conversely, the operating instruction for the EDGs, OI 5-1, "Diesel Generators and Fuel," Revision 23, did not contain any of the inspections that the vendor manual recommended be performed before, during, or following diesel generator operation. The licensee responded that, although no formal auxiliary operator rounds sheets existed where these inspections would be documented, the operators, because of their training, are expected to go to the EDG room when the EDG is started and perform inspections similar to those in the vendor manual. This lack of a formal procedure or requirement to perform the vendor-recommended EDG inspections was a weakness in the operating instructions for the EDGs.

As discussed in other sections of this report, the team found a lack of attention to detail by the engineering personnel and examples of a failure to fully evaluate technical issues and problems. These weaknesses together with the increasing number of unresolved open engineering items discussed in Section 5.2, indicate a need for increased management involvement in the engineering functions.

5.4 Training

The motor-operated valve (MOV) training and the electrical MOV training facility were adequate. The training facility contained a number of different styles of MOVs as well as test equipment capable of testing MOVs under selected load conditions.

The training of plant personnel in other areas was adequate with two exceptions. As discussed in Section 4.3, no training program existed for maintenance job analysts, and there was a heavy reliance on contract personnel to perform MOV maintenance. In addition, tray fill data were provided to the engineering personnel, which clearly indicated overfill problems existed in the cable trays, but no training or guidance was given to these engineers on how to use or interpret the data.

5.5 Conclusions

The engineering and technical support at the Trojan plant was adequate, even though the team found numerous examples where the depth of answers provided by engineering personnel, and the attention of these personnel to detail, could be strengthened. The team also felt that the increasing number of open engineering items and the length of time taken to resolve them require additional licensee management attention to ensure that the items are correctly identified and resolved as quickly as possible on the basis of their safety significance.

6.0 GENERAL CONCLUSIONS

The team concluded that, in general, the EDS at the Trojan plant was functional under the required design conditions and that, in general, the Nuclear Plant Engineering (NPE) organization was providing adequate engineering and technical support to the other onsite organizations. However, the team did identify a number of deficiencies and weaknesses in the equipment, documents, and programs reviewed. The weaknesses related to engineering support included incomplete evaluations of technical problems and a lack of attention to detail in engineering work.

Examples of technical problems that the licensee had not evaluated completely included the following:

- Overfilled cable raceway: NPE organization had identified overfilled cable trays but had not recognized the significance of the problem, had not identified a similar problem with conduits, and had not used the data that were available for plant modifications.

- Undersized power cable for the B train hydrogen recombiner: The NPE organization had reduced the current carrying capacity of the cable because of the addition of fire protection to the circuit. Although the reduced capacity was significantly less than the rated full-load capacity of the equipment itself, the NPE organization had accepted the condition without an adequate evaluation.

Examples of a lack of attention to detail in engineering work included the following:

- The NPE organization had incorrect values in a calculation to determine the satisfactory operation of dc MOVs. The correct values would have shown that the operator for valve MO-3071, steam supply to the auxiliary feedwater pump, would not operate properly under low-voltage conditions.

- Other omissions or errors were found in several other calculations performed by the NPE organization.

- The NPE organization had provided plant maintenance personnel with criteria for testing 125-Vdc circuit breakers. However, previous test data on the circuit breakers were not compared to the criteria. In making such a comparison, the team identified two of seven circuit breakers that did not meet the new criteria.

- The licensee had replaced its safety-related inverters during the 1989 plant outage. At that time, the Region V staff had cited the utility for not providing qualification for the required output of the inverters. The NPE organization had tabulated the voltage requirements for the inverter loads but had not determined the inverter outputs required to maintain the required voltages at the loads.

7.0 EXIT MEETING

The NRC staff held an exit meeting with Portland General Electric (PGE) Company's management on August 31, 1990, at PGE's training facility at the Trojan plant site near Rainier, Oregon. Appendix B to this report identifies the PGE personnel, visitors invited by the licensee, and the NRC staff who attended the meeting. The team's more significant findings and the team's preliminary conclusions were discussed. Except where noted in the report, licensee actions taken after the close of the inspection period were not evaluated by the team and are not addressed in this report.

APPENDIX A

Unresolved Items

The team identified the unresolved items that follow as those that require additional review or action by the licensee or NRC to fully resolve them or to verify corrective actions. The section numbers following the item title refer to the sections of this inspection report in which the item is discussed. When applicable, the associated requirements from 10 CFR Part 50 and commitments from the updated Final Safety Analysis Report (UFSAR) are identified for each deficiency.

UNRESOLVED ITEM 90-200-01

Design Control Calculation Problems
(Sections 2.1.3, 2.1.6, and 3.3.2 of report)

DESCRIPTION OF CONDITION:

The inspection team reviewed various design calculations performed by the licensee and others and noted several deficiencies in the licensee's design control measures. These design control deficiencies related to the verification of the adequacy of the calculations. The licensee's Nuclear Division Procedure 200-4 (Ref. 1) required calculations to be checked for completeness, adequacy of assumptions and methods, and mathematical accuracy. It also required referenced calculations to be checked for applicable assumptions and accuracy.

O The licensee performed Calculation TE-147 (Ref. 2) to determine cable ampacity deratings because of the application of thermal wrapping and to ensure that the full-load currents of thermal-wrapped cables do not exceed the derated cable ampacities. This calculation used input from Calculations TE-085, TE-089, TE-094, and TE-096 (Refs. 3, 4, 5, and 6). When the team requested copies of these four calculations, the licensee stated that they had not been issued and had been superseded by Calculation TE-147. As a result, the team questioned the validity of the input data and the results of Calculation TE-147. In response to this finding, the licensee issued CAR C90-5263 to resolve this deficiency.

O Calculation TE-147 indicated that the power cables to hydrogen recombiner X318B had derated ampacities of 76 amperes whereas the full-load current was 90 amperes. The licensee concluded in the calculation that the application was acceptable because the hydrogen recombiner "is only required after a loss-of-coolant accident and, other than periodic testing, it is not used under normal conditions." The inspection team questioned the application of Class 1E cables beyond their derated capacities without further analysis and justification. The licensee issued CAR C90-5263 (Ref. 7), to address the condition.

An operability determination by the licensee, documented in ODN-90-184 (Ref. 8), found the recombiner operable by determining the equipment would draw 76.28 amperes at 480 V. However, the team felt the voltage at the recombiner terminals would be less than 480 V, resulting in a full load current greater than 76.28 amperes. The licensee then determined that a full-load current of 80 amperes (460-V supply) for 1 year would result in a cable operating temperature less than the temperature used in the vendor's qualified life determination of 373 days. The licensee indicated that the hydrogen recombiner would only be required to operate for a few days following an incident. The licensee told the team that it would revise ODN-90-184 to document the additional analysis and that it still had to determine a permanent resolution of the concern.

O The licensee performed Calculation TE-126 (Ref. 9) to support Request for Design Change (RDC) 84-128. The calculation evaluated the application of a three-conductor, no. 12AWG cable that provided power to a 7-1/2-hp, 460-Vac, three-phase motor associated with the fuel transfer cart. The team raised questions about the assumed motor operating current and the cable length that could change the licensee's conclusion that the cable was properly sized. In addition, the cable did not appear to be completely protected based on the time-current protection device curves attached to the calculation.

The licensee performed a preliminary review of the calculation and determined that the cable length should have been approximately 350 feet rather than the assumed 120 feet and the motor current should have been approximately 7.1 amperes rather than the assumed 9.7 amperes. The licensee agreed to fully review the calculation, including the implied cable protection.

- The licensee performed Calculation TE-174 (Ref. 10), which analyzed cable sizing and voltage drop in cables, to demonstrate that 125-Vdc motors for motor-operated valves (MOVs) developed sufficient torque to perform their safety functions under degraded voltage conditions. However, the calculation used less conservative values than those recommended by Limitorque for stem coefficient of friction (Ref. 11) and for pullout efficiency (Ref. 12) for MOV MO-3071 (auxiliary feedwater trip/throttle valve). The calculation also did not consider the additional loads from control circuits for MOV MO-3071. The team determined that, when considering the vendor-recommended values of stem coefficient of friction and pullout efficiency, sufficient torque was not available to operate valve MO-3071 under degraded voltage conditions.

  The licensee performed a preliminary recalculation of TE-174 and showed that for all 125-Vdc valve motor operators, except MO-3071, large margins of torque were available. For MO-3071, the recalculation showed that the cable was adequately sized for degraded voltage conditions, but the margin for error was only 2.6 percent. As a result, the licensee initiated a Trojan Commitment Tracking Action Record to increase motor torque for valve MO-3071 by changing the valve operator gearing.

- The licensee performed Calculation TE-145 (Ref. 13) to determine the theoretical fault currents in the Class 1E 125-Vdc system. The calculation evaluated fault current levels at typical points in the two redundant trains of the system. At one typical point (the load side of circuit breaker AD1001 on battery bus D10X/D30X), the licensee failed to consider the current contribution of battery charger 3. Since one battery charger in each redundant system would normally be in service, its contribution to total fault current at the load side of the affected circuit breaker should have been included. As a result of this finding the licensee issued CAR C90-5259 (Ref. 14) to revise the calculation.

- A Bechtel calculation related to the emergency diesel generator room ventilating system (Ref. 15) showed that the air flow to the EDG room needed to maintain a room temperature of 116°F was 62,700 cfm, including the 19,300 cfm required for diesel engine combustion air. The discharge air flow required for the room would be 43,400 cfm. The calculation also determined that, with the current design flows of 57,800 cfm supply and 38,500 cfm discharge, the room temperature would exceed 116°F, which was the design requirement.

- The licensee performed Calculation TM-123 (Ref. 16) to determine a heat balance for the emergency diesel generator rooms. The calculation had several weaknesses: (1) the combustion air temperature was assumed to be 102°F, whereas the design temperature was 104°F, (2) no error margins were indicated for the test readings taken, and (3) the combustion air flow was assumed to be 18,000 cfm, whereas the design value was 19,300 cfm. The team felt these weaknesses invalidated the calculation's result.

REQUIREMENT:

10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that measures be established for verifying the adequacy of design and changes to the design.

REFERENCES:

1. Nuclear Division Procedure 200-4, "Quality Related Calculations," Revision 3, dated July 28, 1989.
2. Calculation TE-147, "Thermal Wrap Cable Ampacity Derating," Revision 0, September 2, 1988.
3. Calculation TE-085, "Cable Tray Derating," Revision 0, January 22, 1985.
4. Calculation TE-089, "Cable Tray Derating," Revision 0, March 28, 1985.
5. Calculation TE-094, "Cable Tray Derating," Revision 0, June 20, 1985.
6. Calculation TE-096, "Fire Rated Cable Wrap Systems," Revision 0, July 26, 1985.
7. CAR C90-5263, "Calculation TE-147 Contains Invalid Information," August 9, 1990.
8. ODN-90-184, "Operability Determination, Cables BB2234B and BB2234C Associated With Q318B Electrical Hydrogen Recombiner," Revision 0, August 9, 1990.
9. Calculation TE-126, "Cable Sizing, RDC 84-128, DCP 4," Revision 1, August 1, 1990.
10. Calculation TE-174, "DC Motor-Operated Valve Failure to Develop Sufficient Torque Due to Improper Cable Sizing," Revision 0, October 11, 1984.
11. Limitorque Procedure SEL-1, "Gate and Globe Valve Selection Procedure," May 21, 1979.
12. Limitorque Procedure SEL-7, "Gate and Globe Valve Efficiency Chart," April 8, 1979.
13. Calculation TE-145, "125-VDC Fault Currents," Revision 4, July 5, 1990.
14. CAR C90-5259, "Calculation TE-145, 125-VDC, Fault Currents," August 8, 1990.
15. Bechtel Calculation, "Emergency Diesel Generator Room H&V Calculations," December 1, 1973.
16. Calculation TM-123, "EDG Ventilation Heat Load," Revision 0, November 31, 1984.

UNRESOLVED ITEM 90-200-02

Emergency Diesel Generators Loading Requirement
(Section 2.1.7 of the report)

DESCRIPTION OF CONDITION:

On page 4-3 of the EDG DBD (Ref. 1), a requirement from the original Bechtel procurement specification (Ref. 2) for emergency diesel generators was quoted. The requirement stated that the EDG should be capable of starting a 750-hp motor when carrying a base load of 4182 kW. The team concluded that the EDGs did not have this capability because the inrush power requirement for a motor of this size would be approximately 1060 kW. This when added to the 4182-kW load would exceed the short-term rating of the EDGs (5003 kW) by 239 kW.

In response to the team's concerns, the licensee agreed to determine the applicability of the Bechtel requirement to the Trojan plant.

REQUIREMENT:

10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires in part, that measures be established to ensure the design-basis is correctly translated into specifications, drawings, procedures, and instructions.

REFERENCES:

1. Design-Basis Document DBD-24, "Emergency Diesel Generator."
2. Bechtel Procurement Specification G478-M-16.

UNRESOLVED ITEM 90-200-03

Untimely Corrective Actions for Deficiencies in the 120-Vac Inverters
(Section 2.3 of the report)

DESCRIPTION OF CONDITION:

Elgar inverters were installed at the Trojan plant during the 1987 and 1988 outages. NRC Inspection Report 344-50/89-09 (Ref. 1) noted that the licensee had failed to identify and resolve inverter output voltage requirements that differed from design-basis document specifications and the Elgar inverter technical manual.

The team concluded that the issue of proper inverter output voltage requirements would not be resolved until line drop voltages and transfer setpoint calculations were completed. The licensee had previously committed to perform the calculations in NPE Action Plan 90-007 (Ref. 2). The licensee's scheduled completion date for these calculations was May 31, 1991. The team concluded that the licensee actions regarding the inverter output voltage requirements were not sufficiently timely, given the importance of the issue.

In response to the team's concerns, the licensee agreed to complete the inverter calculations and make voltage changes, if necessary, during the next refueling outage.

REQUIREMENT:

10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," states, in part, that measures shall be established to assure that conditions adverse to quality, such as failure, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected.

REFERENCES:

1. U.S. Nuclear Regulatory Commission, Inspection Report 344-50/89-09, August 29, 1989.
2. Trojan Nuclear Plant Engineering Action Plan 90-007, Revision 4, July 21, 1990.

UNRESOLVED ITEM 90-200-04

Lack of Tornado Protection for Diesel Storage Tank Vent Lines
(Section 3.2.2 of the report)

DESCRIPTION OF CONDITION:

Section 3.3 of DBD-C2 (Ref. 1) stated that the diesel fuel storage and supply system was required for safe shutdown after a tornado. The design-basis tornado for this system, stated in the UFSAR (Ref. 2), was a 200-mph tornado generating such missiles as a 4000-lb passenger car striking with a velocity of 40 mph over an impact area of 20 ft^2, or a 3-inch-diameter by 10-feet-long Schedule 40 steel pipe (75.8 lb) traveling at a velocity of 75 mph.

The two diesel storage tanks, T119 A and B, were located in close proximity to each other and were buried underground. The vent pipe and flame arrestor from each tank extend approximately 7 feet above ground. Although these vent lines were seismically qualified, they were not qualified to withstand a tornado. Therefore, a tornado-generated missile could either sever or crush both vent lines. If the lines were severed, each tank would be exposed to the ambient atmosphere and a fire or explosion could occur because the flame arrestors would no longer be available. In addition, dirt and debris could enter the tanks, clogging or damaging the transfer pumps (transfer pumps are located inside the storage tank). If the lines were crushed, pump cavitation could result as a vacuum was drawn in the tanks, and possibly result in the storage tanks being crushed. In both cases, the possibility existed that a tornado could impair the operation of both diesel fuel oil systems.

The licensee felt that these possibilities were remote because they were not probable. However, it had no firm basis for this argument. A team walkdown inspection of the system showed that two possible tornado missiles, a trailer and a steel waste container, were located in close proximity to the vent lines. However, documents related to the original licensing of Trojan indicated that only tornado effects on structures (buildings) were addressed. This item remains unresolved until NRC's Office of Nuclear Reactor Regulation performs a review to determine if such effects on components are applicable to the plant's design.

REQUIREMENT:

10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," requires, in part, that structures, systems, and components important to safety be designed to withstand the effects of tornadoes.

REFERENCES:

1. Design Basis Document DBD-C2, "Site External Hazards," Revision 0.
2. UFSAR Section 3.

UNRESOLVED ITEM 90-200-05

Emergency Diesel Generator Room Temperature Not Maintained
(Section 3.3.2 of the report)

DESCRIPTION OF CONDITION:

The UFSAR (Ref. 1) stated that all equipment in the turbine building was designed for operation at 104°F. Since the EDG rooms are a part of the turbine building, all equipment in the EDG rooms was required to be qualified for operation at 104°F when the diesels were not in operation. However, the ventilation system for the EDG rooms was designed to maintain the room temperature below 116°F, with the EDGs running, during summer design conditions. The team identified the following deficiencies:

O The ventilating system for the EDGs and EDG rooms would not start unless the EDGs were running, and the heat loads in the rooms could raise the temperature to above 104°F. On August 9, 1990, the temperature in the west EDG room was 106°F as indicated by a local thermostat. However, the local thermostat had a setpoint of 104°F.

The licensee issued CAR C90-1049, on August 10, 1990, to determine if the EDG ventilating system can maintain the temperature below 116°F if the initial temperature is greater than the UFSAR value of 104°F. However, this CAR did not address the following: (1) the maximum temperature that can occur in the EDG rooms if the ventilating system was not operating, (2) the immediate effects of room temperatures higher than the design limit on the electrical and mechanical equipment in the room, and (3) the long-term effects of temperatures higher than the design limit on equipment in the room. As an interim measure to ensure the temperature in the EDG rooms does not exceed 104°F, the licensee began monitoring the room temperatures and manually starting the ventilating fans when the temperature neared 104°F.

O Section 9.4.3.1.3.2 of the UFSAR stated that the temperature in the EDG room should not exceed 116°F under summer design conditions with the diesels operating. The original Bechtel calculation (Ref. 2) and the licensee's Calculation TM-123 (Ref. 3) supported this value. Both calculations assumed the air drawn into the EDG room was outside air at a temperature of 91°F (summer design condition). However, this assumption may not be conservative because the air was actually brought in from the turbine building, where the air temperature can be higher.

The original Bechtel calculation (Ref. 2) determined that the required air flow to the EDG room to maintain an EDG room temperature of 116°F was 62,700 cfm with a required discharge air flow of 43,400 cfm, values that are greater than the current design air flows. The Bechtel calculation also determined that, for the present design flows of 57,800 cfm supply and 38,500 cfm discharge, the room temperature would be 116.5°F if no safety margin for room heat loads was used and 119°F if a 10 percent safety margin was used.

As part of Calculation TM-123, a heat balance was performed using data obtained during a diesel operational test. The heat output from the diesel generator to the ventilation air was then determined. Since the calculated heat output value fell within 5 percent of design data provided by Morrison-Knudsen, the licensee assumed this method of calculation was valid and extrapolated the values for the summer design condition. The result was an EDG room temperature of 115°F. This calculation had several weaknesses: (1) the combustion air temperature was assumed to be 102°F whereas the design temperature was 104°F; (2) no error margins were indicated for the test readings taken; and (3) the combustion air flow was assumed to be 18,080 cfm, whereas the design flow was 19,300 cfm (Ref. 4). The team felt these weaknesses invalidated the calculation's results.

The licensee reviewed these calculations and issued CAR C90-1049 on August 25, 1990, to review the EDG room HVAC calculations. Higher design temperatures in the room could affect the operation of all the electrical and mechanical equipment located in the room. This item will remain a unresolved issue until the licensee provides further information.

REQUIREMENTS:

10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that measures be established to verify the adequacy of design and that the design-basis be correctly translated into specifications, drawings, procedures, and instructions.

10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," requires, in part, that measures be established to assure conditions adverse to quality, such as deficiencies and nonconformances, are promptly identified and corrected.

REFERENCES:

1. UFSAR, Section 9.4.3.
2. Bechtel Calculation, "Emergency Diesel Generator Room H&V Calculation Book 5," December 1, 1973.
3. Calculation TM-123, "EDG Ventilation Heat Load," Revision 0, November 19, 1984.
4. Drawing M-245, "Air Flow Diagram - Turbine and Containment Building Ventilating and Cooling Systems," Revision 16.

UNRESOLVED ITEM 90-200-06

Ventilation for West EDG Room on Failure of Ventilating System
(Section 3.3.2)

DESCRIPTION OF CONDITION:

The UFSAR (Ref. 1) stated that if a fire occurred in the east EDG room, which would close a fire damper in the supply ducting for the west EDG room or should the west EDG room supply fan fail to discharge sufficient air, that an adjustable louvre (VX103) located on the south wall of the west EDG room would be opened by damper DM 10405 to provide the required air flow. However, no calculations were available to prove that sufficient air for both diesel combustion and room cooling would enter through this adjustable louvre. Normally, the west EDG room supply fan provided 57,800 cfm of air for both combustion and room cooling. However, with no supply fan associated with the adjustable louvre, room air could only be supplied by demand from the diesel turbochargers and from the two exhaust fans rated at 19,250 cfm each. No calculations existed that proved that sufficient air and flow distribution existed to provide combustion air and room cooling to meet all design temperature conditions.

Because the louvre was located on the south wall of the west EDG room, the tandem diesel was in the middle of the room, and the electrical and mechanical support equipment was located near the north wall, the air path for cooling the electrical equipment was uncertain. In addition, this layout could result in local hot spots in the room. Both these factors could lead to electrical equipment failure or reduced equipment life.

The licensee issued CAR C90-1054 to investigate this item. This item will remain an unresolved issue until the licensee completes its review.

REQUIREMENT:

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

REFERENCES:

1. UFSAR Section 9.4.3.2.3.
2. Air Flow Diagram - Turbine and Containment Building Ventilating and Cooling System, M-245, Revision 16.
3. Emergency Diesel Generator Room - Plan El. 45'0", M-294, Revision 14.

UNRESOLVED ITEM 90-200-07

Effects of Tornado-Induced Depressurization on EDG Components
(Section 3.3.3 of the report)

DESCRIPTION OF CONDITION:

General Design Criterion 2 of Appendix A to 10 CFR Part 50, as committed to by the licensee in the UFSAR (Ref. 1), requires that structures, systems, and components be designed to withstand the effect of tornadoes. The UFSAR stated that the Trojan design-basis tornado applicable to the emergency diesel generator rooms was a 200-mph tornado. Associated with a tornado of this magnitude is an induced pressure differential of 1.5 psi occurring over a 1.5-second interval. DBD C-2 (Ref. 2) stated that the ventilating system for the EDG room was required for safe shutdown after a tornado.

DBD C-2 indicated that the structures were designed for the pressure differential but did not indicate if the EDG room ventilation ducting or diesel exhaust ducting were similarly qualified. The licensee stated that the ducting had not been analyzed for this pressure differential. However, in some instances, the licensee had analyzed the effect of tornadoes on systems (e.g., control building ventilating system, CB1). If any of this EDG ducting is not qualified, the ducting could be crushed under the design-basis tornado. This could greatly limit the amount of cooling to the EDG rooms so that design temperatures would be exceeded (i.e., they would be greater than the UFSAR limit of 116°F) or could impair the release of combustion gases, thereby rendering the diesel engines inoperable. This item will remain unresolved until further review by the NRC's Office of Nuclear Reactor Regulation to determine if such tornado effects on components are applicable to Trojan's design.

REQUIREMENT:

10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," requires, in part, that structures, systems, and components important to safety to be designed to withstand the effects of tornadoes.

REFERENCES:

1. UFSAR, Section 3.1.1.
2. Design Basis Document DBD-C2, "Site External Hazards," Revision 0, September 28, 1988.

UNRESOLVED ITEM 90-200-08

Factors Not Considered in the Design of the Service Water System
(Section 3.5)

DESCRIPTION OF CONDITION:

The team identified two considerations that were not included in the design of the service water system (SWS).

- None of the design documents the team reviewed for the SWS specified a minimum temperature for the system, although a maximum design temperature of 75°F was specified. Similarly, analyses for components and systems serviced by the SWS did not consider a minimum SWS temperature, but did address a maximum temperature. However, components were identified with design requirements for a minimum SWS water temperature. For example, the air intake coolers for the EDGs had a specified temperature range of 40°F to 104°F. Historical data in DBD-11 (Ref. 1) indicated that SWS water temperatures had been as low as 32°F to 33°F.

  The licensee confirmed that there was no minimum SWS design temperature and stated that it would review the effect of cold service water on ESF equipment. The licensee also received preliminary information (dated August 30, 1990) from the EDG manufacturer that stated that diesel performance would not be affected by combustion air temperatures below 24°F.

- Pressure transients from starting a partially drained system had not been considered, although the design considered two types of transients for the system full of water. The team determined through the piping and instrumentation diagram for the system (Ref. 2) that when both the service water pumps and the service water booster pumps were shut down, it was possible to partially drain the system of water. The water between the service water pumps and the booster pumps could drain through the service water strainer to the discharge and dilution structure or via the service water pump bearings to the river. The water down stream of the booster pumps also could drain to the discharge and dilution structure. An automatic start of the service water pumps after a partial drain could induce a pressure transient that could damage the pumps, piping, heat exchangers, or other equipment.

  The licensee agreed that pressure transients (waterhammer) could occur and stated that it would investigate the situation to determine what appropriate actions should be taken.

This item will remain unresolved until the licensee completes its reviews.

REQUIREMENT:

10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that measures be provided for verifying and checking the adequacy of design.

REFERENCES:

1. Design-Basis Document DBD-11, "Service Water System," Revision 1, May 7, 1990.
2. Drawing M-218, "Service Water System Piping and Instrument Diagram," Revision 44.

UNRESOLVED ITEM 90-200-09

HVAC Margin for Component Cooling Water Pumps - System AB-1
(Section 3.6 of the report)

DESCRIPTION OF CONDITION:

The UFSAR (Ref. 1) indicated that the fan cooling units are to maintain ambient temperatures at or below 104°F at each of the component cooling water (CCW) pump motors. The UFSAR also indicated that each cooler started when the associated CCW pump started. However, the design was such that a failure of the fan unit would not prevent operation of the CCW pump. The temperature in the CCW pump room could exceed 104°F because of the continuing major heat load from operation of both CCW pumps. This situation could go unnoticed for some time because the room temperature was only indicated locally and in the control room only on operator demand. Primarily, the room temperature was monitored by an operator during rounds made at least once a shift.

A recent Bechtel calculation (Ref. 2) showed that the heat load in the room during normal operation, when the two CCW and two service water booster pumps are operating, was 319,116 Btu/hr, while the total room cooling capacity was 319,216 Btu/hr, a marginal difference of 100 Btu/hr. These values were based on a service water temperature of 75°F, a room temperature maintained at 104°F, an air flow 12 percent less than design (assuming a dirty filter), and a service water flow 3 percent less than design. A second Bechtel calculation (Ref. 3) showed that the major room coolers, V256 A and B (associated with the CCW pumps), each had a cooling capacity of 137,677 Btu/hr. Therefore, the failure of one unit would eliminate 137,677 Btu/hr room cooling capacity, which by far exceeds the marginal excess cooling capacity of 100 Btu/hr. Thus, the room temperature would exceed the design value of 104°F. An undetected high room temperature could lead to failure of both CCW pumps and might affect electrical cables.

The negligible difference between the actual room heat load and the cooling capacity was another concern. With the small difference between the heat load generated by the operating pumps and the capacity of the cooling fans, system cooling cannot accommodate such variations as reduced heat exchanger surface area, reduced cooling water flow, or higher service water temperature. A Bechtel calculation (Ref. 3) showed that a 16.6-percent reduction in heat exchanger surface for only one room cooler (V256 A or B) would reduce the room cooling capacity more than 11,000 Btu/hr below the heat load in the room of 319,116 Btu/hr.

The licensee stated it was still reviewing the Bechtel calculations and that this review would include the effect of losing one cooler unit while both CCW pumps continue to operate. This item will remain an unresolved issue until the licensee completes its evaluation.

REQUIREMENT:

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

REFERENCES:

1. UFSAR Section 9.4.2.1
2. Bechtel Calculation 30-2, Revision 0, May 8, 1990.
3. Bechtel Calculation 30-3, Revision 0, May 7, 1990.

UNRESOLVED ITEM 90-200-10

Nonconformance to Design Basis Criteria for Electrical Cable Conduit Fill
(Section 4.1.6)

DESCRIPTION OF CONDITION:

The UFSAR (Ref. 1) stated that conduit-fill limits were based on the 1971 National Electric Code (Ref. 2) and that any exceptions to the fill limits would be justified. The team reviewed the licensee's computerized cable tray and conduit raceway schedules (Refs. 3 through 7) and identified more than 145 safety-related conduits designated by the schedule as overfilled. During a field inspection of a sample of safety-related conduits, the team verified the overfilled conditions and found numerous discrepancies between the raceway schedule and the field conditions of the conduits (see Unresolved Item 90-200-11). In addition, the licensee was unable to locate any supporting analysis to justify overfilled conditions for either originally installed conduits or for recent plant modifications that involved overfilled conduits.

According to the raceway schedule, the identified conduits were designated as control and instrument cable conduits. Since the UFSAR permits control cables to be mixed with 600-V power cables up to number 1/0, the team expressed concerns about cable derating in the affected conduits and the resulting ampacity capabilities of safety-related cables. In addition, the team was concerned about possible seismic loading of overfilled conduits and potential cable damage resulting from cable pulls in overfilled conduit.

In response to the team's concerns, the licensee issued CARs C90-5267 and C90-5268 and performed an operability determination to address immediate operability concerns. The licensee stated that the CARs will address the conduit overfill, analysis and justification for overfilled conditions, and some programmatic changes to ensure that future overfill conditions are prevented or justified.

REQUIREMENTS:

UFSAR Section 8.3.1.3.2, "Cable Trays," states, in part, that "conduit limits are based on the 1971 National Electric Code, Chapter 9, Table 4. A computerized circuit and raceway schedule is utilized to determine percentage conduit and cable tray fill" and "any exceptions to the above percentages will be justified by notations in the raceway schedule."

National Electric Code, 1971, Chapter 9, Table 4, lists fill limits for various conduit sizes and cable conductor numbers.

Trojan Fire Protection Plan (Ref. 8) states, in part, that "conduit fill limits are based on the 1971 National Electrical Code, Chapter 9, Table 4. The computerized circuit and raceway schedule is utilized to determine percentage conduit and cable tray fill" and "any exceptions to the above percentages are justified by notations in the raceway schedule."

REFERENCES:

1. UFSAR Section 8.3.1.3.2, "Cable Trays."
2. National Electrical Code, Chapter 9, Table 4, 1971.
3. PGE Raceway Schedule, Conduits, E-191, Volumes 1 through 3.
4. PGE Raceway Schedule, Trays with Cable, E-191, Volumes 1 through 8.
5. PGE Circuit Schedule, E-192, Volumes 1 through 6.
6. PGE Cable Code Schedule, E-192A.
7. PGE Raceway Code Schedule, E-191A.
8. Trojan Fire Protection Plan - Program Description, Volume 1, Chapter 4, Section 5.
9. Summary of original Bechtel electrical cable system and raceway design transmitted to PGE by letter August 24, 1990.

UNRESOLVED ITEM 90-200-11

Inaccurate Information in Design Input Documents - Cable Raceway Schedule

(Section 4.1.6 of the report)

DESCRIPTION OF CONDITION:

The licensee was using a computerized cable raceway schedule (Refs. 1 through 5) to determine cable routing, raceway types, raceway sizes, and raceway fill for various design modifications. In addition, the UFSAR (Ref. 6) referenced the computerized schedule and stated that the schedule will be used to determine the percentage of conduit and tray fill to ensure that UFSAR limitations on fill are not exceeded. When the team reviewed the conduit raceway schedule, it noted at least six conduits for which cable fill levels were more than 100 percent. The licensee stated to the team that the area used is the physical cross-sectional raceway area, and therefore, all listings indicating over 100-percent fill were in error. The team then decided to review the raceway schedule by randomly selecting 10 raceways and field verifying portions of the information in the schedule. Of the 10 raceways examined, 6 matched the information in the schedule, 3 did not have the same number of cables in the raceway as that listed in the schedule (actual field raceways had less cables in these 3 cases), and the size of one raceway was different from that in the schedule and the raceway number appeared twice in the field on different raceways.

The licensee stated that the schedule was a controlled document and was used regularly for design modifications to determine cable routing. In fact, relevant sections of the raceway schedule were routinely included in design modification packages. As a result, the team was concerned that incorrect design input documents could have an adverse effect on the outcome of a design modification and could affect a safety system design.

In response to the team's concern, the licensee issued CAR C90-5268 to address raceway schedule errors. In addition, it stated that a field verification process used before implementing any cable runs would identify problems with cable routing before installation.

REQUIREMENTS:

10 CFR Part 50, Appendix B, Criterion VI, "Document Control," requires, in part, that "these measures shall assure that documents, including changes, are reviewed for adequacy and approved for release by authorized personnel."

10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," requires, in part, that "measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected." The licensee as part of its normal design process, had not discovered the six conduits for which fill levels were more than 100 percent. It also had not discovered these discrepancies when it reviewed the schedules and found the 150 overfilled cable trays.

REFERENCES:

1. PGE Raceway Schedule, Conduits, E-191, Volumes 1 through 3.
2. PGE Raceway Schedule, Trays with Cable, E-191, Volumes 1 through 8.
3. PGE Circuit Schedule, E-192, Volumes 1 through 6.
4. PGE Cable Code Schedule, E-192A.
5. PGE Raceway Code Schedule, E-191A.
6. UFSAR Section 8.3.

UNRESOLVED ITEM 90-200-12

Failure To Fully Identify the Necessary Corrective Action Regarding Cable Tray and Conduit Overfill

(Section 4.1.6 of the report)

DESCRIPTION OF CONDITION:

After reviewing the findings from a previous NRC inspection at another plant, the licensee applied these findings to Trojan and identified 150 overfilled control and instrumentation cable trays by using its cable tray and conduit raceway schedules (Refs. 1 through 5). The overfill exceeded the UFSAR (Ref. 6) limits. As a result, the licensee issued a CAR to address the overfill and made an operability determination regarding the cables in the overfilled trays. However, when the team reviewed the same raceway schedules, it found more than 145 overfilled conduits that the licensee had not identified. After finding that the UFSAR allowed 600-V power cables up to number 1/0 to be mixed with control cables, the team raised concerns about cable derating and ampacity with regard to overfilled trays and conduits identified as "control" trays. Until the team raised these concerns, the licensee had not realized that power and control cables were mixed in trays and conduits and had not considered the potential derating problems in the operability determination of the overfilled trays that it had found.

As a result of the team's concerns about ampacity for cables in the power and control trays and conduits, the licensee reanalyzed the overfilled trays and found 12 worst-case trays for which potential ampacity concerns existed. The licensee performed an analysis to justify the operability of the cables in these trays and intends to propose UFSAR changes to justify the acceptance of these 12 trays. In addition, the licensee has committed to reexamine the design-basis, its UFSAR, and its design process to ensure that all designers are aware of the full safety and regulatory impact when implementing corrective actions and future designs.

REQUIREMENTS:

UFSAR Section 8.3.1.3, "Physical Identification of Safety-Related Equipment," provides an explanation of a tray numbering and labeling system that denotes tray and conduit contents. Under a description of the second letter in the tray/conduit designation, the UFSAR states, "B or C = 600 volt control and power cables up to number 1/0 inclusive." It further states that "the computerized circuit and raceway schedules are utilized to establish correct circuit routing through the raceway system" and "the schedule establishes A, B, C, D, or N channel raceway networks, and these networks are further broken down within each channel according to cable classification as listed above." The listing referred to in the UFSAR contains the "B or C" category as denoted above in quotation marks.

UFSAR, Section 8.3.1.3.2, "Cable Trays," states, in part, that "a computerized circuit and raceway schedule is utilized to determine percentage conduit and cable tray fill."

10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that measures be established to assure that applicable regulatory requirements

and design-basis, as defined in § 50.2 and as specified in the licensee application, for those structures, systems, and components to which this appendix applies are correctly translated into specifications, drawings, procedures, and instructions."

10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," requires, in part, that measures be established to assure that conditions adverse to quality, such as deficiencies, deviations, and nonconformances, are promptly identified and corrected.

REFERENCES:

1. PGE Raceway Schedule, Conduits, E-191, Volumes 1 through 3.
2. PGE Raceway Schedule, Trays with Cable, E-191, Volumes 1 through 8.
3. PGE Circuit Schedule, E-192, Volumes 1 through 6.
4. PGE Cable Code Schedule, E-192A.
5. PGE Raceway Code Schedule, E-191A.
6. UFSAR Sections 8.3.1.3 and 8.3.1.3.2.

UNRESOLVED ITEM 90-200-13

Unanalyzed Effects of Overfilled Cable Raceway on Electrical Modifications
(Section 4.1.6 of the report)

DESCRIPTION OF CONDITION:

A review of a sample group of electrical modifications showed that the effect of overfilled cable trays on four modifications (the licensee stated there were more) of safety-related systems had not been analyzed. The capability to readily detect overfilled trays using the raceway schedule has existed since approximately 1982 when Bechtel turned over the schedules to the licensee. The computerized raceway schedules (Refs. 1 and 2) places an asterisk next to tray and conduit designations for which an overfill condition exists. In addition, approximately 2 years ago the licensee began routinely including relevant raceway schedule sections in design modification packages.

The team was concerned about the effect on ampacity derating of adding cables to already overfilled trays and about seismic loading. In addition, the team was concerned about the design modification process in that it did not detect modifications performed on overfilled trays and did not require justification for the overfill conditions as required by the UFSAR (Ref. 3).

In response to the team's concerns, the licensee issued CAR C90-5195 and C90-5196 which will address the team's concerns as stated above. In addition, the licensee orally committed to reexamine the design process and implement changes where appropriate. An analysis performed by the licensee in response to the team's concerns about cable tray and conduit overfill addressed immediate operability concerns. (See Unresolved Item 90-200-10.)

REQUIREMENTS:

UFSAR Section 8.3.1.3.2, "Cable Trays," states, in part, that "a computerized circuit and raceway schedule is utilized to determine percentage conduit and tray fill" and "any exceptions to above percentages will be justified by notations in the raceway schedule."

Trojan Fire Protection Plan (Ref. 4) states, in part, that "the computerized circuit and raceway schedule is utilized to determine percentage conduit and tray fill" and "any exceptions to the above percentages are justified by notations in the raceway schedule."

10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that design control measures provide for verifying the adequacy of design, including design changes.

REFERENCES:

1. PGE Raceway Schedule, Conduits, E-191, Volumes 1 through 3.
2. PGE Raceway Schedule, Trays with Cable, E-191, Volumes 1 through 8.
3. UFSAR Section 8.3, "Cable Trays."
4. Trojan Fire Protection Plan - Program Description, Volume 1, Chapter 4, Section 5.

UNRESOLVED ITEM 90-200-14

Lack of Acceptance Criteria in Electrical Maintenance Procedures
(Section 4.3 of the report)

DESCRIPTION OF CONDITION:

Several Trojan maintenance procedures lacked appropriate acceptance criteria. For example, Maintenance Procedures (MP) 1-2 (Ref. 1) and MP 1-16 (Ref. 2), require the recording of polarization index values. However, the procedures did not contain minimum acceptance criteria or instructions to workers as to the actions required when unacceptable values were identified.

REQUIREMENT:

10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," requires, in part, that procedures contain appropriate quantitative or qualitative acceptance criteria.

REFERENCES:

1. Maintenance Procedure MP 1-2, "Transformers," Revision 13, November 17, 1988.
2. Maintenance Procedure MP 1-16, "Motor Maintenance," Revision 11, August 2, 1990.

UNRESOLVED ITEM 90-200-15

Corrective Action for Low Motor Polarization Index Values
(Section 4.3 of the report)

DESCRIPTION OF CONDITION:

Maintenance records for several engineered safety system pump motors indicated a decreasing trend in polarization index values over a 5-year period. The latest recorded values for four 4.16-kV motors were less than the values recommended by industry standards for alternating current motors. The licensee had not evaluated the consequences of the low polarization index values nor had it initiated corrective action to return the polarization index to acceptable values.

REQUIREMENT:

10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," requires that adverse conditions be promptly identified and corrected.

REFERENCES:

Maintenance Procedure MP 1-16, "Motor Maintenance," Revision 11.

UNRESOLVED ITEM 90-200-16

Lack of a Documented Fuse Control Program
(Sections 2.2.1 and 4.3 of report)

DESCRIPTION OF CONDITION:

The licensee did not have a documented program to control the identification, labeling, and replacement of fuses. The team believed that lack of a fuse control program had contributed to past problems with misplaced fuses. Eight CARs pertaining to incorrect fuse size, voltage, and labeling and duplicate fuse identification numbers had been issued in 1990. The licensee agreed to develop and implement a fuse control program.

REQUIREMENT:

10 CFR Part 50, Appendix B, Criterion II, "Quality Assurance Program," requires, in part, the development, documentation, and implementation of a program to control activities affecting quality.

REFERENCE:

Drawing E-22, "Electrical Fuse Schedule," Revision 14, July 9, 1990.

APPENDIX B

Persons Contacted

Portland General Electric Company Personnel:

S. E. Anderson
M. Couksey
D. Cummings
*G. Ellis
B. G. Guy
J. L. Hughes
*D. McCaig
D. C. Mohr
*D. Nordstrom
*J. Perry
*T. Rae
*S. Saylors
*L. Slaughter
*J. E. Uwagbae
*W. J. Williams
*J. Benjamin
*D. Couch
*B. DuCamp
*N. B. Farah
*J. Gebhardt
*D. Judd
*J. Mearns
*L. Morgan
*E. N. Parks
*J. Popp
*W. R. Robinson
*M. Schwartz
R. Steel
J. A. Vingerud
*P. Yundt
T. Berquam
*J. E. Cross
*H. Ek
M. Gander
*M. Hoffman
*R. Lindley
*S. Miller
*R. Nelson
M. Peery
*R. Prewitt
*D. Rogers
*J. Seibel
*G. Tingley
*T. D. Walt

Persons Invited by the Licensee:

*S. A[illegible]tus, Bechtel Power
*R. Chaudhuri, Washington Public Power Supply System
*L. H. Clark, Florida Power and Light
*A. Kar, Pacific Gas and Electric Company
*H. Moomey, Oregon Department of Energy
*R. Seidl, Washington Public Power Supply System
*D. Smyers, Arizona Public Service
*D. L. Williams, Bonneville Power Administration
*D. Wizhers, Arizona Public Service

Nuclear Regulatory Commission Personnel:

*D. Acker, Region V
*C. Caldwell, Region V
*G. Garten, NRR/DRIS
*J. Haller, Consultant
*W. Lanning, NRR/DRIS
*J. Neisler, Region III
*S. Richards, Region V
*R. Barr, Region V
*F. Daniels, NRR/DRIS
*F. Gee, Region V
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*J. Lindley, Consultant
*G. Rhoads, Consultant
*S. Stein, NRR/DRIS

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* Indicates those persons who attended the exit meeting on August 31, 1990.