NOTICE OF VIOLATION

Wisconsin Electric Power Company
Point Beach Nuclear Plant
Units 1 and 2

Dockets No. 50-266; 50-301
Licenses No. DPR-24; DPR-27
EA No. 90-159

During an NRC Electrical Distribution System Functional Inspection (EDSFI) conducted on March 12 through 16 and March 26 through April 6, 1990 and the subsequent followup inspection conducted on August 20 through 24, 1990, violations of NRC requirements were identified. In accordance with the "General Statement of Policy and Procedure for NRC Enforcement Actions," 10 CFR Part 2, Appendix C (1990), the violations are listed below:

A. 10 CFR 50, Appendix B, Criterion III, "Design Control" requires, in part, that measures be established to assure that applicable regulatory requirements and the design basis are correctly translated into specifications, drawings, procedures, and instructions. These measures shall include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled.

Contrary to the above, the design basis was not properly translated into specifications, drawings, procedures, or instructions in that:

1. As of March 31, 1990, the design basis for the licensee's emergency diesel generator (EDG) loading capacity, as described in Calculation No. 0870-103-011, did not reflect the actual loads that the EDGs would be subjected to during the use of the plant's emergency operating procedures. This had the potential for overloading the EDGs during manual operations.

2. Since May 26, 1988 for Unit 1 and October 13, 1988 for Unit 2 until April 6, 1990 (for both units), there existed the potential for the safety-related bus undervoltage relays to be damaged during a seismic event by movement of the 4.16 kV breakers. This could have prevented the automatic closure of the G01 EDG output breaker. This was due to the seismic adequacy of the 4.16 kV tie breakers in their racked out position not being determined prior to the licensee placing the breakers in such a position.

This is a Severity Level IV violation (Supplement I).

B. Technical Specification 15.6.8 "Plant Operating Procedures," requires in part that the plant be operated and maintained in accordance with approved procedures of a type used for surveillance and testing of safety-related equipment.

10 CFR Part 50, Appendix B, Criterion V requires, in part, that activities affecting quality be prescribed by documented instructions, procedures, or drawings of a type appropriate to the circumstances and accomplished in accordance with these instructions, procedures, or drawings.

Contrary to the above, since installation of the inverters in 1988 until April 1990, the licensee failed to include in an approved procedure the calibration of the Elgar inverter undervoltage trip function. This had the potential for tripping the inverters when they were receiving power from only their battery source.

This is a Severity Level IV violation (Supplement I).

C. 10 CFR 50, Appendix B, Criterion II, "Quality Assurance Program," requires, in part, that the quality assurance program shall provide control over activities affecting the quality of the identified structures, systems, and components, to an extent consistent with their importance to safety.

Contrary to the above, as of April 6, 1990, the licensee's quality assurance program failed to provide control over the calibration of safety-related protective relays which were not addressed in the technical specifications.

This is a Severity Level IV violation (Supplement I).

Pursuant to the provisions of 10 CFR 2.201, the Wisconsin Electric Power Company is hereby required to submit a written statement of explanation to the U. S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555 with a copy to the Regional Administrator, U. S. Nuclear Regulatory Commission, Region III, 799 Roosevelt Road, Glen Ellyn, Illinois 60137, and a copy to the NRC Resident Inspector at the Point Beach Nuclear Plant, within 30 days of the date of this Notice of Violation (Notice). This reply should be clearly marked as a "Reply to a Notice of Violation" and should include for each violation: (1) the reason for the violation if admitted, or if contested, the basis for disputing the violation, (2) the corrective steps that have been taken and the results achieved, (3) the corrective steps that will be taken to avoid further violations, and (4) the date when full compliance will be achieved. If an adequate reply is not received within the time specified in this Notice, an order may be issued to show cause why the license should not be modified, suspended, or revoked or why such other actions as may be proper should not be taken. Where good cause is shown, consideration will be given to extending the response time.

FOR THE NUCLEAR REGULATORY COMMISSION

A Bert Davis

A. Bert Davis
Regional Administrator

Dated at Glen Ellyn, Illinois
this 30th day of November 1990

Lougheed

SEP 27 1990

Docket No. 50-266
Docket No. 50-301
EA 90-159

Wisconsin Electric Power Company
ATTN: Mr. C. W. Fay
Vice President
Nuclear Power
231 West Michigan Street - P379
Milwaukee, WI 53201

Gentlemen:

This refers to the routine safety inspection conducted by Mr. D. S. Butler of this office on August 20-24, 1990, of activities at the Point Beach Nuclear Plant, Units 1 and 2, authorized by NRC Operating Licenses No. DPR-24 and No. DPR-27 and to the discussion of our findings with Mr. T. J. Koehler and others of your staff at the conclusion of the inspection. The purpose of this inspection was to follow up previously identified deficiencies that were discussed in Electrical Distribution System Functional Inspection (EDSFI) Reports No. 50-266/90201 and No. 50-301/90201.

The enclosed copy of our inspection report identifies areas examined during the inspection. Within these areas, the inspection consisted of a selective examination of procedures and representative records, observations, and interviews with personnel.

During this inspection, certain of your activities appeared to be in violation of NRC requirements. We are releasing this report at this time for your information. Following an Enforcement Conference, you will be notified by separate correspondence of our decision regarding enforcement actions based on the findings of this inspection. No written response is required until you are notified of the proposed enforcement actions.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosed inspection report will be placed in the NRC Public Document Room.

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

ORIGINAL SIGNED BY ROBERT J. [illegible]
H. J. Miller, Director
Division of Reactor Safety

See Attached for Enclosures
and Distribution

RIII	RIII	RIII	RIII	RIII
DAB yes	yes	RJG	MPR	yes copies CP
Butler/jk	Beck/jw	Gardner	Ring	Pederson
09/18/90	09/24/90	09/24/90	09/24/90	09/25/90

RIII	RIII
Martin	Miller
09/27/90	09/27/90

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Enclosures and Distribution

Enclosures:
1. Inspection Reports
   No. 50-266/90018(DRS);
   No. 50-301/90018(DRS)
2. Appendix A

cc w/enclosures:
G. J. Maxfield, Plant Manager
DCD/DCB (RIDS)
OC/LFDCB
Resident Inspector, RIII
Virgil Kanable, Chief
  Boiler Section
Charles Thompson, Chairman
  Wisconsin Public Service
  Commission
Leroy E. Conner, Acting Administrator
  WI Div. of Emergency Government
Teri L. Vierima, Chief
  Radiation Protection Section
  WI Department of Health and
    Social Services
S. Stein, NRR
B. Grimes, NRR

bcc w/enclosures:
J. Lieberman, OE
J. Goldberg, OGC
J. Partlow, NRR

U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-266/90018(DRS); No. 50-301/90018(DRS)

Docket Nos.: 50-266; 50-301 Licenses No. DPR-24; DPR-27

Licensee: Wisconsin Electric Power Company
231 West Michigan Street - P379
Milwaukee, WI 53201

Facility Name: Point Beach Nuclear Power Plant - Units 1 and 2

Inspection At: Point Beach Site, Two Rivers, WI 54241

Inspection Conducted: August 20-24, 1990

Inspector: D. S. Butler 9/24/90
Date

Approved By: R. N. Gardner, Chief 9/24/90
Plant Systems Section Date

Inspection Summary

Inspection on August 20-24, 1990 (Reports No. 50-266/90018(DRS); No. 50-301/90018(DRS))

Areas Inspected: Routine, announced inspection to follow up previously identified Electrical Distribution Safety Functional Inspection (EDSFI) deficiencies (Inspection Procedures 62705 and 37701).

Results: In the area that was reviewed, the following items were identified: one apparent violation of design control criteria with six (6) examples (Paragraphs 2.a., 2.g., 2.h., 2.j., 2.o., and 2.w.); one apparent violation of ··lity assurance program criteria (Paragraph 2.y.); one apparent violation of nnical Specification 15.6.8 required procedures (Paragraph 2.z.); one arent deviation from FSAR commitments (Paragraph 2.e.); and three unresolved .ems (Paragraphs 2.r., 2.t., and 2.u.). During the course of the inspection, the following strengths were noted:

- The licensee's staff provided good technical responses in a timely manner.
- The corrective actions which the licensee has committed to implement were comprehensive and should correct the deficiencies identified by the EDSFI.
- The licensee identified additional related inspection action items that they were pursuing.

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DETAILS

1. Persons Contacted

   Wisconsin Electric Power Company (WEPCo)

   G. Maxfield, Plant Manager
   *T. Koehler, General Superintendent - Maintenance
   *J. Reiserbuechler, General Superintendent - Operations
   *P. Katers, Senior Electrical Engineer
   W. Hennig, Electrical and Instrument System Engineer
   *J. Jack, Quality Specialist, Regulatory Services
   *K. Nickels, Quality Specialist, Regulatory Services
   F. Flentje, Administrative Specialist, Regulatory Services

   U. S. Nuclear Regulatory Commission (NRC)

   C. Vanderniet, Senior Resident Inspector
   *J. Gadzala, Resident Inspector

   The NRC inspector also contacted and interviewed other licensee personnel.

   *Denotes those present at the exit interview on August 24, 1990.

2. Licensee Action on Previous Inspection Findings

   The purpose of this inspection was to follow up deficiencies previously identified in Electrical Distribution System Functional Inspection (EDSFI) Reports No. 50-266/90201 and No. 50-301/90201. A number of the EDSFI deficiencies will be closed in this report based on additional inspections conducted and a review of licensee commitments documented in the licensee's August 3, 1990 response to the EDSFI report. The remaining deficiencies will be assigned a tracking number associated with this report. The attached appendix contains the complete list of deficiencies and their status.

   a. Deficiency No. 90-201-01: Non-Conservative Diesel Generator Steady-State Loading Calculation

      The safety-related AC electrical loads applied to the emergency diesel generators (EDGs) during the injection and recirculation phases of accident mitigation were identified in the Final Safety Analysis Report (FSAR), Tables No. 8.2-1 and 8.2-2. The EDSFI noted that the steady-state diesel generator load analysis performed in Calculation No. 0870-103-011 was based on an assumption that was different than identified in the FSAR. The emergency operating procedures (EOPs) were also used as a design input to the calculation and the EDSFI noted that the EOPs manually added additional loads to the EDGs. The EDSFI postulated that the already marginally sized (near full load capacity ratings) EDGs would be manually overloaded when using the EOPs.

The licensee walked down the EOP procedures and calculated (No. N-90-042, 06/28/90) the new EDG load values for the EOPs. The walkdown determined that there were loads that were not required and could be manually stripped. The loads removed were greater than the FSAR loads to be added. As a result, the true load on both EDGs actually decreased.

Failure of the licensee to consider all the available loads in the EDG loading calculation is an example of an apparent violation of 10 CFR 50, Appendix B, Criterion III, Design Control (266/90018-01a; 301/90018-01a).

The affected EOP procedures have been corrected and the operators trained on the procedure corrections.

The G02 diesel is the highest loaded EDG and will automatically load to 2246 KW during a reactor trip or safety injection (EOP-0). The addition of manual loads will result in a load of 2947 KW. The overload alarm is set at the 2000 hour EDG rating of 2850 KW. During a loss of reactor or secondary containment (EOP-1) the EDG could have been loaded to 3030 KW. Subsequently, the licensee has determined that the boric acid heat tracing was not required and removal of this load would ultimately reduce the load to 2949 KW. During containment sump recirculation (EOP-1.3) the load remained at 2949 KW.

The following are the manufacturer's recommended operating ratings:

- 2500 KW continuous operation
- 2850 KW for 2000 hours per year
- 2963 KW for 200 hours per year
- 3000 KW for 4 hours per year
- 3053 KW for 0.5 hours per year

The inspector discussed these ratings with Morrison-Knudsen (Power Systems Division) engineering. The above ratings are based on the one year annual EDG maintenance schedule. The hours per year ratings are not accumulative. If the diesel is operated at 3053 KW for 30 minutes, it should receive its annual maintenance inspection. Also, load testing at the continuous rating (2500 KW) was adequate to prove operability at higher loads. The load testing requirement per Electro-Motive Division (engine manufacturer) was to exceed a minimum load of 20% of unit rating. Testing at 2500 KW would also keep from accumulating maintenance hours. During accident conditions, it is up to the operator to determine what loads should be placed on the EDG and when it should be shut down. The ratings could therefore be exceeded up to 3053 KW. The engine capacity is limited by the maximum injection of fuel at 3053 KW. The licensee informed the inspector that the EDGs have been operated at the 3053 KW rating during adjustment and/or replacement of the mechanical overspeed trip mechanism. This run time was typically for only five (5) minutes. During site acceptance testing (1970 time frame) the G01 diesel was run at approximately 3053 KW for ten (10) continuous hours followed by load cycling between 2850 to 3053 KW for an additional fourteen (14) hours. Based on the above information, the PBNP emergency diesel generators would have been able to handle a design basis accident.

b. Deficiency No. 90-201-02: Lack of Transient Analysis of Diesel Generator Loading

The EDSFI was concerned that the steady-state EDG loading calculation should have included a dynamic analysis of the capacity of the diesel generator to handle starting loads and sequencing intervals. The licensee does perform a partial transient load test of the EDG each refueling outage. Procedure No. ORT 3, "Safety Injection Actuation with Loss of Engineering Safeguards AC Unit 1," starts the residual heat removal, service water, and auxiliary feedwater pumps; verifies that certain valves travel to their required position; verifies load shedding; and verifies sequencing times. The largest pumps, safety injection (SI), are not started during this test. The inspector discussed the SI pumps with the Duty Shift Supervisor (DSS). The DSS indicated that the starting of the SI pumps on recirculation test lines was not a preferred alignment. This alignment may cause excessive equipment vibration. The DSS indicated that it was also difficult to establish actual operating conditions. The DSS also indicated that the Point Beach Nuclear Plant was looking into a future full scale (start all loads) SI plus Loss of Offsite Power (LOSP) test.

The EDGs are currently tested monthly to 2500 kW. The licensee determined that the non-shed loads plus the automatic sequenced loads were 2246 kW. The EDGs are being tested to a load greater than the injection phase required automatic loads and receive a partial transient type load test each refueling outage. The licensee has committed to analyze the transient behavior of the EDG and related systems. Computer software will have to be purchased to perform this type of analysis. Based on the above commitments and based on the determination that the EDGs were sized to start and carry the engineered safety features required loads (2246 kW), this item is considered closed.

c. Deficiency No. 90-201-03: Incorrect Load Ratings Listed in the Emergency Operating Procedures

The EDSFI was concerned that incorrect load tables could result in overloading the EDGs during manual loading. The EDG loading issue was previously discussed in Deficiency No. 90-201-01. The inspector reviewed the following list of procedures:

EOP 0, App. C, Rev. 8	ECA 0.0, App. D, Rev. 7
EOP 1, App. A, Rev. 8	ECA 0.2, App. A, Rev. 5
EOP 1.1, App. A, Rev. 6	ECA 2.1, App. A, Rev. 7
EOP 3, App. B, Rev. 8	ECA 3.1, App. A, Rev. 8

All of the above procedures have been revised with the new EDG loading list.

The above procedures were previously inadequate; however, the root cause appears to be a result of inadequate Calculation No. 0870-103-011. Apparent violation numbers 266/90018-01a and 301/90018-01a addressed this calculation. Therefore, this item is considered closed.

d. Deficiency No. 90-204-04: EDG Loading as Instructed by EOPs for a Design Basis Accident (DBA)

The EDSFI was concerned that the EDG manual loading steps were not detailed enough to prevent EDG overloading during a DBA. The EDG loading issue was previously addressed in Deficiency No. 90-201-01. Procedures EOP-1 and EOP-1.4 were adequately changed to provide additional guidance to the operators for managing EDG loads during an accident. Therefore, this item is considered closed.

e. Deficiency No. 90-201-05: Nonconformance to Design Basis Criteria for Electrical Cable Tray Fill and Cable Ampacity Derating

The EDSFI was concerned that FSAR and Bechtel cable fill requirements had been exceeded. The Bechtel design criteria required that cable ampacity be decreased using a derating factor for a maximum of 24 cables in a tray without maintained spacing. The team identified that tray FK07 contained 55 cables. The licensee issued Nonconformance Report (NCR) N-90-092. The inspector reviewed the results of the NCR and concluded that the cables were adequately sized to handle the load current. WEPCo determined that 210 power and control cable tray sections and 15 instrumentation cable tray sections also did not conform to FSAR and Bechtel electrical design criteria. This is considered an apparent deviation (266/90018-02; 301/90018-02) from FSAR Section 7.2, "Protection Against Multiple Disability for Protection Systems."

f. Deficiency No. 90-201-06: Lack of Assessment of Available Short-Circuit Current Due to High Battery Temperature

The EDSFI was concerned that the DC system short-circuit current analysis should be analyzed at the maximum battery temperature rather than 77°F. The 77°F battery electrolyte temperature is a standard temperature used by battery manufacturers and is adopted in the IEEE Standards for rating batteries. The EDSFI postulated for batteries D05 and D06 that the available short-circuit current at 77°F was approximately 20,000 A. The licensee performed Calculation No. N-90-058 and determined the short circuit current to be 20,983 A (D05) and 20,977 A (D05) at 90°F. While the IEEE Standards do not define the temperature at which the maximum short-circuit current should be determined, the maximum battery temperature should be considered to ensure breaker interrupting capability is adequate. The licensee has committed to factor the increased short circuit current into the existing DC distribution system calculation. Based on this commitment, this item is considered closed.

g. Deficiency No. 90-201-07: Inadequate Seismic Evaluation for Modifications to 4160 Vac Safeguards Bus Tie-Breaker

The EDSFI determined that a seismic evaluation had not been considered by the licensee for racking-out the Unit 1 (1A52-61) and Unit 2 (2A52-72) maintenance tie-breakers. The breakers were placed in their racked-out position as a result of a Westinghouse (W) Part 21 notification (October 21, 1987) on the malfunction of W Type W-2 cell switches.

The racked-out position of a breaker completely disconnects a breaker for personnel and equipment safety. This is a designed position for a breaker to be placed in. The W Type DH air circuit breaker, used at PBNP, is completely free of its racking mechanism when in the racked-out position. The breakers are equipped with wheels to facilitate moving the breakers. Mounted on the switchgear cubicle door are the safety-related bus undervoltage (UV) relays (1-271X2 and 1-272X2). One set of the UV contacts are in the auto-close circuitry of the EDG (G01) output breaker. The potential existed for a seismic event to produce motion in the racked-out breakers which would disable the UV relays and prevent G01 from automatically loading its safety busses. The breakers were subsequently removed from their cubicles.

Failure of the licensee to consider the effect of seismic events on the racked-out tie-breakers is an example of an apparent violation of 10 CFR 50, Appendix B, Criterion III, Design Control (266/90018-01b; 301/90018-01b).

The inspector reviewed the schematic diagrams and determined that only the G01 diesel would have been affected if such an event had occurred.

h. Deficiency No. 90-201-08: Single Failure of Safeguards 480 Vac Bus Tie Breaker

The EDSFI identified that a short circuit between adjacent cables in a shared raceway could result in the spurious closure of the 480 Vac safeguards bus tie-breakers (1B52-16c or 2B52-40C). This had the potential to parallel redundant voltage sources. The licensee had implemented a modification (MR 85-053) to correct other single-failure deficiencies associated with the 480 Vac tie-breakers, but did not identify this failure mechanism.

Failure of the licensee to identify the cable single-failure mechanism is an example of an apparent violation of 10 CFR 50, Appendix B, Criterion III, Design Control (266/90018-01c; 301/90018-01c).

The licensee placed the breakers' control power fuse blocks in their off position and placed an operator aid near the fuse blocks and on the main control boards. The inspector verified that the fuse blocks were off and adequately identified. In addition, the inspector verified that Operating Instruction (OI) 35, "Electrical Equipment Operation," was revised to reflect the new control power configuration.

The licensee submitted Licensee Event Report (LER) No. 90-004-00 to the NRC describing the single failure and their corrective actions. This deficiency has existed since original plant construction.

i. Deficiency No. 90-201-09: Incorrect Safety Classification and Non-Conformance with Separation Criteria of Control Cabling of 480 Vac Bus Tie-Br aker

The EDSFI identified that the control cables associated with the 480 Vac tie-breakers were incorrectly classified as nonsafety-related. The licensee committed to determine the appropriate classification. These cables are the cables identified in apparent violation numbers 266/90018-01c and 301/90018-01c. A determination of any additional corrective actions will be included with the corrective actions to be taken for the apparent violations. Therefore, this item is considered closed.

j. Deficiency No. 90-201-10: Nonconformance with FSAR Separation Criteria, and Potential for Consequential Common-Mode Failure of Both Trains of the Component Cooling Water (CCW) Pumps

The EDSFI identified the potential for a cable line to line DC short within vertical Riser No. 82 that could simultaneously blow control power fuses for both Unit 1 CCW pump breakers. This condition also existed in the Unit 2 CCW pump circuitry. The licensee opened (slide links) the low header pressure start circuit for the "B" pump in each unit. The "A" pump circuit was left as-is and the operators were informed that the "B" pump was the preferred running pump. Failure of the licensee to identify the cable separation and common-mode failure of either unit's CCW pumps is an example of an apparent violation of 10 CFR 50, Appendix B, Criterion III, Design Control (266/90018-01d; 301/90018-01d).

This deficiency has existed since original plant construction. The operators had available annunciators (such as motor trip and low CCW header pressure) and CCW flow indication. In addition, Procedure No. AOP-9B, "Loss of Component Cooling," provided the operator's adequate steps on how to manu. restore CCW flow.

k. Deficiency No. 90-201-11: Use of Non-Qualified Components in Safeguards Bus Breaker Control Circuits

The EDSFI identified that a common control relay in the miscellaneous relay rack (MRR) was shared by both trains of CCW. The rack assembly and relay had not been seismically qualified. The licensee stated that the MRR rack and relays were of the same type as the adjacent safeguards relay racks (SRR) which were qualified as part of the original design. The inspector observed the MRR installation and determined the racks, relays and rack mounting to be similar to the SRRs. The licensee committed to evaluate the adequacy of the MRRs. There is also an ongoing industry study by the Seismic Qualification Utility Group (SQUG) which will also address these types of installations.

A unit's CCW pumps may be manually or automatically started by a CCW low header pressure signal. Normally, one pump is running all the time. On a loss of offsite power, the CCW pumps are load shed; however, they are not automatically reloaded onto the bus. An 86 relay will energize on the load shed and seal-in to prevent the automatic start of the CCW pumps until the 86 relay circuit is reset by a reactor operator. If the common relays were to chatter (during a seismic event), the 86 relay contact would prevent the common relay contacts from automatically starting the CCW pumps during automatic loading of the EDGs. This would prevent the transient loading of the CCW pumps onto the EDGs during the first minute of the injection phase when other large motor loads are being sequenced onto the EDGs. Subsequent manual loading of the CCW pumps onto the EDGs had been analyzed and was acceptable. The licensee has taken additional corrective actions which are described in the preceding deficiency (No. 90-201-10). Based on the above, this item is considered closed.

l. Deficiency No. 90-201-12: Vulnerability of Switchgear Control Power to Seismic Event That Opens Manual Transfer Switches

This item was previously addressed in NRC Inspection Reports No. 50-266/89033 and No. 50-301/89032. During an enforcement conference, the use of manual transfer switches (knife switches) was discussed. The licensee determined that during a seismic event, these switches would not inadvertently open. Based on the above, this item is considered closed.

m. Deficiency No. 90-201-13: Nonconforming Diesel Generator Sequence Logic

The EDSFI identified that the EDG breaker closing logic operated differently than represented on vendor Drawing No. 8413730. The breaker would close if the EDG was at speed and the generator field had flashed within six (6) seconds instead of at speed and voltage. The licensee performed a special test of both EDGs. This test demonstrated that the G01 output breaker would close at 4432 volts and the G02 output breaker would close at 4274 volts. These values are acceptable. The licensee made a commitment to modify the circuit to close the breaker on an at voltage signal or to change the FSAR to better represent the design, and to evaluate the need to perform periodic testing to determine the EDG output breaker closing voltage. Based on the above commitments, this item is considered closed.

n. Deficiency No. 90-201-14: Excessive DC Voltage Applied to Equipment Terminals

The EDSFI was concerned that PBNP was exceeding the battery float voltage as recommended in the EXIDE vendor manual. The vendor manual stated that a lead-calcium (1.215 specific gravity) battery should be floated at an average voltage between 2.17 to 2.26 volts per cell. The licensee uses procedure RMP 46, "Station Battery," once per month to set the float voltage per the battery's temperature. In addition, Operating Instruction (OI) 33, "Paralleling Battery Chargers," limits the Westinghouse Rectomatic Charger DC output to between 131 and 135 Vdc. The maximum volts per cell is 2.29 Vdc. This exceeds the vendor's recommended volts per cell by 0.03 Vdc. However, the vendor's volts per cell range is an average value. The maximum volts per cell recommended during equalization is 2.42 Vdc. The PBNP battery installation does not permit the batteries to be equalized during normal operation without removing the battery from service. The licensee uses the slightly higher float voltage (depending on cell temperature) to ensure the battery remains fully charged.

The EDSFI also was concerned that float charging at 135 Vdc could exceed the control voltage rating of W Type DHP switchgear. The licensee provided documentation from Westinghouse (CPDW-90-480, August 21, 1990) which states, in part, that the Type DHP breakers comply with the requirements of ANSI C37.06 and therefore, are qualified to operate at up to 140 Vdc.

The licensee had previously made a commitment to install an additional safety-related and nonsafety-related battery. This would permit the transfer of the safety-related bus to the alternate battery to permit the normal battery to be equalized following operation at a lower float voltage. In addition, the licensee has committed to review the the DC system for other components that could be affected by excessive DC voltages. Based on the above, this item is considered closed.

o. Deficiency No. 90-201-15: Inadequate Fuel Oil System Seismic Category I Classification

The EDSFI requested the seismic calculations for the EDG fuel oil transfer piping located in the fuel oil pump house. No calculations were available for the team's review. The licensee indicated the 2-inch piping was installed using the seismic methods recommended for small-bore piping and that they were in the process of analyzing the piping located in the fuel oil pump house. As a result of that analysis, the pump house fuel oil transfer piping was determined to be seismically unqualified. The licensee declared both EDGs inoperable on April 9, 1990, and requested and received from the NRC on April 10, 1990, a temporary waiver of compliance for seven (7) days to modify the piping supports. Redesign of the piping supports was completed on April 12, 1990, and the supports were installed by April 15, 1990. This condition had existed since original plant construction. The licensee issued LER No. 90-003-00 describing this condition.

Failure of the licensee to seismically support the fuel oil transfer piping is an example of an apparent violation of 10 CFR 50, Appendix B, Criterion III, Design Control (266/90018-01e; 301/90018-01e).

p. Deficiency No. 90-201-16: Fuel Oil Cloud Point Substantially Higher than Required

The EDSFI was concerned that the winter temperature extremes seen at PBNP were below the cloud point (temperature which the fuel becomes cloudy as the result of the formation of wax crystals) of the fuel oil. The cloud point of the diesel fuel should be based on average ambient temperatures as recommended by ANSI/ASTM D975, "Standard Specification for Diesel Fuel Oils." The PBNP FSAR states that the units use No. 2 diesel oil. The No. 2 diesel fuel oil may have a cloud point of only -7°F (based on ANSI/ASTM D975) which is above the temperature extremes seen at PBNP. However, the emergency fuel oil supply and piping is located either underground or in the fuel oil pump house which has electrical heaters. There appears to be no EDG operability concern during the winter months.

The nonsafety-related fuel oil storage tanks (FOST) are located above ground and are connected to the pump house through an above ground 4-inch pipe. It is this section of pipe that may be susceptible to the high cloud point which could impair the flow of fuel oil to the emergency tank. The licensee has revised Instruction PBNP No. 4.12.22, "Fuel Oil Ordering and Sample Disposition Instruction," to require the delivery of No. 1 fuel oil during the months of October through March. The blending of the fuel in the FOST will effectively lower the cloud point. The licensee is currently developing a fuel oil specification based on Nuclear Maintenance Assistance Center (NMAC) guidelines for all of the systems that utilize diesel fuel oil. Based o. the above, this item is considered closed.

q. Deficiency No. 90-201-17: No Procedure to Control Upgrade of Fuel Oil System to Safety-Related Status

The EDSFI was concerned that a procedure was not available for upgrading a nonsafety-related system to a safety-related system. The licensee was using an approach for the fuel oil transfer system upgrade that was similar to what they had used to upgrade the spent fuel pool. Procedure No. QP2-1 (Rev. 0), "Upgrading of Non-QA Scope Systems or Components to QA-Scope Status," was in place at the time of the EDSFI inspection. The licensee has committed to enhance Procedure No. QP2-1 or issue a new procedure to better describe the upgrading of systems to safety-related. Based on the above, this item is considered closed.

r. Deficiency No. 90-201-18: Undocumented Upgrade of Fuel Oil System to Quality Assurance (QA) Status

The EDSFI identified that several modification packages for the fuel oil system had not been classified as QA. The modifications identified in the EDSFI report had been implemented prior to the licensee developing an upgrade procedure (QP-2-1, dated November 12, 1987). An engineering action request has existed to upgrade the fuel oil system to safety-related status since 1989 (PBAR 89-013).

The licensee has recently completed evaluation NPM-90-582 (July 19, 1990), "Evaluation of the Fuel Oil Supply and Transfer System for the Emergency Diesel Generators for Upgrading to Safety-Related Status." The evaluation has not been reviewed by the NRC. This item is considered unresolved (266/90018-03; 301/90018-03) pending further review of this item by the NRC.

s. Deficiency No. 90-201-19: Procedure PBNP 4/12/22, Revision 13, Deficient for Delivering Fuel Oil Under Emergency Conditions

The EDSFI had several comments on Procedure No. PBNP 4.12.22, Revision 13, "Fuel Ordering, Receipt & Sample Disposition Instruction," relating to fuel oil delivery under emergency conditions. The licensee issued the following changes to Procedure No. 4.12.22 to address the EDSFI's comments:

- No. 1 fuel oil must be delivered during the months of October through March.
- The truck must be dispatched with a barreling nozzle and 150 feet of companion hose.

In addition, the licensee issued special order PBNP 90-01, Revision 0, "Emergency Fuel Oil Supply," on how to supply fuel oil to the EDGs and diesel fire pump day tanks if the normal supply is unavailable.

The inspector reviewed the changes incorporated into PBNP 4.12.22 and determined that the licensee adequately addressed the EDSFI's observations. This item is considered closed.

t. Deficiency No. 90-201-20: Feasibility of Appendix R Scenario Inadequately Investigated by the Licensee

The EDSFI was concerned that during an Appendix R scenario (where power is lost to the fuel oil transfer pumps) the gravity feed of fuel oil from the FOST to the emergency fuel oil tank may not be accomplished during winter conditions due to fuel oil wax buildup (cloud point). The licensee committed to perform a gravity feed test during January 1991. This item is considered unresolved (266/90018-04; 301/90018-04) pending the completion of the gravity feed winter test by the licensee and subsequent review by the NRC.

u. Deficiency No. 90-201-21: Nonconservative Calculation for Emergency Diesel Generator Room Temperature

The EDSFI was concerned, based on a review of Calculation Nos. N-88-034 and N-88-040, that the EDG room design temperature may be exceeded. The licensee has committed to re-evaluate the room temperature calculation by May 1991. This item is considered unresolved (266/90018-05; 301/90018-05) pending the re-evaluation of the EDG room temperature calculation by the licensee and subsequent review by the NRC.

v. Deficiency No. 90-201-22: Inadequate Physical Independence of Redundant Class 1E Cables

This deficiency was written to address overall EDSFI concerns relating to cable separation. The licensee identified twenty-five (25) additional cases of inadequate cable separation. The cables identified in Deficiency Nos. 90-201-10 and 90-201-23 were the only ones that had an impact on equipment operability. The licensee was in the process of upgrading the Cable and Raceway Data System (CARDS) prior to the EDSFI. In addition, the licensee committed to review the CARDS data base for any needed program changes; to verify existing routing information; and to upgrade the CARDS data bank. Deficiency Nos. 90-201-10 and 90-201-23 have been categorized as examples of apparent design control violation numbers 266/90018-01d, 301/90018-01d and 301/90018-01f. Even though the 25 cases of inadequate cable separation are all examples of a deviation from FSAR commitments, only two affected operability. The licensee promptly corrected the two deviations affecting operability and has completed evaluation of the other cases. Corrective actions include physical separation by modification and correction of errors in the CARDS database. The licensee anticipated completing these actions by the end of 1990 for Unit 2, subject to the availability of required equipment, and for Unit 1 by the end of the spring 1991 refueling outage. Based on the above, this item is considered closed.

w. Deficiency No. 90-201-23: Potential for Common-Mode Failure of Unit 2 Turbine Driven Auxiliary Feedwater (AFW) Pump Automatic Start

The EDSFI identified that cables ZC2NA012D and ZD2NA012B, which provide redundant open signals to the Unit 2 turbine driven AFW steam supply valve, were routed through a common conduit. A single failure of any cable within the conduit could defeat the undervoltage automatic start signal. The licensee corrected the original design deficiency by rerouting one of the cables into the correct conduit. The motor driven AFW pump was operable at the time of discovery. The Unit 1 turbine driven AFW pump steam supply valve control circuit was correctly wired. Failure of the licensee to provide adequate cable separation for the Unit 2 steam driven AFW steam supply valve auto open circuit is an example of an apparent violation of 10 CFR 50, Appendix B, Criterion III, Design Control (301/90018-01f).

The inspector reviewed Procedure No. EOP-0, "Reactor Trip on Safety Injection," and determined that there were sufficient procedure steps on how to perform a manual start of the steam driven AFW pump.

x. Deficiency No. 90-201-24: Venting Steam on Safety-Related Cables

The EDSFI team observed that a Unit 1 condensate receiver tank vent was venting steam onto safety-related cable trays JE06, JE07, FV12, and FV13. The licensee inspected the cable trays and determined that several safety-related cables had some jacket discoloration and several nonsafety-related cables had some jacket damage. The licensee taped the nonsafety-related cables and has committed to change out the affected safety-related cables. Steam is emitted from this vent only during a Unit 1 outage. The licensee had developed a modification package (89-04) to correct this overpressurization. Based on the above, this item is considered closed.

y. Deficiency No. 90-201-25: Inadequate Program for Calibration of Protective Relays

The EDSFI found that all of the protective relays at PBNP were being calibrated by the WEPCo relay group from Appleton, Wisconsin. The team determined that their activities at PBNP were not being controlled by WEPCo's approved QA program. The licensee placed a Stop Work Order on the Appleton group until the extent of the relay group's involvement at PBNP could be determined. The licensee has committed, as a minimum, to provide QA orientation to the relay group; to control the measuring and test equipment used at PBNP for relay calibrations; to assure that the relay settings match the PBNP setpoint document; to write and issue additional test procedures for non-Technical Specification safety-related relays; to control the procurement and replacement of parts; to maintain proper documentation; and to assure that completed work is reviewed by PBNP personnel.

Failure of the licensee to apply adequate QA measures to assure that the calibration of safety-related protective relays were being adequately controlled is considered a violation of 10 CFR 50, Appendix B, Criterion II, Quality Assurance Program (266/90018-06; 301/90018-06).

z. Deficiency No. 90-201-26: Inadequate Surveillance Procedure for Elgar Inverters

The EDSFI identified that Procedure RMP-45, "Elgar Instrument Bus Inverters," did not include a check of the inverter's low-voltage shutdown circuit. The licensee tested the shutdown circuit setpoints and determined the following:

Inverter	As-Found (Vdc)	As-Left (Vdc)
1DY03	110.84	100.04
DYOC	101.13	100.05
2DY03	101.10	100.05
1DY04	99.4	100.1
DYOD	98.05	99.97
2DY04	99.5	100.0

Inverter 1DY03 was the only inverter that had a nonconservative setpoint. This inverter is supplied from battery D105. The most recent performance test of battery D105 (November 9, 1989) determined the battery's capacity to be 103%. The inspector requested the licensee to determine if the inverter would be able to meet FSAR

Table 8.2-3 one (1) hour load profile prior to tripping the inverter on a low-voltage shutdown trip. The licensee determined that after a one (1) hour discharge, the voltage at the inverter would be 111 Vdc; therefore, inverter 1DY03 was operable. In addition, common inverter DYOC was operable with its as-found low-voltage shutdown trip at 101.13 Vdc. Procedure No. RMP-45 provided adequate steps on how to transfer inverters.

Failure of the licensee to test the inverter low-voltage shutdown trip is an apparent violation of Technical Specification 15.6.8, "Plant Operating Procedures" (266/90018-07; 301/90018-07).

aa. Deficiency No. 90-201-27: No Acceptance Criteria in Routine Maintenance Procedure (RMP-46) for Locating Grounds

The licensee has been monitoring and recording the ground resistance readings on each of the DC systems. The EDSFI observed that Procedure No. RMP-46, "Station Battery," calculated the ground resistance; however, no specific acceptance criteria was given. The licensee committed to develop such criteria and was pursuing the purchase of more sensitive equipment to perform this measurement. The inspector reviewed the FSAR and Technical Specifications and determined that the ground detection circuitry was not specified in the safety analysis or Technical Specification bases. Based on the above, this item is considered closed.

In summary, the licensee provided the inspector with good technical answers for the questions that were asked. The licensee involved both plant and corporate personnel to resolve the questions and provided the answers in a timely manner. The inspector noted that the commitments made by the licensee in response to the EDSFI were good and should correct the deficiencies identified. In addition to the EDSFI commitments, the licensee identified other related inspection action items that they were pursuing on their own.

3. Unresolved Items

Unresolved items are matters about which more information is required in order to ascertain whether they are acceptable items, items of noncompliance, or deviations. Unresolved items disclosed during the inspection are discussed in Paragraph Nos. 2.r., 2.t., and 2.u.

4. Exit Interview

The inspector met with licensee representatives (denoted in Paragraph 1) following the inspection on August 24, 1990, to discuss the scope and findings of the inspection, including the apparent violations. The inspector also discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspector during the inspection. Licensee representatives did not identify any such documents or processes as proprietary.

APPENDIX A

	Deficiency Number	Title	Status
a.	90-201-01	Nonconservative Diesel Generator Steady-State Loading Calculation	266/90018-01a 301/90018-01a
b.	90-201-02	Lack of Transient Analysis of Diesel Loading	Closed
c.	90-201-03	Incorrect Load Ratings Listed in EOPs	Closed
d.	90-201-04	EDG Loading as Instructed by EOPs for a Design Basis Accident	Closed
e.	90-201-05	Nonconformance to Design Basis Criteria for Electrical Cable Tray Fill and Cable Ampacity	266/90018-02 301/90018-02
f.	90-201-06	Lack of Assessment of Available Short-Circuit Current Due to High Battery Temperature	Closed
g.	90-201-07	Inadequate Seismic Evaluation for Modification to 4160 Vac Safeguards Bus Tie-Breaker	266/90018-01b 301/90018-01b
h.	90-201-08	Single Failure of Safeguards 480 Vac Bus Tie-Breaker	266/90018-01c 301/90018-01c
i.	90-201-09	Incorrect Safety Classification and Nonconformance with Separation Criteria of Control Cabling for 480 Vac Bus Tie-Breakers	Closed
j.	90-201-10	Nonconformance with FSAR Separation Criteria and Potential for Common-Mode Failure of Both CCW Pumps	266/90018-01d 301/90018-01d

	Deficiency Number	Title	Status
k.	90-201-11	use of Nonqualified Components in Safeguards Bus Breaker Control Circuit	Closed
l.	90-201-12	Vulnerability of Switchgear Control Power to Seismic Event that Opens Manual Transfer Switches	Closed
m.	90-201-13	Nonconformance Diesel Generator Sequence Logic	Closed
n.	90-201-14	Excessive DC Voltage Applied to Equipment Terminals	Closed
o.	90-201-15	Incomplete Fuel Oil System Seismic Category I Classification	266/90018-01e 301/90018-01e
p.	90-201-16	Fuel Oil Cloud Point Substantially Higher than Required	Closed
q.	90-201-17	No Procedure to Control Upgrade of Fuel Oil System to Safety-Related Status	Closed
r.	90-201-18	Undocumented Upgrade of Fuel Oil System to QA Status	266/90018-03 301/90018-03
s.	90-201-19	Procedure 4.12.22, Revision 3, Deficient for Delivering Fuel Oil Under Emergency Conditions	Closed
t.	90-201-20	Feasibility of Appendix R Scenario Inadequately Investigated by Licensee	266/90018-04 301/90018-04
u.	90-201-21	Nonconservative Calculation for Emergency Diesel Generator Room Temperature	266/90018-05 301/90018-05
v.	90-201-22	Inadequate Physical Independence of Redundant Class 1E Cables	Closed

	Deficiency Number	Title	Status
w.	90-201-23	Potential Common-Mode Failure of Turbine Driven AFW Pump Automatic Start Circuitry	301/90018-01f
x.	90-201-24	Venting Steam on Safety Related Cables	Closed
y.	90-201-25	Inadequate Program for Calibration of Protective Relays	266/90018-06 301/90018-06
z.	90-201-26	Inadequate Surveillance Procedure for Elgar Converters	266/90018-07 301/90018-07
aa.	90-201-27	No Acceptance Criteria in Routine Maintenance Procedure 46 for Locating Grounds	Closed

NRC FORM 766
(11-81)
IE MC 0535

U.S. NUCLEAR REGULATORY COMMISSION

INSPECTOR'S REPORT

Office of Inspection and Enforcement

PRINCIPAL INSPECTOR (Name, last, first, and middle initial): Butler David S

REVIEWER: Gardner Ronald N

INSPECTORS

LICENSEE/VENDOR	TRANSACTION TYPE	DOCKET NO. (8 digits) OR LICENSE NO. (BY PRODUCT) (13 digits)	REPORT NO.	SEQ	NEXT INSPEC. DATE MO	YR
Wisconsin Electric Company Point Beach Nuclear Plant	X I – INSERT	05000266	90018	A		
	M – MODIFY	05000301	90018	B		
	D – DELETE			C		
	R – REPLACE			D		

PERIOD OF INVESTIGATION/INSPECTION FROM (MO DAY YR)	TO (MO DAY YR)	INSPECTION PERFORMED BY	OTHER	ORGANIZATION CODE OF REGION/HQ CONDUCTING ACTIVITY: REGION	DIVISION	BRANCH
08 20 90	08 24 90	X 1 – REGIONAL OFFICE STAFF 2 – RESIDENT INSPECTOR 3 – PERFORMANCE APPRAISAL TEAM		3	2	2

(See IEMC 0530 "Manpower Reporting—Weekly Manpower Reporting" for code.)

REGIONAL ACTION (Check one box only)

1 – NRC FORM 591
X 2 – REGIONAL OFFICE LETTER

TYPE OF ACTIVITY CONDUCTED (Check one box only)

X 02 – SAFETY
03 – INCIDENT
04 – ENFORCEMENT
05 – MGMT. AUDIT
06 – MGMT. VISIT
07 – SPECIAL
08 – VENDOR
09 – MAT. ACCT.
10 – PLANT SEC.
11 – INVENT. VER.
12 – SHIPMENT/EXPORT
13 – IMPORT
14 – INQUIRY
15 – INVESTIGATION

INSPECTION/INVESTIGATION FINDINGS (Check one box only) A B C D

1 – CLEAR
2 – VIOLATION
3 – DEVIATION
4 – VIOLATION & DEVIATION

TOTAL NUMBER OF VIOLATIONS AND DEVIATIONS A B C D

ENFORCEMENT CONFERENCE HELD A B C D 1 – YES: To be held OCT. 4, 1990

REPORT CONTAIN 2.790 INFORMATION A B C D 1 – YES

LETTER OF REPORT TRANSMITTAL DATE

NRC FORM 591 OR REG. LETTER ISSUED: MO DAY YR 09 27 90

REPORT SENT TO HQ. FOR ACTION: MO DAY YR

MODULE INFORMATION

REC. ORD TYPE	NUMBER	PHASE	MANUAL CHAPTER	PROCEDURE NUMBER	LEVEL	SEQ	PRIORITY	DIRECT INSPECTION EFFORT IN STAFF HOURS EXPENDED THIS INSPECTION	PERCENTAGE COMPLETED TO DATE	STATUS	FOLLOWUP PHASE	MANUAL CHAPTER	PROCEDURE NUMBER	LEVEL
8	01	5	30	703		A		001						
Entrance/Exit						B								
						C								
						D								
8	02	5	62	705		A		006						
Electrical Maint						B								
						C								
						D								
8	03	5	37	701		A		040						
Facility Mods						B								
						C								
						D								
8						A								
						B								
						C								
						D								

* CIRCLE SEQUENCE IF VIOLATION OR DEVIATION

INSPECTION PLAN

Facility: Point Beach
Inspection Report No: 266/90018 301/90018
Inspection Date(s): 8/20-8/24/90
Resident Notified: CLARK Vandermiet
Inspection Type: Core ____ Regional Init. X Team ____ Reactive ____
Other (specify) ____
Announced X Unannounced ____
SALP Weaknesses addressed ____

Inspection Focus (SALP Weakness, Core Program, Regional Initiative, Event Followup)	Module/TI No.	SALP Area/ Rating	Priority No.	Open Item No. (OIL)
Followup on the pilot				
Electrical SSFI (90201)				
unresolved items				
Electrical Maintenance	62705			
(1) Relay calibration				
(2) Test Procedures				
Facility Modifications	37701			
(1) Single failure Concerns				
(2) Cable Separation Concerns				
(3) EDG Fuel Oil System				

Plan Prepared By: David S. Butler Date: 8/16/90
Lead Inspector

Plan Approved By: Ron Gardner Date: 8/16/90
Section Chief

Plan Reviewed By: [signature] Date: 8/16/90
Project Section Chief
(or DRS/S Branch Chief)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

PRIORITY ROUTING

June 1, 1990

Docket Nos. 50-266
and 50-301

Mr. C. W. Fay, Vice President
Nuclear Power
Wisconsin Electric Power Company
231 West Michigan Street - P379
Milwaukee, Wisconsin 53201

Dear Mr. Fay:

SUBJECT: ELECTRICAL DISTRIBUTION SYSTEM FUNCTIONAL INSPECTION AT POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2; REPORT NUMBER 50-266/90-201 AND 50-301/90-201

We are forwarding the report of the electrical distribution system functional inspection (EDSFI) conducted by the NRC Office of Nuclear Reactor Regulation during March 12 through 16 and March 26 through April 6, 1990. This EDSFI was one of several pilot inspections performed in accordance with an NRC Inspection Manual draft temporary instruction entitled "Electrical Distribution System Functional Inspection." The inspection team consisted of NRC Headquarters and Region III personnel and five consultants.

The inspection was performed to determine whether the electrical distribution system as designed, installed, and configured at Point Beach Nuclear Plant, Units 1 and 2, would be capable of performing its intended safety functions. During the inspection, the team reviewed available calculations and supporting documents for this system at your Nuclear Power Department offices in Milwaukee and at the Point Beach plant and conducted system walkdown inspections. The team also reviewed other activities associated with the electrical distribution system at the Point Beach plant.

The team identified weaknesses regarding the functionality of your electrical systems. The three issues that raised the most concern were (1) apparent emergency diesel generator (EDG) loading exceeding the EDG ratings under certain accident scenarios, (2) portions of the EDG fuel oil system were not seismically designed, and (3) safety-related cables were routed in the same raceways as were cables of the redundant division. These three issues and a number of significant team findings were discussed during the exit meeting, which was held at Wisconsin Electric Power Company's Milwaukee offices on April 17, 1990. During that meeting, WEPCO discussed the actions it had taken immediately following the inspection to resolve many of the findings. By means of reviews, evaluations, and system modifications, WEPCO alleviated the NRC's immediate operability concerns for the three major issues.

As a result of the inspection, the team identified four general areas of weaknesses and numerous technical deficiencies. The areas of weaknesses the team identified were (1) design and modification deficiencies in the EDG and 125-Vdc systems, (2) lack of available design and engineering information, (3) design features where a single failure can disable redundant equipment, and (4) engineering support that did not fully evaluate design or changes to design.

JUN 5 1990

While planning corrective actions based on the weaknesses identified in the enclosed report, it is important that you realize that the focus of this inspection was only on the electrical systems. Therefore, consideration should be given to identifying and correcting similar problems in other safety-related systems. Given the nature and importance of our inspection findings, we expect to closely follow these and other corrective actions you may take to assure improvement is sustained.

We recognize that you have already taken or plan to take corrective actions relating to several of our concerns including undertaking a design basis reconstitution effort, installing an additional emergency diesel generator, and hiring additional engineering support staff. You have initiated modifications to electrical distribution systems, such as separation of offsite power supplies to address weaknesses identified in your own reviews. We have received your letter of May 10, 1990, which reflects the information presented at the April 17, 1990 exit meeting, describing steps you have taken or plan to take to address the inspection findings presented at our exit meeting.

Any enforcement actions that result from this inspection will be forwarded by the NRC Region III office under separate cover.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosure noted below will be placed in the NRC Public Document Room.

Please respond to this office within 60 days to inform us of the date that actions taken related to the items identified in the enclosed inspection report will be completed for possible followup inspection. Should you have any questions concerning this inspection, please contact the NRR Project Manager, Warren Swenson, at (301) 492-1386, or the inspection team leader, Steven R. Stein, at (301) 492-0977.

Sincerely,

Gary M. Holahan

Gary M. Holahan, Acting Director
Division of Reactor Projects III/IV/V
and Special Projects
Office of Nuclear Reactor Regulation

Enclosure:
NRC Inspection Report 50-266
and 50-301/90-201

cc w/enclosure: See page 4

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IS Distribution

cc:
Ernest L. Blake, Jr.
Shaw, Pittman, Potts and Trowbridge
2300 N Street, N.W.
Washington, DC 20037

Mr. James J. Zach, Manager
Point Beach Nuclear Plant
Wisconsin Electric Power Company
6610 Nuclear Road
Two Rivers, Wisconsin 54241

Town Chairman
Town of Two Creeks
Route 3
Two Rivers, Wisconsin 54241

Chairman
Public Service Commission
of Wisconsin
Hills Farms State Office Building
Madison, Wisconsin 53702

Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
Office of Executive Director
for Operations
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Resident Inspector's Office
U.S. Nuclear Regulatory Commission
6612 Nuclear Road
Two Rivers, Wisconsin 54241

U.S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR REACTOR REGULATION

Division of Reactor Inspection and Safeguards

NRC Inspection Report: 50-266/90-201
50-301/90-201

License Nos: DPR-24
DPR-27

Dockets: 50-266
50-301

Licensee: Wisconsin Electric Power Company

Facility Name: Point Beach Nuclear Plant

Inspection Conducted: March 12 through 16 and March 26 through April 6, 1990

Inspection Team: Steven R. Stein, Team Leader, NRR
Jeffrey B. Jacobson, Assistant Team Leader, NRR
Gary E. Garten, NRR
Rolf A. Westberg, RIII

NRC Consultants: C. J. Crane, Electrical Design Review
J. M. Leivo, Instrumentation and Control Design Review
S. Traiforos, Mechanical Design Review
D. C. Ford, Installation Configuration, Surveillance Review
J. Garrey, Installation Configuration, Surveillance Review

Approved by: [signature] 5/24/90
Steven R. Stein, Team Leader
Team Inspection Section C
Special Inspection Branch
Division of Reactor Inspection and Safeguards
Office of Nuclear Reactor Regulation
Date

Approved by: [signature] 5/24/90
Stephen C. Guthrie, Chief
Team Inspection Section C
Special Inspection Branch
Division of Reactor Inspection and Safeguards
Office of Nuclear Reactor Regulation
Date

Approved by: [signature] 5/29/90
Wayne D. Lanning, Chief
Special Inspection Branch
Division of Reactor Inspection and Safeguards
Office of Nuclear Reactor Regulation
Date

9006060192 87pp.

EXECUTIVE SUMMARY

INSPECTION REPORT 50-266/90-201 AND 50-301/90-201
WISCONSIN ELECTRIC POWER COMPANY
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

During the periods of March 12 through 16 and March 26 through April 6, 1990, the Special Inspection Branch of NRR conducted an electrical distribution system functional inspection (EDSFI) at the Point Beach Nuclear Plant (PBNP) and the Wisconsin Electric Power Company (WEPCO) Nuclear Power Department offices in Milwaukee, Wisconsin. An exit meeting was conducted on April 17, 1990, at WEPCO's Milwaukee offices. The inspection was performed to determine whether the electrical distribution system as designed, installed, and modified at PBNP Units 1 and 2 would be capable of performing its intended safety functions. During the inspection, the team reviewed available calculations and related documents, surveillance testing and other testing data, and performed system walkdown inspections to verify system and component configurations.

At the conclusion of the inspection, the team was unable to determine that the systems that form the electrical distribution system at Point Beach would function under all design conditions. This indeterminate status was based on the number and significance of the technical issues the team identified. The three major issues that raised the most concern were

- O emergency diesel generator (EDG) loading that potentially could exceed the EDG ratings,
- O the nonseismic design of portions of the EDG fuel oil system, and
- O safety-related cables that were routed in the same raceway as cables of the redundant division.

Based on the potential inability of the EDS to perform its safety function, the team questioned the operability of the system. WEPCO alleviated the team's immediate operability concerns for the above issues by actions it took immediately following the inspection and presented at the exit meeting.

As a result of the inspection, the team identified more than 27 specific deficiencies. Each deficiency is discussed in the report and the deficiencies and issues that require additional review or evaluation are discussed in detail in Appendix A of the report. The team also identified general weaknesses in the following areas: (1) design and modification deficiencies in the EDG and 125-Vdc systems, (2) lack of available design and engineering information, (3) design features where a single failure can disable redundant equipment, and (4) engineering support that did not fully evaluate design or changes to design. The first area of weakness involved deficiencies in the emergency diesel generators and fuel systems, and in the batteries and 125-Vdc system. Because of PBNP's design (only two EDGs and two safety-related batteries shared by both units), these two systems have great safety significance. Within the EDG system, the team found the steady-state loading of the diesels to be marginal with the potential to be exceeded. In addition, no transient analysis existed for the dynamic loading of the EDG. The fuel oil system between the seismic emergency storage tank and the seismic day tanks was not seismically designed and installed, and the fuel oil quality did not meet the appropriate requirements. Finally, a voltage level interlock described in the Final Safety Analysis Report (FSAR) and in system logic diagrams was not part of the EDG design or installed configuration.

The team's findings in the 125-Vdc system included a nonconservative calculation for sizing replacement batteries. The float voltage for the batteries exceeded the manufacturer's recommendation and component ratings. The procedure for measuring ground resistances on the system did not include acceptance criteria or limits, and the safety significance of the results of measurements taken was not evaluated. The maximum available short-circuit current was not determined when circuit breakers were replaced because of a recently disclosed problem (the dc breakers did not have a maximum fault-interrupting capability). The licensee was evaluating its final resolution for the main dc bus breakers.

The team's second identified area of weakness involved a lack of design documents and information. The team's review of the adequacy of the electrical distribution system was complicated by the lack of adequate and complete calculations and analyses. The team could not confirm ratings of certain equipment or determine fault currents to equipment. A steady-state load calculation for the EDGs did not exist until the inspection, and a transient analysis had not been performed. In addition, calculations for many device setpoints did not exist. The team recognized that WEPCO had several existing programs that would address these concerns. However, the programs were preliminary efforts implemented too recently to be evaluated.

The team identified a third area of weakness involving a number of conditions that, given a single failure, could jeopardize redundant equipment required for safe operation of the plant. Three examples of these conditions were the result of original design and two conditions were the result of plant modifications. These conditions included (1) routing of redundant safety-related cables in the same raceway, (2) single failure of the tie breaker between the redundant safety-related 480-V busses, (3) potential seismic failure of devices caused by the tie-breakers between the safety-related 4160-V busses, and (4) potential loss of redundant trains from an automatic shutoff feature on new inverters.

The fourth area of weakness was WEPCO's engineering support program. Several of the team's findings indicated that WEPCO did not evaluate design adequacy or establish adequate bases for certain changes or modifications to the plant. The findings also indicated that when WEPCO identified a problem with the original design, it did not address the full extent of the problem or the possibility of other similar problems in all cases. Examples included: (1) a full load profile for sizing replacement batteries was not developed, (2) the maximum available short-circuit current for replacing dc system circuit breakers and batteries was not determined, (3) the effect of excessively high battery float voltages was not fully evaluated, and (4) the effects of fuel oil that did not meet quality requirements was not evaluated. Other examples of weaknesses in the engineering support program included (1) performing some modifications without considering industry-standard practices, (2) adding incorrect information into emergency operating procedures, (3) upgrading safety-related status of systems without a controlling program or procedure, and (4) permitting adverse conditions to exist in the plant for over 10 years. The team concluded that a lack of design basis documents and information contributed to the engineering program weaknesses it found. The team also believed that the limited size of the engineering workforce contributed to the engineering support weaknesses.

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1.0 BACKGROUND

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 Reactor Special Inspection Branch (RSIB) of NRC's Office of Nuclear Reactor Regulation (NRR) developed a draft temporary instruction for the NRC Inspection Manual, which describes how teams from the NRC regions are to conduct electrical distribution system functional inspections (EDSFIs).

The EDSFI performed by RSIB at the Point Beach Nuclear Plant (PBNP) was one of several pilot inspections to be conducted before the NRC issues the temporary instruction. The inspection was conducted at Wisconsin Electric Power Company's (WEPCO's) Nuclear Power Department's offices in Milwaukee, Wisconsin, during the period March 12-16, 1990, and at the PBNP site during the period March 26 - April 6, 1990. The team consisted of NRC employees and consultants.

2.0 OBJECTIVES AND METHODOLOGY

The primary objective of this inspection was to assess the functional capability of the electrical distribution system at PBNP. A secondary objective was to assess how well WEPCO's engineering organization provided engineering and technical support to site organizations. The inspection team was composed of two groups: 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 electrical distribution system and by extensive walkdown inspections of plant electrical wiring and components.

The areas reviewed and the safety significance of identified deficiencies are described in Sections 3, 4, 5, and 6 of this report. Conclusions are given at the end of each of these sections. The conclusions and weaknesses are then summarized in Section 7 of this report. Each deficiency addressed in the report that remains unresolved is discussed in Appendix A, each deficiency is numbered, and the section of this report in which it is discussed is cited. Personnel contacted are listed in Appendix B and persons attending the exit meeting on April 17, 1990, are indicated there, too.

3.0 ELECTRICAL SYSTEM DESIGN REVIEW

The team evaluated portions of the safety-related electrical systems at PBNP, Units 1 and 2, by examining and assessing the technical adequacy of the design as defined by various design documents. The team reviewed the design and design control process for compliance with (1) the General Design Criterion (GDC) to which WEPCO committed in its FSAR, (2) the Criterion of Appendix B to the current 10 CFR Part 50, and (3) the station's Final Safety Analysis Report (FSAR). To obtain additional understanding of the design, the team interviewed responsible WEPCO personnel and inspected selected safety-related electrical equipment.

The team reviewed the limited available design documentation, including a number of calculations that WEPCO was able to retrieve, design changes, one-line diagrams, elementary wiring diagrams, schematics, logic diagrams, and equipment specifications. The team conducted specific reviews of (1) emergency diesel generator loading, (2) the 125-Vdc system, (3) cable ampacity and tray fill, (4) protective relaying and breaker coordination, (5) the diesel loading sequence and safeguards bus interlocks, and (6) the 120-Vac vital instrument bus system.

3.1 Electrical Loading

The team reviewed and evaluated the design of the PBNP emergency diesel generator (EDG) system and the 125-Vdc supply and distribution system to determine whether electrical loading had exceeded the ratings for the systems and system components. Electrical cable routing, tray fill, and ampacity were also reviewed.

3.1.1 Emergency Diesel Generator Loading

Two EDGs (G-01 and G-02) supplied emergency power for the engineered safeguards system electrical busses for both units. Each EDG was designed to be of sufficient size to start and carry the engineered safety features loads following a loss-of-coolant accident in one unit and a shutdown of the other unit concurrent with a loss of offsite power. The team reviewed the steady-state loading on the EDGs and attempted to review the dynamic loading. Each of these issues is presented below.

3.1.1.1 Steady-State

The team reviewed the FSAR loading description and Calculation 0870-103-011, which determined the steady-state loading on each EDG. This calculation was recently prepared by a contractor for WEPCO. Before the calculation was issued, there was no comprehensive listing of loads for the EDGs. The calculation identified that the worst-case loading scenario was the loading on EDG G-02. For this case, the loading was calculated to be:

- 97.8 percent of the 2000-hour (continuous) rating during the injection phase
- 94.1 percent of the 200-hour rating during the injection phase
- 103.1 percent of the 2000-hour rating during the recirculation phase
- 99.2 percent of the 200-hour rating during the recirculation phase

The team found that the steady-state loading calculation was nonconservative because it assumed that a containment accident fan for the non-faulted unit was not operating during the injection and recirculation phases of the accident scenario. Exclusion of the fan load from the EDG calculation was inconsistent with the FSAR, which required one containment fan to be manually started in the non-faulted unit. The team also found that the plant emergency operating procedures for the non-faulted unit did not exclude starting a single containment accident fan (see Section 3.1.1.3, below). Using the actual run current amperes under normal operation, the team determined that the containment fan represented a 61.3 kW load. The addition of this load onto diesel generator G-02 during the recirculation phase would increase the loading to 101.27 percent of the 200-hour rating.

The team concluded that the EDGs, under design basis accident conditions, would be operating with little or no margin with respect to steady-state loading. This was considered significant because it appeared that the plant emergency operating procedures were not completely correlated with the steady-state loading calculation. Therefore, additional loads on the EDG could be added by the operators, resulting in overloading the EDG and reducing plant safety. The team concluded that the safety significance of this issue warranted WEPCO's prompt and thorough evaluation. This is considered an unresolved item (see Appendix A, Deficiency 90-201-01).

3.1.1.2 Transient

The team found that WEPCO had not analyzed the EDGs' capacity to handle starting loads and sequencing intervals under dynamic conditions. Therefore, in-rush currents, starting load (kW) under low-voltage conditions, acceleration time of large motors, loads due to motor-operated valves, and allowable tolerance of load sequence timing relays had not been analyzed.

Since there appeared to be little or no margin for the steady-state loading of the EDGs in both the injection phase and the recirculation phase, the team considered the lack of a transient analysis for diesel generator loading to be a significant deficiency. In support of this conclusion, the team found that WEPCO did not have data on the tolerance and accuracy of the EDG load sequence timing relays based on seismic testing. Because a seismic event could potentially shift the relay accuracy, there was no basis for establishing the tolerance to which these relays were checked. Possible shifts in accuracy could impair EDG transient loading. Also, the team found that protective overcurrent relays on the safety injection pumps were set based on assumed motor acceleration time with no basis for this assumption. Pending further review by the licensee and NRC of diesel generating loading, this is considered an unresolved item (see Appendix A, Deficiency 90-201-02).

3.1.1.3 Operational Considerations

As a result of the team's concerns regarding EDG loading, the team reviewed loading from an operational perspective using the load requirements of the emergency operating procedures (EOPs) as a starting point. The team reviewed EOP-0, EOP-1, EOP-1.3, EOP-1.4, and Emergency Contingency Action (ECA) 0.0 in detail with WEPCO senior operating staff to determine what EDG loads would be required by the EOPs to safely mitigate the consequences of a design basis accident (DBA) scenario concurrent with a single failure of one EDG. The team listed the loads the operator stated would be added onto the EDG in accordance with the EOPs, the timing of these loads, and whether or not the senior operating staff felt these loads were necessary to safely mitigate the consequences of the DBA scenario. After progressing through the required EOPs, the team noted the following concerns. The safety significance of the team's concerns were heightened because both units share two EDGs; therefore, the assumed failure for one EDG train affects both units.

- o The EOPs did not coordinate the accident unit and the non-accident unit with respect to EDG loading. The team was concerned that if additional loads were required by the non-accident unit to maintain safe shutdown, or if loads were added without coordination with the necessary accident loads, the potential existed for overloading the EDG. In response to an overload, the EDG could fail, losing its ability to perform its intended safety function.

- o The only method available to the operator for monitoring EDG loading was a single kilowatt meter and related annunciator that was calibrated on a 6-year interval. The team noted that the margin for EDG loading was small and no allowance had been included in existing EDG load profiles for the meter tolerance. Since the meter and its associated window annunciator were the primary method for monitoring EDG loading, the team also questioned the 6-year calibration interval. WEPCO provided no basis for the calibration interval including vendor recommended intervals. Furthermore, the annunciator alarm could activate at the EDG's 2000-hour rating and WEPCO stated that, in certain scenarios, the 2000-hour rating may be exceeded to handle the required accident loads. In those scenarios, the annunciator indication would give the operator no useful information and the operator would be forced to rely only on the kilowatt meter. Meter inaccuracies or meter failure would impair the operator's ability to determine EDG loading and could contribute to operator actions that could overload the EDG.

- o The EOPs required specific equipment to mitigate the consequences of the DBA. The team analyzed the kilowatt ratings of the EOP-required equipment, the FSAR-required loads, and the loads that were not shed with a loss of offsite power and safety injection signal. The team found that the EDG exceeded its 200-hour rating of 2963 kW. The severity of this situation was further heightened since the EDG 4-hour rating was only 37 kW above the 200-hour rating. The team was concerned about the load level, since it was unclear if the EDG ratings were conservative and whether or not the EDG could, in fact, perform its intended safety function in this challenged condition. Furthermore, such limited load margins did not allow for possible deviations in equipment load characteristics, tolerances in the kilowatt meter, or the addition of other safe shutdown loads for the non-accident unit. Also, there were other loads that the team felt may be needed that were not considered in the FSAR EDG load profile and the EOPs. For example, control room air conditioning may be required to both ensure the operability of control instrumentation and for control room habitability concerns. At the time of the team's review, control room air conditioning was not considered as part of the EDG load profile. If the control room air conditioning were loaded onto the EDG with the EOP-designated loads, the EDG would then exceed its 4-hour rating (in the case of G-02, it would exceed its half-hour rating) during the DBA.

- The team questioned what operator actions would be expected once the EDG loading capacities stated in the EOPs had been exceeded. The team was told that the operator would probably remove certain loads to reduce the EDG load level. However, the team found that the EOPs provided no guidance to the operator concerning the choice and timing of loads to be removed. The team could not determine that the correct loads would be terminated such that the ability of the plant to mitigate the consequences of the accident in the one unit and maintain the safe-shutdown condition of the other unit would not be compromised. Furthermore, the team could not determine which of the loads could be terminated based on the current plant operational needs and still provide a reasonable assurance that the consequences of the DBA could be safely mitigated while maintaining the second unit in a safe shutdown condition.

- Within the EOPs that the team reviewed, were reference notes that gave the EDG capacity ratings, cautioned against overloading the EDG, and referred the operator to an appendix table that listed the load ratings of critical equipment. The EOP instructed the operator to refer to these lists before loading the equipment on to the EDG. The team reviewed two appendix tables and found the equipment load ratings were incorrect and non-conservative with respect to both the FSAR and a recent EDG load analysis (Calculation 0870-103-011) performed by a contractor for WEPCO. The incorrect load ratings could cause operator actions that would overload the EDGs and could result in EDG failure. The team concluded that WEPCO failed to translate applicable design bases into plant procedures. The applicable requirement is found in 10 CFR Part 50, Appendix B, Criterion III. This item remains unresolved (see Appendix A, Deficiency 90-201-03).

Based on its findings and observations, the team expressed concerns about the EDG loading and its affect on the ability of the EDGs to perform their intended safety function. Because of the team's concerns and findings, WEPCO performed an indepth review of the EOPs immediately following the inspection. As a result of performing this review, WEPCO made temporary changes to the EOPs to provide additional guidance to the operators in managing loads during an accident. The team did not review these corrective measures or other measures taken to address the other concerns discussed above. Pending additional review by WEPCO and the NRC, this item is considered unresolved (see Appendix A, Deficiency 90-201-04).

3.1.2 125-Vdc System Loading

The 125-Vdc system consisted of four main battery distribution busses, each powered by a battery charger and each having a station battery as a backup power source. Two swing chargers were also available. The FSAR required the station batteries to be of sufficient size to carry shutdown loads on both units for a period of 1 hour following a plant trip and loss of all ac power.

Station battery D-05 had been replaced previously under Modification Package 88-074. The team reviewed Calculation N-89-025, which determined the cell size and capacity for the replacement of D-05. The team found that 21 dc loads, such as diesel generator field flashing, were not included in the battery sizing calculation, and that minor random loads were not addressed as required by the Institute of Electrical and Electronics Engineers (IEEE) Standard 485-1983. In sizing the battery, WEPCO used this standard and the original duty cycle diagram and load table provided as the design basis by Bechtel in 1985. However, the load tabulation provided by Bechtel was not detailed in a manner that would allow independent verification of all loads. Only major loads were identified, while other loads were simply grouped. In sizing the battery, WEPCO correctly modified the original load table because it found several discrepancies between the original design loads and the actual loads.

In response to the team's concerns, WEPCO performed a preliminary assessment which showed that the battery was sized to accommodate these 21 additional loads. WEPCO stated that it would revise the calculation to address the team's concerns in this area. The team also determined that the battery test had sufficient margin to ensure the adequacy of the battery. The team concluded that the incomplete battery sizing calculation constituted a weakness in WEPCO's engineering support program.

3.1.3 Electrical Cable Ampacity and Cable Tray Fill

The team reviewed the FSAR to determine the cable tray fill and cable ampacity derating criteria used in the design. The team also randomly selected cables connected to safety-related equipment to determine cable type, ampacity derating, routing, and associated tray fill. The team observed that Section 7.2 of the FSAR required that system cables be derated in accordance with the requirements of the National Electrical Code (NEC). Cable derating is the process of limiting the maximum current a cable will carry in a given ambient temperature to prevent exceeding the cable insulation's temperature rating. Section 7.2 of the FSAR also limited the fill for power and control cable trays to less than 30 percent and instrumentation cable trays to less than 40 percent. The team also noted that Section 8.2 of the FSAR provided a conflicting requirement which specified cable derating in accordance with Institute of Power Cable Engineers Association (IPCEA, currently ICEA) guidelines. Section 8.2 of the FSAR provided a conflicting requirement which limits the fill to 40-percent for all cable trays. WEPCO showed the team that the true basis for cable ampacity rating and derating criteria was the 1965 National Electrical Code.

Based on the team's review, WEPCO identified 210 power and control cable tray sections and 15 instrument cable tray sections that did not conform to the FSAR and the original design criteria with respect to tray fill and ampacity derating. WEPCO analyzed all cables contained in one tray, FK07, which demonstrated that those cables had adequate current-carrying capability and would not exceed their maximum operating conductor insulation temperature. This determination was made using the methodology for ampacities in open top cable trays from ICEA Publication P-54-440, which is the currently accepted industry standard for cable ampacities. However, use of this standard was contrary to the FSAR commitment and original design basis. WEPCO stated that all remaining cable tray sections which exceed the FSAR and original design criteria would be fully analyzed. Pending additional evaluations by WEPCO and review by NRC, this item is considered unresolved (see Appendix A, Deficiency 90-201-05).

3.2 Protection and Coordination

Contractors for WEPCO had performed circuit breaker coordination studies for portions of the EDS. However, a full EDS coordination program was scheduled for completion in 1991.

3.2.1 4160-Vac System

The team reviewed the motor protection scheme, protection criteria, and protective relay settings for the safety injection pump 1-P15A powered from Class 1E bus 1-A05. The review consisted of evaluating motor data and curves; relay, metering and one-line diagrams; and other data used to calculate and establish the protective relay setpoints. The relays included the instantaneous and long-time phase overcurrent relay (device 50/51), the percentage differential relay (device 87), and the zero sequence ground fault relay (device 50G). Bus undervoltage and degraded grid relays were also reviewed. The team did not identify any deficiencies or concerns in this area other than the concern with overcurrent relays for the safety injection pumps, which is discussed in Section 3.1.1.2.

3.2.2 480-Vac System

The team reviewed several features of the 480-Vac system dealing with switchgear and motor control centers. The team selectively evaluated motor starter operation under reduced voltage and a selection of thermal overload relays and heaters for motor-operated valves. Although full circuit-breaker coordination studies were not available, the team reviewed several studies performed by contractors. The team did not identify any deficiencies or concerns in this area.

3.2.3 125-Vdc System Short-Circuit Current

The team reviewed Calculation N-89-025, which was performed to determine the cell size and capacity for the new station battery (D-05) replaced in 1988 under Modification Request 88-074. The battery was sized on the basis of a conservative 63 °F temperature which represented the lowest recorded electrolyte temperature. However, the team found that WEPCO had not performed an analysis to determine the maximum available short-circuit current from the new battery based on the highest possible electrolyte temperature. Based on the team's review in this area, WEPCO contacted the battery vendor and came to the preliminary conclusion that the maximum available short-circuit current from the battery could be as high as 22,700 amperes. The original design basis was a maximum available current of 20,000 amperes. The team concluded that using the unverified design value and not establishing the maximum available current constituted a weakness in WEPCO's engineering program. Pending additional evaluations by WEPCO, this item is considered unresolved (see Appendix A, Deficiency 90-201-06).

Additional problems regarding the 125-Vdc system were previously identified and resulted in NRC Region III issuing enforcement action. In a letter dated November 10, 1989, from C. W. Fay to the NRC on the subject "Request for Discretionary Enforcement Related to Technical Specification 15.3.0.A," WEPCO reported that a single 125-Vdc train could be lost owing to a fault such as a short circuit. This condition was caused by the original design's use of circuit-breakers which only had thermal trip devices and did not have magnetic trip devices. These breakers were not capable of interrupting fault current of the magnitude postulated to occur on the bus. WEPCO replaced certain breakers feeding common equipment (such as switchgear normal and alternate supply), thus eliminating the possibility of common-mode failure on both trains.

3.3 Electrical Distribution System Interlocks and Load Sequencing Logic

The team reviewed the control logic, elementary wiring diagrams, schematics, and certain vendor drawings that described the PBNP design for detection, initiation, and execution of the automatic safeguards loading sequence for loss-of-offsite-power events, including those scenarios involving design basis events. The design attributes of primary interest in the drawing review were (1) adequacy of the logic under design basis conditions, (2) vulnerability to single failure, (3) vulnerability to undetected failures, and (4) independence and separation. The team's findings are discussed in the sections that follow.

3.3.1 Potential Common-Mode Failures

The team identified four deficiencies related to potential common mode failure of all onsite 4160-Vac and 480-Vac power when offsite power was unavailable. In one of those cases, described in Section 3.3.1.3 below, the common-mode failure could also prevent the supply of power to engineered safety features loads even with offsite power available.

3.3.1.1 Bus Tie-Breakers for Safety-Related Busses

The team identified a deficiency involving inadequate seismic evaluation for a modification to the 4160-Vac safeguards bus tie-breakers. The team was concerned that because the breaker was not seismically restrained in its new configuration, the breaker could disable critical relays and other devices mounted in the same compartment during a design basis earthquake. The nonseismic configuration was contrary to the requirement of 10 CFR Part 50, Appendix A, GDC 2, "Performance Standards" (see Appendix A, Deficiency 90-201-07). In response to this finding, WEPCO removed the tie-breakers from the switchgear compartments and secured them in a storage area. The team asked WEPCO to confirm that this new configuration would not compromise any actions such as those required by their commitments to 10 CFR Part 50, Appendix R, since WEPCO indicated that it would be difficult to reinstall this breaker.

The team also identified a deficiency concerning the single failure of the safeguards 480-Vac bus tie-breaker. The team recognized that a spurious closure of the tie-breaker between the redundant safeguards busses could connect the redundant diesel generator outputs when the voltages are out of phase, resulting in a potential loss of all onsite power from a single event. The team identified at least one such mechanism for this initiating event. In response to the team's concern, WEPCO performed both a 10 CFR 50.59 evaluation and a failure analysis. WEPCO removed the control power fuses to disable the control circuit and preclude the effects of single electrical failures. However, the team was then concerned that, with the breaker circuit in this new configuration, breaker position would no longer be remotely monitored since control power had been removed. Consequently, the breaker could be closed manually at the switchgear (tieing the busses together) and this condition could remain undetected. Should the plant lose offsite power, both onsite sources would be connected and all 4160-Vac and 480-Vac power could be lost. The relevant requirement is found in GDC 39. This item is considered unresolved (see Appendix A, Deficiency 90-201-08).

Another deficiency involved th 80-Vac safeguards bus tie-breaker. The team determined that two of the re ant control cables were incorrectly classified as nonsafety-related and that ey connected the train A and train B switchgear by sharing common raceways fo the entire route. This was not in accordance with the FSAR criteria for cable separation. Resolution of the tie-breaker single-failure deficiency previously described may also resolve this item. Pending additional actions by the licensee, this item is considered unresolved (see Appendix A, Deficiency 90-201-09). A more general deficiency regarding cable separation is discussed in Section 5.1.1 of this report.

3.3.1.2 Component Cooling Water Pumps

The team identified a deficiency that involved the component cooling water (CCW) pump motor circuit-breaker control circuit. Portions of the 125-Vdc control wiring for train A and train B pumps shared the same raceway. Although the CCW system was not considered safety related in the original design of the plant, the system provided vital support to safety-related system components. The plant was in the process of upgrading the system to safety-related status and was treating the system accordingly. The team identified that a single failure could disable the control circuits of both CCW pumps. The licensee had been unaware of this potential for failure. This item is considered unresolved pending additional WEPCO actions (see Appendix A, Deficiency 90-201-10).

The team identified a second deficiency regarding components in the control circuits of the feeder breakers for the CCW pump motors. A common relay that distributed a start signal to both CCW pumps was located in a nonsafety-related cabinet. Therefore, WEPCO could not demonstrate the relay's seismic qualification. Since the relay and cabinet were similar in structure and configuration to the qualified safeguards relays and cabinets, the team expected that qualification can be demonstrated if supporting documentation is provided. However, an ongoing industry study by the Seismic Qualification Utility Group (SQUG) may resolve this issue. This item remains open until the licensee demonstrates that the component and related circuits and structures are qualified for use in a safety-related circuit (see Appendix A, Deficiency 90-201-11).

3.3.1.3 DC Control Power Switches

WEPCO was unable to produce analyses demonstrating the seismic qualification of knife switches used to connect alternate dc sources for switchgear control power. The knife switches were mounted on the vertical panels of the switchgear, were normally in the up position, and were only secured by the friction forces necessary to ensure sufficient electrical contact. If the switches shook loose, all dc control power would be lost to the switchgear busses, and all automatic and remote control would be disabled for engineered safeguards and safe-shutdown loads. This would render the automatic load sequencing and remote manual control inoperable, even though offsite and onsite ac power were available. The relevant requirement is found in GDC 2. This item is considered unresolved (see Appendix A, Deficiency 90-201-12). WEPCO was in the process of qualifying this configuration, and committed to take necessary corrective actions if the qualification proved unsuccessful.

3.3.1.4 Diesel Generator Output Interlocks

The team identified a deviation from the FSAR commitment to provide a voltage interlock on the diesel generator output breaker. WEPCO committed in the FSAR that the EDG breaker would not close until the generator reached rated output voltage. This requirement was also reflected on WEPCO logic diagrams reflecting a typical industry practice for generator output breaker closing logic. A speed interlock (also required by the FSAR) was provided, but no voltage interlock or sensing device existed. In the absence of the voltage interlock and any supporting documents such as a transient load analysis and periodic testing, it was uncertain that the diesel generators would be at the proper voltage before breaker closure on an automatic start and load sequence. This was of particular concern to the team because significant loads were immediately connected to the diesel generator when the output breaker closed. WEPCO presented a test performed in 1974 to show the EDG output voltage when the breaker closed. However, the test data was not completely auditable.

In response to this deficiency, WEPCO committed to perform a representative test the week of April 9, 1990, and was also analyzing the adequacy of the current design with the consultation of the diesel generator vendor. Pending completion of these actions, this item is considered unresolved (see Appendix A, Deficiency 90-201-13).

3.3.2 Drawing Discrepancies

During its review of a significant sample of drawings, the team identified two separate errors on a safeguards wiring diagram and on an elementary wiring diagram for the diesel generator. The first error was a discrepancy in terminal identification of external connections for an alarm circuit in a safeguards logic cabinet. The alarm circuit function was shown two different ways on two different sheets of the drawing, and the terminations were identified differently. The discrepancy was between Sheet 8 and Sheet 15 of Westinghouse Drawing 110E163. WEPCO stated and the team agreed that Sheet 15 was functionally correct.

The team identified a second error on the elementary wiring diagram for the emergency diesel. Terminals 6A3 and 6A4 in a safeguards rack were incorrectly identified as terminals A3 and A4 on Sheet 1508 of Wiring Diagram 499B466. The cross-referenced safeguards drawings showed the terminals correctly, and the circuits would presumably not test successfully if wired incorrectly.

The team verified that the installed wiring was correct in both instances. During the inspection, WEPCO initiated a nonconformance report (NCR) to correct the first error and the team understood that WEPCO would also correct the second error.

3.4 Safety-Related 120-Vac Instrument Power System

The 120-Vac instrument power system supporting both units consisted of 16 busses divided among 4 channels. Each of the 4 channels was allocated 4 busses which were subdivided further into 2 bus groups, one group serving Unit 1 and the other group serving Unit 2. Each channel could obtain power from three inverters. One inverter was dedicated to the Unit 1 bus group and a second inverter was dedicated to the Unit 2 bus group. The third inverter was a backup which could swing between the Unit 1 and Unit 2 busses of the same channel. WEPCO used the third inverter to provide power to the bus while performing maintenance on the inverter that was normally connected to the bus.

The team performed a cursory review of the 120-Vac instrument power system. This review included the major Modification E-206, "Upgrade of Power Supplies to Instrument Busses," installed in 1985. This modification added inverters, regulating transformers, distribution panels, and cabling for two instrument bus channels. The team also reviewed specifications and ratings for the new inverters as well as the maintenance history of the original and new inverters.

Although no limits for dc ripple (remaining ac component after rectification) were initially specified for the inverters (or for new battery chargers installed on a different modification), WEPCO stated that the specifications were later evaluated and ripple limits were established. WEPCO reported that subsequent tests were conducted to confirm that actual ripple was well below the specified limits. WEPCO also stated that it had not changed any channel assignments for safety-related instruments, except for a small number of indicating channels that were reassigned in response to NRC requirements.

The team concluded that the addition of the two batteries and two inverter groups resulted in a distribution configuration that should substantially improve instrument bus reliability and availability relative to the original design. However, the team identified a significant concern regarding control of the inverter dc input low-voltage shutdown setpoint. This concern is discussed in Section 5.2.3 and Appendix A, Deficiency 90-201-26, of this report. The team also identified several weaknesses in the 120-Vac system, some of which WEPCO was apparently addressing. These weaknesses are described in the four items that follow.

- The first weakness the team identified was the absence of requirements for surge withstand capability (SWC). WEPCO had not provided SWC requirements in the specification for the new (Elgar Company) inverters. WEPCO apparently did not consider standards that were available at the time the specification was developed, such as IEEE Standard 472-1974, "Guide for Surge Withstand Capability (SWC) Tests."

- The second weakness identified was a lack of surge protection for the inverters. Several critical components in the Elgar inverters, such as input capacitors, were rated at 500 V or less, and the team's review of the vendor manual indicated that the inverter design did not include any comprehensive surge protection. Because of switching surges common in power plants, impulse voltages substantially higher than the 500-V ratings may be expected on the dc and 120-Vac systems, and could be sufficient to break down dielectrics and semiconductors. For example, the NRC Office for Analysis and Evaluation of Operational Data (AEOD) Case Study Report C605, "Operating Experience Involving Losses of Electrical Inverters," identified electrical disturbances as a dominant contributor to inverter failures. This lack of protection was of particular concern at Point Beach because the FSAR allows for 480-Vac, 125-Vdc, and 120-Vac control cables to be routed for long runs in the same raceways.

The team performed a cursory review of a small sample of maintenance work requests (MWRs) and an MWR summary list for both the original (Westinghouse) and new (Elgar) inverters. This review identified a significant number of capacitor and diode failures (predominantly on the original Westinghouse inverters) as well as unexplained failures. These failures could be indicative of component failures due to voltage impulses.

0 The third weakness identified was the out-of-specification condition for total harmonic distortion (THD) on the 120-Vac system. An MWR reviewed by the team indicated that the THD that WEPCO measured in February 1990 on one of the new instrument busses was about 12 percent. The specification limits permitted only 5 percent THD. Although a noteworthy program for measuring THD on the instrument busses was recently initiated by WEPCO in an attempt to restore the system to within-THD specifications, the team noted that no provisions had been made for monitoring impulse amplitudes. However, the team understood that WEPCO intended to use the services of one of its groups from off site that was experienced in the monitoring and analysis of power line disturbances, and the team encouraged this effort as a supplement to the THD study already under way.

The team noted that the plant computer systems, which were connected to instrument busses only through circuit breakers, might be contributing to the harmonic distortion on the vital instrument busses since the systems likely contained switching-mode power supplies. WEPCO stated that if isolation was available, it was provided within the computer systems equipment; however, WEPCO had apparently not evaluated computer system isolation. The team noted that the circuit breakers only provided fault isolation. The team also noted that other sources of harmonics external to the instrument busses and their loads also could be coupled to the 120-Vac instrument power system.

The team also found that "isolation transformers" procured for the instrument bus distribution system would only be effective for low-frequency (60 Hz) isolation and would provide little isolation of impulses having fast rise times or higher-order harmonics. WEPCO had provided regulating transformers, without interwinding shields, as isolation transformers and these transformers will not provide a broad spectrum of isolation.

The team had some other concerns regarding the instrument bus THD being out of specifications: (1) possible effects on the life and performance of instrument loop power supplies and other components that support the reactor protection and engineered safety features actuation systems instrumentation, (2) possible effects on protection system loop accuracy, (3) the extent of the THD problem on other safety-related instrument busses, and (4) the potential for common-mode degradation of multiple protection channels. The team recommended that WEPCO assess these effects in its current THD evaluation.

0 The team identified a fourth weakness with the sizing of cables for the 120-Vac instrument bus upgrade. WEPCO stated that cables were sized to the National Electrical Code, but that no documentation was retrievable for voltage drop, short circuit, or ampacity calculations. The team

noted that the primary electrical supply cables from the inverters were routed from the primary auxiliary building to the cable spreading room distribution panels; these panels in turn served distribution panels in the control room, computer room, and primary auxiliary building. These long runs of cable could experience greater voltage drops if the THD was too far out of specifications, since voltage drop calculations typically assume a 60-Hz sinusoidal wave with little distortion.

The team concluded that these concerns represented weaknesses in WEPCO's engineering program.

3.5 Voltage Regulation

The team determined, using the methodology presented in Section 6.1.1 of IEEE Standard 485-1983 and the maximum cell float voltage (2.26 V) recommended by the battery manufacturer, that the maximum allowable battery voltage was 133.3 Vdc. The team found that the actual float voltage for battery D05 was 135 V and station procedures allowed a float voltage higher than 135 V. Battery float voltages exceeding 133.3 V were not consistent with the battery manufacturer's recommendations or guidance provided by IEEE Standard 485.

NRC Information Notice 83-08 notified the industry that certain components subjected to voltages above their rated voltage may degrade due to heating and embrittlement. WEPCO previously had issued NCR N-88-069, which identified that the voltage rating for the close coil circuit in the Westinghouse 4-kV type-DHP switchgear was exceeded by the high battery float voltage. The team noted that although WEPCO knew that the 125-Vdc system was on a high float voltage, and switchgear close coil ratings were exceeded, WEPCO conducted no further evaluations of this problem. The team concluded that WEPCO failed to ensure that applicable design bases were correctly translated into plant procedures and nonconforming conditions were promptly evaluated and corrected. The relevant requirements are found in 10 CFR Part 50, Appendix B, Criteria III and XVI. This item remains unresolved (see Appendix A, Deficiency 90-201-14).

3.6 Conclusion

The team did not identify any areas in which the electrical distribution system would clearly fail to perform its intended design function. However, because the team identified a number of significant design deficiencies, it could not determine that the system would function under all postulated design and accident conditions. These deficiencies included a substantial number of conditions that were susceptible to common-mode or single-failure vulnerabilities.

Many of the team's findings resulted from deficiencies in the original design that had previously been undetected. However, other findings related to plant modifications reflected an inadherence to the Point Beach design basis for the electrical systems and equipment. The team found that this condition was caused in part by inadequate design basis documentation and poor design controls for performing proper engineering evaluations and analyses to support more recent modifications. The team found that the FSAR did not commit to any IEEE Standards, and that some modifications were performed without considering industry accepted standards. The team also believed that the small size of the engineering staff may also contribute to the incomplete engineering for modifications.

With respect to design basis documentation, the team noted that WEPCO had only recently completed a steady-state loading analysis of the emergency diesel generators, and a transient analysis did not exist. The team found that the EDGs would be operating with little or no margin with respect to steady-state loading, and that there were additional loads (some specified by the emergency operating procedures and some that were not) which were not included as EDG loads in the load calculation. The team found that this issue must be evaluated in detail to ensure that the diesel generators are capable of starting and carrying all required loads. Also, the team found that a transient analysis of diesel generator loading should be conducted.

Regarding the unavailability of calculations, ANSI Standard N45.2.11-1974, "Quality Assurance Requirements for the Design of Nuclear Power Plants," to which WEPCO is committed, specifies that design analyses be sufficiently detailed so that the adequacy of their results can be determined without recourse to the originator. The team recognized that several WEPCO programs offered the potential to address the concern regarding a lack of design documents and information. However, these were new programs still in a preliminary stage.

4.0 MECHANICAL DESIGN REVIEW

The team reviewed and evaluated the adequacy of design for selected mechanical systems that supported the electrical distribution system. The team reviewed in detail engineering, licensing, and other documents, and inspected systems and components. The types of documents reviewed included (1) the FSAR and Technical Specifications, (2) selected modifications and safety evaluations associated with the emergency diesel generators (EDGs) and associated mechanical support systems, as well as heating, ventilating, and air conditioning (HVAC) systems for electrical equipment rooms, (3) mechanical systems calculations, (4) drawings, (5) EDG manufacturer technical manuals, and (5) WEPCO responses to NRC bulletins and information notices on EDGs and support systems.

4.1 Emergency Diesel Generator Fuel Oil System

The team identified several deficiencies with the fuel oil and fuel oil transport system for the emergency diesel generators at PBNP.

4.1.1 Seismic Condition

The PBNP Technical Specifications and basis for availability of the EDGs required that 11,000 gallons of fuel oil be available. WEPCO commitment during original licensing was that this capacity would be available in a seismic Category I structure, the emergency storage tank. However, the fuel oil transfer system that transports the fuel oil from the emergency storage tank to the EDGs was only partially qualified as Category I. WEPCO was in the process of analyzing the piping located in the fuel oil pump house and preliminary results indicated that the piping stresses were above ASME Code allowable values. WEPCO planned to modify system supports, but did not yet have any detailed calculations that the team could review. WEPCO indicated the piping in the EDG rooms was originally installed according to architect/engineer handbook methods for installing seismic small-bore piping, and was, therefore, qualified. However, again WEPCO did not have any calculations that supported the seismic adequacy of this piping. The team was concerned that the nonseismic condition of the fuel oil system could interfere with the availability of the fuel oil in the emergency storage tank under design basis conditions.

After considering both the team's concerns and additional information, WEPCO performed a more detailed evaluation of the fuel oil system immediately after the inspection. WEPCO determined that the system was inoperable and modified the piping supports before declaring the system operable. Pending review of WEPCO's corrective actions, the NRC considers this item unresolved (see Appendix A, Deficiency 90-201-15).

4.1.2 Quality of Fuel Oil

The team reviewed records of test results of fuel oil purchased for the EDGs as well as for several items that were not classified as safety related. The review revealed that the cloud point of the fuel oil had always exceeded (by 12 to 22 °F) the maximum recommended by the American Society for Testing and Materials (ASTM) Standard D975. In 1980, WEPCO committed to purchase oil to this standard. Records indicated that, although in some cases WEPCO had noted the excessive cloud point, nothing was done to rectify the problem. In extremely cold weather, a high cloud point could interfere with the ability of the fuel oil (1) to drain down directly to the EDGs to meet an Appendix R scenario, (2) to replenish the emergency storage tank, and (3) to flow to the gas turbine required to operate during a station blackout. The records also indicated that WEPCO was aware of the discrepant condition with the fuel oil quality but had not taken corrective actions. The team concluded that WEPCO failed to take corrective actions. The relevant requirement is found in 10 CFR Part 50, Appendix B, Criterion XVI. This item is unresolved (see Appendix A, Deficiency 90-201-16). WEPCO made an incorrect presentation as to the safety significance of the finding at the exit meeting, apparently due to a misreading of temperature units in the ASTM standard.

4.1.3 Upgrade to Safety-Related and QA Status

The team reviewed WEPCO's documented evaluation of NRC Information Notice (IN) 89-50, "Inadequate Emergency Diesel Generator Fuel Supply." WEPCO was unable to show that PBNP met the IN recommendation for a 7-day supply of fuel oil because of inconsistencies in the FSAR and Technical Specifications and a lack of a documented design basis for fuel oil capacity. The team noted that WEPCO proposed in the evaluation several action items regarding the adequacy of the fuel oil supply. In its review of fuel oil capacity, the team was informed by WEPCO that the fuel oil system was not classified as safety related; however, WEPCO indicated that it planned to upgrade the system to a safety-related status. It was the team's position that because the system performed a safety function, it should have been classified as safety related. The team found that WEPCO did not have a procedure to implement such an upgrade, but planned to use a process similar to one used in a previous upgrade of the spent fuel pool. The team concluded that WEPCO failed to describe activities affecting

The team also reviewed several fuel oil system modifications that WEPCO performed in the early 1980s. The modifications had not been classified as QA. Although the fuel system between the emergency tank and the EDGs was not classified as QA at the time of the modifications, WEPCO had subsequently upgraded the system to QA status. The team requested the documentation of the upgrade including the relevant procedure. The team was told that no procedure for implementing such an upgrade had been available during the period when the upgrade was performed. The team's review of the specific modifications revealed that WEPCO could not produce QA-required records for material procurement and installation. The team concluded that WEPCO failed to maintain sufficient records to furnish evidence of activities affecting quality. The relevant requirement is found in 10 CFR Part 50, Appendix B, Criterion XVII. This item is unresolved (see Appendix A, Deficiency 90-201-18).

4.1.4 Fuel Oil Delivery Under Emergency Conditions

The team reviewed Procedure PBNP 4.12.22, "Fuel Oil Ordering, Receipt & Sample Disposition Instruction," Revision 13, dated October 30, 1989. The procedure provided the method of fuel delivery to one emergency diesel generator should the normal method for transferring fuel oil be unavailable. The team found several deficiencies with the procedure that related to fuel oil delivery under emergency conditions:

- A large number of staggered truck deliveries might be required with short intervals to accomplish the required operations. For example, one 7,000-gallon tank truck would be required every 34 hours if the only user of the fuel oil were the one diesel generator.
- The current contractual agreement with the fuel supplier did not require a 7-day inventory at the supplier's premises, or delivery of No. 1 Grade fuel oil during winter months as required by the procedure.
- A barreling nozzle and 150 feet of companion hose needed to supply the EDG day tank, and required by the procedure, are not available on site and are not a requirement of the contractual agreement with the fuel supplier.

Until WEPCO solves these problems, the staff considers this item unresolved (see Appendix A, Deficiency 90-201-19).

The original design of the fuel oil system could not deliver oil to the EDG day tanks in cases of control room inaccessibility or fire in the fuel oil pumphouse. These emergencies could incapacitate both fuel oil transfer pumps. WEPCO had modified the system piping to bypass the fuel oil transfer pumps and to deliver fuel to the EDG day tanks by draining fuel down from the outside storage tanks to address these contingencies under the requirements of 10 CFR Part 50, Appendix R. By performing a calculation and a test, WEPCO had established the feasibility of this approach. The team reviewed the feasibility of the Appendix R scenario and had concerns with WEPCO's calculation and test results of the approach.

- The calculation used a single fuel density and viscosity for the whole system. Parts of the system were above ground level and exposed to the elements, while part of the piping buried underground was above the frost line.

- O Very low temperatures will substantially impede and even stop the flow of the No. 2 Grade fuel oil currently used in the piping connecting the outside storage tanks to the emergency tank. WEPCO recently experienced difficulty starting its gas turbine in cold weather. The difficulty may have been caused by the quality of the fuel oil.

- O WEPCO made no provision for providing fuel oil to the plant's diesel fire pump day tank.

- O Fuel system isometric drawings and calculations for normal flow did not exist.

- O Draining will require appropriate valve lineup as well as establishing the siphon. Access to the valves following a fire in the fuel oil pump house would require retrieval and use of a portable pump stored at another location. WEPCO could not demonstrate that these actions could be effectively implemented in a timely manner and did not include the location and use of the portable pump in the associated procedures.

Pending additional review by WEPCO and the NRC, this item is considered unresolved (see Appendix A, Deficiency 90-201-20).

4.2 Heating, Ventilating, and Air Conditioning Systems

4.2.1 Battery Room Heating

The amount of heat required to keep the temperature in the battery rooms within 5 degrees of 77 °F was computed in Calculation N-88-033. This calculation was performed as part of Modification Request 87-156. Local heaters were recently installed to implement this modification. Since the installation, WEPCO had detected that the temperature in the battery rooms had not been uniform. In a memorandum dated March 20, 1990, WEPCO identified that the problem had been caused by the inappropriate location of the heaters and recommended removing the existing heaters and installing heaters in the cold air supply duct. The recommendation was made because the ventilation air was supplied at 45 °F, a temperature substantially lower than the desired temperature of 77 °F. The team concluded that the modification was ineffective and represented a weakness in the modification program.

4.2.2 EDG Room Heating, Ventilating, and Air Conditioning

WEPCO documented its evaluation of NRC Information Notice 87-09, "Emergency Diesel Generator Room Cooling Design Deficiency," dated February 5, 1987, in NEPB-87-536, dated June 29, 1987, by identifying several deficiencies and recommending solutions to six items. WEPCO indicated that the maximum temperature permitted in the EDG room would be exceeded (by 6 °F) and considered this small deviation acceptable. However, in an internal audit subsequently performed, WEPCO found this higher temperature unacceptable since exceeding the maximum temperature rating could substantially degrade the performance of the diesel generators.

Additional work established a more accurate maximum temperature for the EDG rooms. Work Maintenance Temporary Procedure (WMTP)-9.22 was used to more accurately define several parameters of the room temperature calculation under various conditions. Using the results of WMPT-9.22, WEPCO performed Calculation N-88-034 to derive generator heat losses for the various conditions. Finally, WEPCO used the minimum diesel generator heat losses of Calculation N-88-034 in Calculation N-88-040, which established that the maximum room temperature would be 118 °F, only 4 °F below the maximum temperature recommended by the diesel manufacturer. However, the condition (one fan operating) used in N-88-040 was not one of the conditions assessed in N-88-034. The team also noted that the minimum heat losses used in N-88-040 were approximately one-third of the losses recommended by the EDG manufacturer. This nonconservative heat loss resulted in a lower maximum ambient temperature.

The team did not have enough time to verify WEPCO's justification for its use of the nonconservative heat losses. But because the team found that the loading of the EDGs was marginal and that operating the diesels in an ambient temperature above the maximum recommended could reduce the EDG's capacity, this item remains unresolved pending further review by the NRC (see Appendix A, Deficiency 90-201-21).

4.3 Conclusion

The team's review of mechanical systems design raised significant concerns regarding the ability of the emergency EDG fuel oil system to provide fuel to the EDGs under all design conditions. The team found that the complete system was not seismically designed and installed. In addition, the fuel oil storage and supply system required by plant Technical Specifications was not considered by original design to be a safety-related or QA system and the licensee's programs for upgrading the systems were not documented. The team also found that the fuel oil being purchased by the plant did not meet the appropriate requirements for quality and, under certain conditions, may not be able to reach the diesel generator day tanks.

WEPCO was already aware of each of the team's major concerns. However, it had either not fully evaluated the issue or not fully understood the significance. For example, WEPCO had evaluated the seismic condition of the fuel oil system and found that although modifications were required there were no concerns with system operability. After a more detailed evaluation based on the team's concerns, WEPCO found that the system was inoperable. WEPCO was also aware of the high cloud point for the fuel oil but had not issued a nonconformance report nor fully evaluated the deficiency. Such an evaluation was particularly important because, for certain plant conditions, WEPCO was relying on a gravity drain supply and the feasibility of the gravity drain process under cold weather conditions was not well supported. These are further examples of weaknesses in WEPCO's engineering support.

5.0 SYSTEM CONFIGURATION AND TESTING REVIEWS

The team reviewed installed portions of the EDS and associated subsystems. The review included walkdown inspections of various safety-related electrical components and an assessment of the associated procedures, maintenance orders, instructions, and drawings. In general, the cleanliness and quality of plant installations were acceptable. Electrical system components and associated hardware were in good condition and gave evidence of conscientious maintenance and housekeeping activities. The team, however, did identify several specific design, testing, and installation deficiencies. These issues and pertinent responses from WEPCO are discussed in the following sections.

5.1 Equipment Walkdown Inspections

The physical walkdown of plant equipment consisted of an examination of selected components within the EDS. The team compared the installed configuration of these components with the requirements of design documents for such attributes as location, orientation, system interface, rating, type, and size. Additionally, the team reviewed maintenance and calibration activities associated with the selected equipment.

5.1.1 Separation of Redundant Division Cables

The team examined the installation of Class 1E cables associated with portions of the EDS and identified [illegible] of cable installations which did not comply with the requirements of [illegible] 7.2 and 8.2 of the FSAR. These two sections prohibited the routing of [illegible]ndant Class 1E cables in the same raceway. The team noted that three Clas[illegible] cables in conduit JJ-1 had been routed from division A cable tray JJ[illegible] division B cable tray JE02, thus resulting in division A circuits rou[illegible] both division A and B cable trays. WEPCO indicated that, although [illegible] was not consistent with the FSAR commitment, the subject circuit [illegible] performed a safety-related function and that the condition appear[illegible] result of a construction error. The team then asked WEPCO to search [illegible] computerized cable database in order to determine if additional def[illegible] with respect to cable separation. The resultant computer report [illegible] 25 raceways contained cables of redundant safety divisions. The [illegible]luded that these installations did not meet requirements for system [illegible] and separation. The relevant requirements are found in GDCs 20 and 23. This item remains unresolved (see Appendix A, Deficiency 90-201-22).

The team also asked WEPCO to perform a functional analysis of the affected Class 1E cables to determine if any potential conditions for common-mode failure existed. During the inspection, WEPCO was able to complete a partial review of the 25 raceways and associated cables. From this review, WEPCO determined that cables ZC2NA012D and ZD2NA012B, which were redundant division cables for the automatic start circuit for the Unit 2 turbine-driven auxiliary feedwater pump, had been routed in the same conduit. These circuits sense an undervoltage condition on the redundant 4160-Vac busses 2-A01 and 2-A02 to initiate an automatic start signal which opens steam supply valves 2-2019 and 2-2020 to the auxiliary feedwater pump turbine. Thus, a single failure of any cable within the conduit could impact redundant control functions and defeat the undervoltage automatic start signal for the auxiliary feedwater pump. After this concern was identified, WEPCO issued NCR N-90-058 to document and correct this deficiency and placed Unit 2 in a Technical Specification limiting condition for operation (LCO). The team concluded that this installation violated the requirements for redundancy and separation. The relevant requirements are found in GDCs 20 and 23. This item remains unresolved (see Appendix A, Deficiency 90-201-23).

The team also identified several nonsafety-related cables which were routed through both divisions of engineered safety features raceway. Examples of this deficiency included:

- Nonsafety-related circuits in cable tray CQ09 were routed through division A cable tray CQ14 and division B cable tray CQ08.

- Nonsafety-related cable D4102A was routed from division A cable tray JJ11 to division B cable tray JE02.

The team noted that the configurations observed were not directly prohibited by the FSAR, which permitted routing of non-Class 1E and Class 1E cables through the same raceway. However, the team found that the intent of 10 CFR Part 50, Appendix A, GDC 39 and prudent engineering practices would avoid bridging redundant Class 1E raceways with non-Class 1E circuits.

The team also was concerned about the accuracy of the computerized raceway loading and cable routing program. WEPCO's response to cable routing deficiencies indicated that conduit JJ-1 contained only three cables. However, on inspection of the conduit, the team found that two additional cables were present which were not shown on the computer database. Several additional errors were noted during review of this database. However, WEPCO did not commit to evaluating the database for errors.

5.1.2 Cable Damage

During a walkdown inspection, the team observed that a condensate receiver tank vent was venting steam on to safety-related cable trays JE06, JE07, FV12, and FV13. The team inspected the cables in the affected trays and noted that the jackets of a number of single conductor cables showed signs of deterioration and, in one case, the jacket had peeled back, exposing the inner insulation. Other cables in the trays were discolored. The team questioned WEPCO and determined that the licensee was aware of the venting steam and that the condition had existed for many years. However, WEPCO had not investigated the effect of the steam on the safety-related cables. A deterioration of safety-related cables could result in cable faults and could prevent the end devices connected to the affected cables from performing their intended safety functions.

As a result of this finding, WEPCO inspected the cables and determined that the most severely damaged cables were connected to nonsafety-related loads. WEPCO also stated that the remaining cables were safety related, were within one train and showed no obvious evidence of damage. Immediately following the inspection, WEPCO issued NCR 90-056 to evaluate the cables and determine what actions to be taken. In the interim, WEPCO stated that it intended to wrap the affected cables in an effort to compensate for insulation damage and to minimize any further effects from the steam. The team concluded that WEPCO failed to promptly identify and correct a known nonconforming condition with a safety-related installation. The relevant requirement is found in 10 CFR Part 50, Appendix B, Criterion XVI. This item remains unresolved (see Appendix A, Deficiency 90-201-24).

5.1.3 Switchgear

The team performed a walkdown inspection of vital 480-Vac and 4160-Vac switchgear. The team also examined portions of the 125-Vdc system including station batteries, associated static inverters, and dc distribution cabinets. On the basis of this examination, the team concluded that vital switchgear components have been installed in accordance with requirements. However, the team identified a deficiency in the 125-Vdc system. Output breakers 72-104 and 72-204 for battery charger D-09 could be closed at the same time, thus connecting redundant vital batteries D-05 and D-06 electrically. Although simultaneous closure was prohibited by Procedure 01-33, WEPCO, by letter, had committed to the NRC in 1980 to install a mechanical interlock between the circuit breakers. The licensee planned a modification to install the interlock next year. The team concluded that WEPCO's untimeliness in implementing the commitment was another example of a weakness in WEPCO's engineering support program.

5.1.4 Transformers and Tap Settings

The team performed a walkdown of the main power transformers, station auxiliary transformers, the 480-Vac, and 4160-Vac transformers. The team reviewed transformer tap settings and physically verified tap configuration on the 480-Vac and 4160-Vac transformers. The team found no deficiencies or other concerns in this area.

5.1.5 Motor-Operated Valves

The team examined three safety-related valves and associated wiring during the inspection. The examination compared installed configuration with the requirements of applicable piping and instrumentation diagrams, schematics, and wiring diagrams. The team noted that WEPCO's program for maintenance and testing of motor-operated valves (MOVs) had greatly benefited from a knowledgeable and dedicated engineering staff. Interviews with PBNP engineering personnel demonstrated a thorough understanding of MOV operation, component weaknesses, and the actions required to ensure reliable component operation.

The examination of safety injection suction blast valve 1SI-826C disclosed a deficiency in wiring of the actuator limit switch. Detail MM of Connection Diagram E-98, Sheet 10, Revision 12, showed a jumper between limit switch rotor 1 (terminal point 1C) and rotor 3 (terminal point 11C). The jumper in question provided valve position indication to the control room. The team observed that this jumper had not been installed. In response to this observation, WEPCO indicated that an NCR would be written to document the deficiency and install the missing limit switch jumper. WEPCO also noted that position for this valve was indicated through the open side of the actuator torque switch. This was confirmed by the team through examination of valve position indicator lights in the control room. The team concluded that the missing jumper, although an installation deficiency, was of minimal safety significance and WEPCO's commitment was sufficient to resolve the problem.

The examination of valves 1SI-871B (containment spray pump suction for the residual heat removal system heat exchanger) and 1SI-825A (refueling water storage tank to safety injection pump) disclosed no additional deficiencies.

5.1.6 Pump Motors

The team reviewed installation and maintenance of the motors for the component cooling water pump 1-P11A, safety injection pump 1-P15B, and charging pump 1-P2B. The team compared nameplate data for model number, horsepower, service rating, insulation class, voltage, and current with the requirements of applicable design documents. The team also reviewed pump and motor performance curves supplied by the manufacturer. These reviews indicated that the subject pump motors were adequately sized for system requirements and that routine maintenance activities had been consistently implemented. The team did not identify any deficiencies or other concerns in this area.

5.1.7 Emergency Diesel Generators

The team reviewed maintenance and test activities associated with EDGs G-01 and G-02. The review focused upon both historical and current work activities in order to gain a thorough understanding of EDG performance and reliability. The team also examined WEPCO's evaluation of several NRC information notices relating to maintenance and operation of plant EDGs. In general, the team considered these evaluations to be technically sound and confirmed that corrective actions, when required, had been properly implemented. After reviewing these activities, the team concluded that the EDGs had been installed and maintained in accordance with maintenance requirements.

The team also monitored WEPCO's performance of the EDG biweekly test, TS-2. Specific observations relating to this test are found in Section 5.2.4 of this report.

5.2 Equipment Testing

5.2.1 Circuit-Breaker Testing

The team reviewed WEPCO programs for periodic testing of circuit breakers. All 480-Vac Westinghouse DB-25, 50, and 75 safety-related circuit breakers and the 4160-Vac breakers were tested annually; however, molded case circuit breakers were not tested periodically. The team reviewed the PM task sheets, which are part of WEPCO's Computerized History and Maintenance Planning System (CHAMPS). The PM task sheets contained the "Callup Instructions," which stated to "inspect, maintain, and multi-amp [current test] breakers, per Westinghouse Bulletin 1B33-850-3C." The team noted that the Westinghouse instruction did not include procedures for circuit breaker overcurrent testing. WEPCO stated that overcurrent testing was performed in accordance with procedures contained in the technical manual for the Multi-Amp current tester and acceptance criteria were contained on data sheets kept by the electrical foreman. Each specific breaker had a corresponding data sheet with test and acceptance criteria for trip currents and times that were provided by the engineering organization. Although the team reviewed several completed data sheets and found no specific deficiencies, it considered it prudent to develop a formal test procedure. In addition, it was unclear as to what future periodic testing would be performed after the modifications to install Amptector trip devices into all Westinghouse DB-25, 50, and 75 circuit breakers are complete.

As a result of these concerns, WEPCO provided draft copies of procedures for performing overcurrent testing using the Multi-Amp machine and for performing testing using the Amptector. These procedures were already under development at the start of the inspection and were not reviewed by the inspection team. The team also expressed concern that no periodic testing was being performed on molded case circuit breakers. Trip times for these breakers can change as a result of changes in lubrication and spring constants. An unidentified change in performance of these breakers could compromise the plant's protective coordination scheme. However, the team recognized that the NRC has no requirements for testing molded case circuit breakers although some licensees are identifying certain safety-related molded case breakers for periodic testing.

5.2.2 Relay Calibration

The team reviewed the documents and procedures relative to the calibration of key safety-related protective relays at PBNP. These relays included the 4160-Vac undervoltage relays, the 4160-Vac degraded grid voltage relays, and the 4160-Vac overcurrent relays. From this review, the team determined that although the relays were apparently being calibrated periodically, these calibrations were being performed by a non-nuclear WEPCO organization located in Appleton, Wisconsin. As a result, the calibrations were not being performed in accordance with a nuclear QA program. The team found deficiencies in the areas of procedures, calibration tolerances, calibration test equipment, procurement, and trending. The team concluded that WEPCO failed to properly document and control activities affecting quality. The relevant requirements are found in 10 CFR Part 50, Appendix B, Criteria IV, V, and XI. This item remains unresolved (see Appendix A, Deficiency 90-201-25).

5.2.3 120-Vac Inverter Surveillance

The team performed a walkdown inspection and reviewed associated surveillance procedures for the Westinghouse and Elgar inverters. The team found that Routine Maintenance Procedure (RMP) 36 for the Westinghouse inverters was generally adequate, except for the fact that inverter output oscilloscopic traces were being manually recorded on data sheets. The team found that this method was inaccurate and did not lend itself to easy trending or evaluation of the output data. In addition, the team identified several deficiencies with RMP-45 for the Elgar inverters. First, this procedure did not require that the oscilloscopic output traces be recorded. Second, the procedure did not include a check or a calibration of the inverters' low-voltage shutdown circuit. This circuit could prematurely shut down the inverters and should be checked at regular intervals. The team concluded that WEPCO failed to translate all design information into site procedures. The relevant requirement is found in 10 CFR Part 50, Appendix B, Criterion III. This item remains unresolved (see Appendix A, Deficiency 90-201-26).

5.2.4 Emergency Diesel Generator Testing

The team monitored the performance of the biweekly EDG test TS-2. This test assessed the operational readiness of EDG G02 and fulfilled testing requirements for diesel air valves CV-3058A and CV-3058B, as required by Section XI of the ASME Code. The test placed EDG G02 in an exercise mode and initiated a cold start and 1-hour run of the diesel engine. The team monitored test activities from the control room and at the EDG. The team noted that station operators had properly reviewed and verified the test prerequisites described in TS-2. Additionally, the team's review of in-process test activities indicated that station operators were familiar with EDG test requirements and thorough in their implementation of those requirements.

The team identified one concern regarding the verification and signoff of sequential test steps. Test Procedure TS-2 required the signature of only one party before proceeding with additional test activities. This process did not reflect the usual industry practice of a two-party signoff and could lead to equipment damage or personnel injury if test steps were overlooked or improperly performed out of sequence.

5.2.5 Battery Testing

The team reviewed the performance and surveillance test activities for vital station batteries. The review included Test Procedure R-5 for service testing of battery D-05 and Maintenance Procedure RMP-46 entitled "Station Battery." Additionally, the team reviewed acceptance tests associated with the replacement of batteries D-05 and D-06. No deficiencies were identified with the acceptance tests; however, the team determined that yearly service tests were not currently planned. Based on a previous Region III concern, the NRC staff is reviewing the issue of battery testing requirements for PBNP.

In addition, the team noted a deficiency in RMP-46: the procedure lacked acceptance criteria for the ground resistance check. The team concluded that, although the procedure provided guidance for measuring and calculating ground resistance, it did not provide acceptance criteria or limits for the calculated values. The relevant requirement is found in 10 CFR Part 50, Appendix B, Criterion XI. This item remains unresolved (see Appendix A, Deficiency 90-201-27).

5.3 Equipment Modifications

5.3.1 Modification of Circuit Breakers

The team reviewed Special Maintenance Procedure (SMP) 975 for the upgrade and replacement of the overloads for Westinghouse DB-50 circuit breakers. The old overloads were operated by an air-type diaphragm and are not as reliable as the new electronic Amptector devices being installed. The procedure contained no specific instructions for performing the modification but rather referenced Westinghouse Instruction Bulletin 33-850-60. The team reviewed the Westinghouse bulletin and found the instructions adequate for completing the work. SMP-975 contained instructions for performing a full-current injection test using the Multi-Amp tester after completion of the modification but before the circuit breakers are reinstalled in their cabinets. The test was considered adequate for postmodification testing.

In addition, the team reviewed Modification Request (MR) 87-034, which contained the engineering proposals, comments, and supporting documents for performance of this modification. The modification request was found to be thorough; all aspects of the modification were considered, including seismic qualification, coordination effects, and commercial-grade versus safety-related procurement. The corresponding purchase order (PO C45129) to Westinghouse for the Amptector overload devices was reviewed and found to contain all pertinent references to Appendix B to 10 CFR Part 50, IEEE 344, and 10 CFR Part 21. Setpoints for the new Amptector overload devices were determined by matching the settings to those on the previous mechanical overloads. In addition, some additional review of coordination was done by the WEPCO protection engineering division for selected devices.

5.3.2 Cable Modifications

The team reviewed activities associated with two plant modifications. Modification Package E-250 provided details for the installation of electrical cables and associated raceways within the Unit 1 containment building and implemented the requirements of several specific plant upgrades, including the containment air temperature upgrade and the core exit thermocouple upgrade. Modification Package E-252 provided similar details for installation of cable and raceways within the auxiliary building. A limited review of work activities associated with these modifications disclosed no design or installation deficiencies.

The team noted that the modification packages included design and installation requirements more stringent than those specified in the FSAR. Of particular interest were references to Standards IEEE 384-1974 and IEEE 383-1974. These nuclear industry standards provided guidance for the design and installation of systems which require physical independence and qualification of Class 1E equipment and materials. Commitment to these standards suggested that some recent plant modifications included current industry practices.

5.4 Conclusion

In general, the team found electrical installations to be adequate. However, the team's examination of the installation and testing of electrical distribution system components revealed several significant deficiencies. Of particular concern were the deficiencies identified in the routing of Class 1E cables. These cable routing deficiencies were violations of the plant licensing requirements and FSAR commitments. The lack of a proper quality program for testing of safety-related relays also was seen as a major programmatic weakness. In addition, the lack of molded case circuit breaker testing could compromise the plant's protective coordination scheme.

6.0 ENGINEERING AND TECHNICAL SUPPORT REVIEW

6.1 Programs and Procedures

6.1.1 Engineering Interfaces

The team reviewed and evaluated the adequacy of the procedures that govern the relationships between the various engineering organizations, both corporate and site. The team's review included interviews with key personnel. The following major program areas were considered:

- procedure writing and input
- procurement and spare parts
- surveillance
- Technical Specifications
- maintenance
- design

The team found no specific discrepancies in its review of the documented programs for engineering relationships. However, the team noted a weakness in the procedure for temporary modifications during the review of the engineering involvement in design and the related review of the design procedures. This weakness is documented in Section 6.1.2 which follows.

6.1.2 Design Procedures

The team reviewed and evaluated the adequacy of the design control procedures including QP 3-1, "Modification Requests," Revision 3, dated October 13, 1989; QP 3-2, "Design Control," Revision 4, dated March 1, 1990; QP 3-6, "Calculation Preparation Review & Approval," Revision 2, dated October 13, 1989; and PBNP 4.17, "Temporary Modifications," Revision 12, dated March 23, 1990.

The team found procedure QP 3-1 for modification requests was complete and that the corporate staff and the plant staff work to the same procedure. The process was considered a strength, since it simplified the often complex engineering relationships between the participating design organizations. However, the team considered the plant's temporary modification procedure, PBNP 4.17, to be weak, since no design organization was responsible for the procedure and the procedure did not prescribe an adequate level of design control. For example:

- The procedure was not enveloped by QP 3-1, "Modification Requests."
- Responsibilities and relationships for the effected individuals and organizations were not defined.
- The initiator of the temporary modification determined if a 10 CFR 50.59 review was required; QP 3-1 requires the modification engineer to make that determination.
- The requirements for a technical reviewer were not the same as in QP 3-1; that is, possession of an appropriate engineering degree, appropriate training, and documented basis for personnel qualification.
- The engineering organization may not be involved in specifying installation instructions and did not provide the testing requirements or acceptance criteria, which are design control items.

6.1.3 Procedures for Upgrading System Status

In reviewing the QA status of the fuel oil transfer system, the team found that before November 12, 1987, there were no procedures for upgrading systems from non-QA to QA status. Revision 0 of procedure QP 2-1, "Upgrading of Non-QA Scope Systems or Components to QA-Scope Status," became effective on November 12, 1987. The team found this two-page procedure inadequate, providing essentially no guidance for such an upgrade. The team was then given the draft of Revision 1 of QP 2-1. The team did not review this draft in detail, but noted that it appeared to be a marked improvement over Revision 0. The team was also given the draft of Revision 0 of Procedure QP 4-2, "Technical Evaluation of Replacement Items." This procedure described requirements and responsibilities for performing part classification, equivalency evaluations, and commercial-grade procurement and dedication. This procedure was to be used in conjunction with QP 4-1, "Procurement of QA Scope Goods and Services."

Again, in reviewing the nonsafety-related status of the fuel oil system, the team found that there were no procedures for upgrading a system from nonsafety-related status to safety-related status. WEPCO indicated it did not plan to write such a procedure.

6.1.4 Maintenance History

The team reviewed and evaluated the adequacy of the established system for the control of maintenance history including the use of the Computerized History and Maintenance Planning System (CHAMPS) and interviews with key personnel. The team had no concerns in this inspection area.

6.1.5 Trending

The team reviewed and evaluated the adequacy of the trending program relative to electrical maintenance. This review included the use of CHAMPS, administrative control systems, selected completed work requests, and interviews with personnel. The team was satisfied with the trending program with one exception: root causes were poorly documented and in some cases the failure mechanism was erroneously documented as the root cause of failure. The team considered this a weakness in the program.

6.2 WEPCO Action on Commitments and Concerns

6.2.1 In-Service Testing Program for EDG Fuel Oil System

A letter from C.W. Fay (WEPCO) to T.G. Colbourn (NRC), dated April 2, 1987, discussed the in-service testing (IST) program for pumps and valves at PBNP, Units 1 and 2. Item 7e of the letter addressed exclusion of the "Emergency Diesel Generator Fuel Oil Transfer Pumps and All Active Inline Valves to Supply the Day Tank," from PBNP's IST program. In support of its effort to exclude the pumps and valves between the bulk storage tanks and the day tanks from IST, WEPCO stated that: "The inventory of diesel fuel necessary to mitigate an accident or to shut down a unit to a safe condition is contained within the day tanks and base tanks for each engine." Each day and base tank had a capacity of approximately 450 gallons. The statement in the letter was not consistent with the plant's Technical Specifications, which required a fuel supply of 11,000 gallons to be available. The 11,000 gallons essentially represented the capacity of the emergency fuel tank (12,000 gallons when completely full).

In the same section of the letter, WEPCO stated that: "The emergency diesel generator fuel oil transfer system pumps and valves located between the bulk storage tank and the day tanks are not safety related. Therefore, the emergency diesel generator fuel oil transfer pumps and active inline valves to supply the day tanks should not be included in our IST program." However, WEPCO had since reconsidered the safety classification of the system and was in the process of establishing an IST program. It was the team's assessment that as evidenced by the above letter, WEPCO had misstated its commitments and engineering requirements.

6.2.2 Responses to NRC Bulletins and Information Notices

Several of WEPCO's responses to NRC bulletins and information notices are covered in the appropriate sections of this report. Some additional responses that the team reviewed are addressed in this section.

IE Bulletin 83-03, dated March 10, 1983, addressed check valve failures in the raw water cooling systems of diesel generators. This bulletin was a followup to IN 82-08 on check valve failures in diesel generator engine cooling systems. In response to this bulletin, the Executive Vice President of WEPCO stated in a letter to J.G. Keppler of NRC Region III, dated June 6, 1983, that: "We have verified that there are no check valves in the flow path of cooling water for the diesel generators." This response failed to consider the system's intake check valves, which were specifically listed as a concern in the bulletin. However, the licensee has since established an in-service test for these valves.

The team reviewed WEPCO's response to NRC Bulletin 88-10, "Nonconforming Molded-Case Circuit Breakers." Originally, WEPCO determined that 57 of 94 breakers being maintained as spares could not be traced to the original equipment manufacturer. As a result, all breakers installed since 1983 were reviewed for traceability. From this review, 116 additional breakers that could not be traced were identified. The majority of these 116 breakers were installed in two auxiliary system instrument panels, one in Unit 1 and one in Unit 2. Justifications for continued operation (JCOs) were written for these 116 breakers. WEPCO was replacing these breakers with traceable breakers procured as safety-related equipment from the original manufacturer. The team reviewed Purchase Order (PO) 140378 to Square D Company for 189 replacement breakers and PO 157849 to Westinghouse for 6 replacement breakers. The purchase orders properly included references to 10 CFR Part 50, Appendix B. In addition, the purchase orders required the vendors to supply the applicable time-current curves which delineate the performance characteristics of the circuit breakers.

The team reviewed WEPCO evaluation of IN 89-21, "Changes in Performance Characteristics of Molded Case Circuit Breakers." The information notice concerned changes made by vendors to the performance characteristics of molded case circuit breakers without notifying the customers of these changes and without changing the part numbers. The team noted that WEPCO had taken appropriate action by requesting new time-current curves for breakers during procurement.

6.2.3 Responses to Other Concerns

As a result of its inspection of the main fuel oil storage tanks on September 30, 1988, WEPCO identified a potential problem described in PBM 89-0125, dated February 1, 1989. The drain line on the bottom of the tank was susceptible to rupture from freezing or other causes. Such a rupture would empty both storage tanks of fuel oil. An engineering analysis was recommended. In PBM 89-0222, dated February 23, 1989, several recommendations were made for alleviating this problem. However, none had yet been implemented.

The team found that the swing battery charger for batteries D05 and D06 did not have an interlock for its output circuit breakers. WEPCO had committed to the NRC, in 1980, to install the interlock. At the time of the inspection, WEPCO was planning to install the interlock in 1991.

6.3 Conclusion

Although the procedures controlling the engineering program were generally complete, the team identified several weaknesses. The team found that the temporary modification procedure did not include many of the requirements of similar or controlling procedures. Procedures for upgrading the QA and safety status of systems were weak and some were absent. There was no effective procedure for upgrading systems from non-QA to QA status, and no procedure existed for nonsafety-related systems to the safety-related category.

In addition, several letters to the NRC and responses to NRC bulletins were not completely adequate. Several WEPCO replies either misstated commitments or engineering basis, or missed key elements of the bulletin. The team also noted 10 years after WEPCO's commitment to the NRC to install circuit breaker interlocks on a battery charger, the interlocks still were not in place.

7.0 OVERALL CONCLUSIONS

The team identified a large number of significant problems from its review of a relatively small sample of the electrical distribution system and support systems. The number and significance of the findings prevented the team from initially determining that the systems were capable of performing their safety functions under all design basis conditions. The three major issues that raised the most concern about operability were (1) emergency diesel generator loading, (2) seismic capabilities of the emergency diesel generator fuel oil system, and (3) redundant division cables routed in the same raceway. The actions taken by WEPCO immediately following the inspection and discussed at the exit meeting on April 17, 1990, alleviated the immediate operability concerns for these three issues.

However, the deficiencies identified by the team indicated general weaknesses in several areas: (1) design and modification deficiencies in the EDG and 125-Vdc systems, (2) lack of available design and engineering information, (3) design features where a single failure can disable redundant equipment, and (4) engineering support that did not fully evaluate design or changes to design. The first weaknesses noted were the deficiencies in the emergency diesel generators and fuel systems, and the batteries and 125-Vdc system. Because of PBNP's design (only two EDGs and two safety-related batteries shared by both units), these two systems have utmost safety significance. Within the EDG system, the team found the steady-state loading of the diesels to be marginal with the potential to be exceeded. In addition, no transient analysis existed for the dynamic EDG loading. The fuel oil transfer system between the seismic emergency storage tank and the seismic day tanks was not seismically designed and installed, and the fuel oil quality did not meet the appropriate requirements. Finally, a voltage level interlock described in the FSAR and system logic diagrams was not part of the EDG installation.

The team's findings in the 125-Vdc system included a nonconservative calculation for sizing replacement batteries. The float voltage for the batteries exceeded the manufacturer's recommendation and component ratings. The procedure for measuring ground resistances on the system did not include acceptance criteria or limits, and the significance of such measurements was not evaluated. The maximum available short-circuit current was not determined when circuit breakers were replaced on the system and the circuit breakers were replaced because of a recently disclosed problem with the dc breakers not having a maximum fault-interrupting capability. The final resolution for the main dc bus breakers was still being reviewed by the licensee.

The second area of weakness was the unavailability of design documents. The team's review of the adequacy of the electrical distribution system was complicated by the lack of adequate and complete calculations and analysis. The team could not confirm ratings of certain equipment or determine fault currents to equipment. A steady-state load calculation for the EDGs did not exist until the inspection and a transient analysis had not been performed. In addition, calculations for many device setpoints did not exist. The team recognized that WEPCO had several existing programs for addressing these concerns in the future. However, the programs represented recent and preliminary efforts and their effectiveness could not be evaluated.

The third weakness the team identified was in the plant design itself. The team recognized that PBNP was designed and built in the late 1960s and early 1970s and would not meet current standards for design and construction. However, the team did not expect to find such a large number of design deficiencies in its relatively small sample. Although the plant was designed to meet the requirements for withstanding the effects of a single failure, the team identified a number of conditions that, given a single failure, could jeopardize redundant equipment required for safe operation of the plant. Three of these conditions were the result of original design and two conditions were the result of plant modification. Ironically, two of the examples had been reviewed and modified by WEPCO to eliminate other single failure problems. These conditions included (1) the routing of redundant safety-related cables in the same raceway, (2) single-failure of the tie breaker between the redundant safety-related 480-V busses, (3) potential seismic failure of the knife switches providing dc control power to the safety-related 4160-V switchgear, and (4) potential failure of redundant 120-Vac channels from an automatic shutoff feature on new inverters.

The fourth area of weakness the team identified was the engineering support provided to PBNP. Several of the team's findings indicated that WEPCO engineering groups did not evaluate design adequacy or establish adequate bases for certain changes or modifications to the plant. The findings also indicated that when WEPCO identified a problem with original design, the full extent of the problem or the possibility of other similar problems was not always addressed. Examples included (1) not developing a full load profile for sizing replacement batteries, (2) not determining the maximum available short-circuit current when replacing dc system circuit breakers and batteries, (3) not fully evaluating the affects of excessively high battery float voltages, and (4) not evaluating the affects of fuel oil that did not meet quality requirements. Other examples of weaknesses in the engineering support program included (1) performing some modifications without considering industry-standard practices, (2) adding incorrect information into emergency operating procedures, (3) upgrading safety-related status of systems without a controlling program or procedure, and (4) permitting adverse conditions to exist in the plant for over 10 years. The team concluded that a lack of design basis documents and design information contributed to the weaknesses it found in the engineering program. The team also believed that the limited size of the engineering staff contributed to the weaknesses with engineering support.

8.0 EXIT MEETING

The NRC held an exit meeting with Wisconsin Electric Power Company management on April 17, 1990. The meeting was held at WEPCO's corporate offices in Milwaukee, Wisconsin. Appendix B to this report identifies the WEPCO and NRC personnel who attended the meeting. The team's more significant findings and the team's conclusions were discussed. WEPCO described the actions it took immediately following the inspection and the status of many of the team's findings and concerns. Of particular interest to the NRC were the operability determinations that WEPCO made regarding diesel generator loading, seismic condition of the diesel fuel oil system, and cable separation deficiencies. 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 DEFICIENCIES

The following deficiencies are those the team identified that require additional review or action by WEPCO or NRC to fully resolve or to verify corrective action. The deficiencies have been individually numbered and are classified as unresolved or open items. The section numbers identified in each deficiency title refer to the inspection report section in which the deficiency is discussed. The associated requirements from 10 CFR Part 50 and commitments from the Final Safety Analysis Report (FSAR) are identified for each deficiency. The references to the General Design Criteria are the requirements to which WEPCO committed in its FSAR.

DEFICIENCY 90-201-01

Deficiency Title: Nonconservative Diesel Generator Steady-State Loading Calculation
(Unresolved Item - Section 3.1.1.1)

Description of Condition:

The safety-related ac electrical loads applied to the emergency diesel generators (EDGs) during the injection and recirculation phases of accident mitigation are identified and tabulated in the Final Safety Analysis Report (FSAR) Table 8.2-1, "Emergency Diesel Generator Loading Following Loss of Coolant Accident Injection Phase," and Table 8.2-2, "Emergency Diesel Generator Loading Following Loss of Coolant Accident Recirculation Phase." The team reviewed Calculation 0870-103-011, which determined the steady-state loading on each EDG (G-01 and G-02) following a loss-of-coolant accident (LOCA) in one unit and a shutdown of the other unit concurrent with the loss of offsite power. Calculation 0870-103-011, page 49A, showed that the worst-case steady-state loading scenario was the loading on EDG G-02 following a LOCA in Unit 1 and the shutdown of Unit 2. For this case the loading on EDG G-02 was calculated to be

- 0 97.8 percent of 2000-hr/yr rating, injection phase
- 0 94.1 percent of 200-hr/yr rating, injection phase
- 0 103.1 percent of 2000-hr/yr rating, recirculation phase
- 0 99.2 percent of 200-hr/yr rating, recirculation phase

The team noted that the steady-state diesel generator loading analysis performed in Calculation 0870-103-011 was based on the assumption (Assumption No. 13 g) that the containment recirculation fans for the shutdown unit to be used during an accident were not automatically or manually started and, therefore, were not running during the accident scenario. The load tabulation in the calculation indicated that the loading for containment fans 1W-001C1 and 1W-001D1 (fed from 480-Vac bus 1B04) was 124.3 kW each for the faulted unit; the loading for containment fans 2W-001C1 and 2W-001D1 (fed from 480-Vac bus 2B04) was 0.0 kW for the non-faulted unit. However, the FSAR Tables 8.2-1 and 8.2-2 require that one containment fan in the non-faulted unit (identified as a 25-kW load) be manually started in the injection phase and continue running in the recirculation phase.

The team determined that Calculation 0870-103-011 was not conservative because it assumed that a containment fan for the non-faulted unit was not operating during the injection and recirculation phases of the accident and, therefore, did not include the fan as a diesel generator load.

Plant personnel told the team that the plant emergency operating procedures for the non-faulted unit did not exclude starting a single containment fan. The team also was told that the actual current that a containment fan draws during normal continuous operation was 82 A. This value represented a 61.3-kW load. The addition of this load onto diesel generator G-02 (as committed to in the FSAR) during the recirculation phase would increase the loading from 99.2 percent to 101.27 percent based on the 200-hr/yr rating.

Requirements and Commitments:

FSAR Section 8.2.3 (page 8.2-13), "Load Evaluation, Diesel Generators," states that "each diesel generator will be sized to start and carry the engineered safety features required for an acceptable post-blowdown containment pressure transient in one reactor unit and provide sufficient power to allow the second reactor unit to be placed in a safe shutdown condition. These loads are tabulated in Table 8.2-1." Table 8.2-1 addresses the injection phase. Loads for the recirculation phase are tabulated in Table 8.2-2.

FSAR Tables 8.2-1 and Tables 8.2-2 state that one 150-hp containment fan (representing a 25-kW load) in the non-faulted unit will be operating during the injection and recirculation phases of a postulated LOCA. This load was added to the other tabulated loads and was considered continuous with respect to emergency generator loading.

Documents Reviewed

1. FSAR Section 8.2.3 (page 8.2-13), "Load Evaluation, Diesel Generators."

2. FSAR Table 8.2-1, "Emergency Diesel Generator Loading Following Loss of Coolant Accident Injection Phase."

3. FSAR Table 8.2-2, "Emergency Diesel Generator Loading Following Loss of Coolant Accident Recirculation Phase."

4. Impell Calculation 0870-103-011, "Diesel Generator Loading Analysis, WEPCO, PBNP," Revision 0, dated March 31, 1990.

DEFICIENCY 90-201-02

Deficiency Title: Lack of Transient Analysis of Diesel Generator Loading (Unresolved Item - Section 3.1.1.2)

Description of Condition:

The team reviewed Calculation OE D-103-011, which analyzed the steady-state loading on each diesel generator with the opposite train inoperable. The calculation did not include a dynamic analysis of the capacity of the diesel generator to handle starting loads and sequencing intervals. Therefore, in-rush currents, starting load (kW) under low-voltage conditions, acceleration time of large motors, loads resulting from the operation of motor-operated valves, and the allowable tolerance of load sequence timing relays were not analyzed. Since a small margin existed for the steady-state loading of the diesel generator in both the injection phase and the recirculation phase, the team considered the lack of dynamic analysis of diesel generator loading to be a significant deficiency. In response to the team's concern, WEPCO pointed out that the Diesel Generator Instruction Manual (Section 1, page 3, figure entitled "Model 999 System Dead Load Pickup Capability") indicated that the diesel generator capacity could accommodate the starting of a large load such as that of the safety injection pump motor. The team considered this response to be inadequate with respect to transient loading of the diesel generator throughout the injection and the recirculation phases.

The team also found two inconsistencies that related to the issue of transient loading of the diesel generators. The first inconsistency involved the protective relay setting for the 50/51 device (instantaneous and long time delay phase overcurrent) for safety injection pump motor 1P15A (Drawing 499B466, Sheet 222), which was based on a time-current characteristic curve prepared by WEPCO in 1982. The time-current curve assumed that the motor acceleration time was less than 5 seconds. The team found that WEPCO did not have a basis for this assumption nor were motor torque-current and torque-speed curves available. Setting of protective relays without motor-starting curves was inconsistent with WEPCO Reference Manual 14-403-1279. More importantly, motor acceleration time could affect diesel transient loading.

The second inconsistency involved diesel generator load sequencing. FSAR Section 8.2.3, page 8.2-12, "Loading Description," provided the loading sequence. The FSAR description of elapsed time for start of loads was misleading because it was based on the assumption that the diesel generator takes 10 seconds to come up to speed and load onto the bus. In Nonconformance Report N-89-348, the licensee stated that Procedure ORT-3 used for the testing of diesel generators showed that the actual time was approximately 5 seconds; therefore, the sequence times in the FSAR were 5 seconds longer than the actual time. WEPCO indicated it was planning to revise the FSAR accordingly. The diesel generator load sequence timing relays (Agastat Series 2400) had repeat accuracies of plus or minus 5 percent (Agastat Catalog page 3). WEPCO established an acceptance criterion (tolerance) for these load sequence timing relays (Procedure ORT-3, Appendix B). However, WEPCO did not have data on the tolerance and accuracy of these timing relays based on seismic testing. Since a seismic event could potentially change the accuracy and tolerance of subsequent operation of the timing relays, WEPCO had no basis for establishing the tolerance. Possible shifts in the accuracy of the load sequence timing relays could adversely affect diesel generator transient loading.

In summary, the team believed that the lack of a transient loading analysis for the diesel generators was a significant deficiency.

Requirements and Commitments:

FSAR Section 8.2.3 (page 8.2-13), "Load Evaluation, Diesel Generators," states that "each diesel generator will be sized to start and carry the engineered safety features required for an acceptable post-blowdown containment pressure transient in one reactor unit and provide sufficient power to allow the second reactor unit to be placed in a safe shutdown condition."

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.

Documents Reviewed:

1. FSAR Section 8.2.3 (page 8.2-13), "Load Evaluation, Diesel Generators."
2. FSAR Section 8.2.3 (page 8.2-12), "Loading Description."
3. Impell Calculation 0870-103-011, "Diesel Generator Loading Analysis, WEPCO, PBNP," Revision 0, March 31, 1990.
4. Diesel Generator Instruction Manual, Section 1, "General Description."
5. WEPCO Engineering and Construction Department Reference Manual 14-403-1279, "Protection of Power Plant Auxiliary Systems," December 1979.
6. Westinghouse Drawing 499B466, Sheet 222, "Elementary Wiring Diagram Safety Injection Pumps 1P15A and 1P15B," Revision 11, July 6, 1987.
7. WEPCO Time-Current Characteristic Curve, "Safety Injection Pumps, 4KV Motor Protection," June 21, 1982.
8. WEPCO Nonconformance Report N-89-348, December 7, 1989.
9. Agastat Catalog, "2400 Series Timing Relay," 1969.
10. WEPCO Review of ORT-3 Test Results, "Appendix B Acceptance Criteria Summary, Page 2," Revision 0, March 30, 1989.

DEFICIENCY 90-201-03

Deficiency Title: Incorrect Load Ratings Listed in the Emergency Operating Procedures
(Unresolved Item - Section 3.1.1.3)

Description of Condition:

The team reviewed emergency operating procedures (EOPs) and emergency contingency actions (ECAs) related to electrical equipment and emergency diesel generator (EDG) loading to determine if the operational load requirements were consistent with EDG capacity. Reference notes in the EOPs and ECAs that the team reviewed stated the EDG capacity ratings and referred the operator to an appendix table that listed the load ratings of critical equipment. The operator was instructed to refer to these lists before loading the equipment onto the EDG. In the two appendix tables reviewed by the team (Appendices to EOP-0 and ECA-0.0), the equipment load ratings were incorrect and nonconservative with respect to both the FSAR and a current EDG loading analysis performed for the licensee (Calculation 0870-103-011). The list of incorrect load ratings could result in operator actions that would overload the EDGs. An overloaded EDG could result in its failure and the loss of its ability to perform its intended safety function.

The team reviewed the incorrect ratings with WEPCO. The licensee stated that it intended to review the ratings and correct them accordingly. However, the licensee did not issue a nonconformance report during the inspection.

Requirements and Commitments:

FSAR Section 8.2.3, "Emergency Power," states that loads to be carried by an EDG are given in Tables 8.2-1 and 8.2-2. These two tables list the kilowatt load ratings of most of the equipment listed in the affected EOP appendix tables.

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

Documents Reviewed:

1. FSAR Section 8.2.3, "Emergency Power."
2. PBNP Emergency Operating Procedure 0, "Reactor Trip or Safety Injection," Revision 6, February 7, 1990.
3. PBNP Emergency Contingency Action 0.0, "Loss of All AC Power," February 7, 1990.
4. Impell Calculation 0870-103-011, "Diesel Generator Loading Analysis, WEPCO, PBNP," Revision 0, March 31, 1990.

DEFICIENCY 90-201-04

Deficiency Title: Emergency Diesel Generator (EDG) Loading as Instructed by Emergency Operating Procedures (EOPs) for a Design Basis Accident
(Unresolved Item - Section 3.1.1.3)

Description of Condition:

The team reviewed in detail EOP-0, 1, and 1.3 and Emergency Contingency Action (ECA) 0.0 with WEPCO senior operations staff. During the review, the team determined the EDG loads that would be required by the EOPs to safely mitigate the consequences of a design basis accident (DBA) concurrent with a single failure of one EDG. The team listed the loads the operator would add to the EDG in accordance with the EOPs and the timing of these loads and determined whether or not these loads were necessary to safely mitigate the consequences of the DBA. After reviewing the required EOPs, the team noted the following concerns:

- The EOPs did not coordinate the sequence of loading the EDG during an accident, and did not take into account additional loads that may be required by the nonaccident unit.

- The only instrumentation available to the operator for monitoring EDG loads was a single kilowatt meter (and related annunciator) that was calibrated once every six years. The licensee provided no basis for the calibration cycle and did not include the meter tolerance in the EDG load profile.

- The EOPs called for specific equipment to mitigate the consequences of the DBA. The team tabulated the kilowatt ratings of that equipment, the FSAR-required loads, and the loads that were not shed with a loss of offsite power and safety injection signal. The team found the EDG would exceed its 200-hour rating. The severity of this situation was further heightened since the EDG 4-hour rating was only 37 kW above the 200-hour rating. In addition, the senior operations staff felt that there were additional loads that were not considered in the FSAR EDG load profile and the EOPs may be needed. For example, control room air conditioning may be required both to ensure the operability of control instrumentation and to resolve control room habitability concerns. At the time of the team's review, control room air conditioning was not considered part of the EDG load profile. If the control room air conditioning were loaded onto the EDG with the EOP-designated loads, the EDG would exceed its 4-hour rating during the DBA. (In the case of diesel generator G-02, it would exceed its half-hour rating.)

- The team questioned what operator actions would be expected once the EDG loading capacities stated in the EOPs had been exceeded. The team was told that the operator would probably remove certain loads to reduce the EDG load level. However, the EOPs provided no guidance to the operator concerning the choice and timing of loads to be removed. Furthermore, the team could not determine which of the loads can be terminated and still provide a reasonable assurance that the consequences of the DBA could be safely mitigated.

On the basis of these and other team findings, the team had serious concerns about the EDG loading and the ability of the EDG to perform its intended safety function in a challenged, accident situation.

Requirements and Commitments:

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. Design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews.

GDC 39, "Emergency Power for Engineered Safety Features," requires, in part, that alternate power systems be provided and designed with adequate independency, redundancy, capacity, and testability to permit the functioning required of the engineered safety features. As a minimum, each onsite power system shall independently provide this capability assuming a failure of a single active component in each system. The load growth and present day plant needs as designated by EOPs and plant documents exceed the EDG capacity ratings.

Documents Reviewed:

1. PBNP Emergency Operating Procedure (EOP) 0, "Reactor Trip or Safety Injection," Revision 6, February 7, 1990.

2. PBNP EOP-1, "Loss of Reactor or Secondary Coolant," Revision 6, February 7, 1990.

3. PBNP EOP-1.3, "Transfer to Containment Sump Recirculation," Revision 6, February 7, 1990.

4. PBNP EOP-1.4, "Transfer to Containment Sump Recirculation, One Train Inoperable," Revision 1, February 7, 1990.

5. PBNP Emergency Contingency Action 0.0, "Loss of All AC Power," Revision 6, February 7, 1990.

DEFICIENCY 90-201-05

Deficiency Title: Nonconformance to Design Basis Criteria for Electrical Cable Tray Fill and Cable Ampacity Derating
(Unresolved Item - Section 3.1.3)

Description of Condition:

The ampacity of an electrical cable is the maximum current a cable can carry in a given ambient temperature without exceeding the insulation temperature rating of the cable. Ampacity derating is the method of reducing the maximum current for a cable based on known physical conditions of the cable's environment. The team reviewed the FSAR to determine the cable tray fill and ampacity derating criteria used in the plant's design. The team also randomly selected the power cable connected to safety-related motor-operated valve 1SI-0841A located inside the containment to determine the cable type, ampacity derating, routing, and associated tray fill.

Elementary Wiring Diagram 499B466 (Sheet 723), and Connection Diagrams E-99 (Sheet 1), and E-92 (Sheet 8), indicated that the power cable connected to 1SI-0841A was a train A cable, designated ZA1324FA (outside containment) and ZA1324FT (inside containment). The power cable consisted of 3-1/C No. 10 American Wire Gauge conductors rated at 600 Vac. The team reviewed the computer-generated raceway report for the subject cable and found that cable tray section FK07 (which carried cable ZA1324FA) w 39.02 percent filled. Cable tray section FK07 (power and control tray) violated the criteria of the FSAR, which stated that power and control cable trays are filled less than 30 percent and instrument trays less than 40 percent.

WEPCO indicated to the team that page 7.2-7 of the FSAR represented the correct design criteria; that is, power and control trays are filled less than 30 percent and instrument trays less than 40 percent. Derating factors used were in accordance with the National Electrical Code (NEC) or with the manufacturer's recommendation, whichever resulted in the lowest rating of cable. WEPCO also indicated that Section 8.2.2 (page 8.2-7) of the FSAR was incorrect in stating that tray fill does not exceed approximately 40 percent and that cables in trays are derated by factors recommended by the Institute of Power Cable Engineers Association (IPCEA, now ICEA). In 1985, Bechtel provided WEPCO with a summary of the original design criteria, including sizing of 4160-V and 480-V cables. The basis for ampacity ratings in the Bechtel discussion was essentially the 1965 National Electrical Code. WEPCO's current practice was to use the most recent version of the National Electrical Code for ampacity determination. WEPCO could not provide any formal guidance for sizing of cables.

For 480-V power cable applications, the team found that Bechtel's design criteria were consistent with the 1965 National Electrical Code. Bechtel used a 0.9 correction factor for cable located in a 40 °C ambient temperature and specified that cable ampacity be decreased further using a 0.7 derating factor for a maximum of 24 cables in a tray without maintained spacing. The team reviewed the computer-generate raceway report for the subject cable and found that cable tray secti rK07 (which carries cable ZA1324FA) contained 55 cables. Loading a tray with 55 power and control cables did not conform to

Bechtel's original design basis, which limits the tray loading to no more than 24 single conductor cables in order to obtain correct ampacity derating in accordance with the 1965 National Electrical Code.

In response to the team's concerns regarding nonconformances to criteria for tray fill and cable derating, WEPCO evaluated the computerized standard report on raceway during the inspection. WEPCO determined that 210 power and control cable tray sections and 15 instrumentation cable tray sections did not conform to FSAR and Bechtel electrical design criteria regarding tray fill. WEPCO then analyzed all cables contained in tray section FK07, demonstrating that these cables had adequate current-carrying capability and would not exceed their maximum operating conductor insulation temperature. However, this determination was made using ICEA Publication P-54-440 methodology for ampacities in open top cable trays, and was not consistent with the FSAR commitment to use the NEC. WEPCO stated that all remaining cable tray sections that did not conform to FSAR and Bechtel design criteria regarding tray fill would be fully analyzed.

Requirements and Commitments:

FSAR Section 7.2 (page 7.2-7), "Protection Against Multiple Disability for Protection Systems," stated in part that "power and control trays are filled less than 30 percent and instrument trays less than 40 percent. All cable is derated for (a) ambient temperature in excess of 30 degrees Centigrade and (b) number of conductors in raceways. Derating factors are used in accordance with the National Electrical Code or with manufacturer's recommendation, whichever resulted in the lowest rating of cable."

The Bechtel electrical design criterion, provided to WEPCO in 1985, states in part "All cables of 250 MCM and less are sized for installation in conduits and trays without maintained spacing. Not more than 24 single conductor cables may be installed in a tray or conduit." This criterion complies with Table 310-12 of the 1965 National Electrical Code and Note 8 of Table 310-12.

Documents Reviewed:

1. FSAR Section 7.2 (page 7.2-7), "Protection Against Multiple Disability for Protection Systems."

2. FSAR Section 8.2.2 (page 8.2-6), "Cable Trays."

3. Westinghouse Elementary Wiring Diagram 499B466, Sheet 723, "Motor Operated Valves," Revision 7, March 30, 1978.

4. Bechtel Connection Diagram E-99, Sheet 1, "Penetration 1Q26 and 1Q57," Revision 15, December 16, 1989.

5. Bechtel Connection Diagram E-92, Sheet 8, "480V Motor Control Center 1B32," Revision 3, November 16, 1987.

6. PBNP Unit 1 Raceway(s) Standard Report Generation 09:41:51, "Cables ZA1324FA and ZA1324FT, Tray FK07," March 14, 1990.

7. National Electrical Code, National Fire Protection Association (NFPA) 70, 1965; Table 310-12, "Allowable Ampacities of Insulated Copper Conductors," and Note 8, "Notes to Tables 310-12 Through 310-15."

8. Summary of original Bechtel design criteria presented to WEPCO in 1985.

9. ICEA Publication P-54-440, "ICEA-NEMA Standards Publication, Ampacities of Cables in Open-Top Cable Trays," Second Edition (NEMA Publication No. WC 51-1975).

DEFICIENCY 90-201-06

Deficiency Title: Lack of Assessment of Available Short-Circuit Current Due to High Battery Temperature
(Unresolved Item - Section 3.2.3)

Description of Condition:

The maximum short-circuit current is the sum of the current delivered by the battery, by the battery charger, and by the contribution from large motors. The available capacity of a battery is affected by its operating temperature. Therefore, a calculation of the available short-circuit current from a station battery must include the consideration of an increase in short-circuit current due to an increase in battery electrolyte temperature.

The team reviewed the safety-related 125-Vdc system, which was shown on single-line Diagram E-6. The team also reviewed Calculation N-89-025, which was performed to determine the size of the new Exide station battery (D-05) that was recently replaced under Modification Request 88-074. Battery D-05 was sized on the basis of a conservative 63 °F temperature, which represented the lowest recorded electrolyte temperature. However, discussions with WEPCO engineering personnel revealed that the battery electrolyte temperature had been recorded to be as high as 90 °F.

The team determined that the available short-circuit current from the battery, at 77 °F, would be approximately 20,000 amperes. Since the battery electrolyte temperature could be much higher than 77 °F, the team asked WEPCO whether the maximum available short-circuit current was evaluated on the basis of the worst-case electrolyte temperature. WEPCO was unable to demonstrate that an assessment of maximum available short-circuit current (from battery D-05) had been prepared as part of the battery replacement modification. WEPCO also informed the team that its preliminary assessment (based on the team's questions and WEPCO's discussions with Exide) indicated that the maximum available short-circuit current from the battery could be as high as 22,700 amperes.

The team was informed of a report (WEPCO Letter VPNPD-89-583 and Internal Memorandum NEM-90-15) that WEPCO had submitted to the NRC concerning an inadequacy in the original design of the 125-Vdc system. The original design of this system stipulated the use of circuit breakers in the distribution panels that had thermal trip elements but do not have magnetic trip elements. This included the input breaker (Westinghouse type HMA 1200 A) from the station battery to the main distribution bus, supply breakers (Westinghouse types HLA 300 A and 400 A) to distribution panels, and panel breakers (Westinghouse type HFA 70 A). These breakers were not capable of interrupting fault currents that were in excess of approximately 10 times the trip rating, and fault currents of this magnitude were considered to be possible. WEPCO informed the team that dc system circuit breakers feeding common equipment were replaced with breakers that have thermal and magnetic trip elements, thus eliminating the potential for common-mode failure.

The team concluded that WEPCO had not performed an evaluation to determine the maximum available short-circuit current (from battery D-05) due to the worst case high electrolyte temperature. The team believes that this determination should have been made as part of the battery replacement modification. The team also recognized that WEPCO planned to take corrective actions to address the breaker interrupt capacity issue, which was part of a previous NRC Region III enforcement action.

Requirements and Commitments:

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.

Documents Reviewed:

1. Bechtel Drawing E-6, Sheet 1, "Single Line Diagram 125Vdc System," Revision 16, January 16, 1989.

2. WEPCO Calculation N-89-025, "Battery D05 Sizing," Revision 1, March 23, 1990.

3. WEPCO Modification Request 88-074.

4. IEEE Standard 946, "Design of Safety Related DC Auxiliary Power Systems for Nuclear Power Generating Stations," 1985.

5. Exide Battery Instruction Manual, Control No. 1384, "Discharge Curve S-1027 for Type GN-17 to 23 Battery."

6. WEPCO Internal Memorandum NEM-90-15, "NE Safety Review Committee Meeting 89-04, DC System Design Deficiency," January 5, 1990.

7. WEPCO Letter VPNPD-89-583, "Request for Discretionary Enforcement Related to Technical Specification 15.3.0.A, Point Beach Nuclear Power Plant Units 1 and 2, Docket Nos. 50-266 and 50-301," November 10, 1989.

DEFICIENCY 90-201-07

Deficiency Title: Inadequate Seismic Evaluation for Modification to 4160-Vac Safeguards Bus Tie-Breaker (Unresolved Item - Section 3.3.1.1)

Description of Condition:

The original design provided, in each unit, a single circuit breaker that can tie the two redundant 4160-Vac safeguards busses together. In 1987, the nuclear steam supply system vendor reported under 10 CFR Part 21 a failure of the breaker's auxiliary cell switch at another plant. The report resulted in the issuance of NRC Information Notice (IN) 87-61. During its review of IN 87-61, WEPCO found that this potential for single failure existed with regard to the 4160-Vac tie-breakers at PBNP. To eliminate this potential failure mode, the licensee implemented Modifications 87-204 and 87-205 (Units 1 and 2, respectively), whereby the tie-breakers were racked out (placed in the withdrawn position) within the switchgear cubicle, and the cell switches were removed from the diesel loading sequence logic.

In developing and implementing these modifications, WEPCO had not performed any seismic evaluation and had indicated none was required, without providing justification. WEPCO change control process included Form QP 3-2.1, "Design Verification Notice," which indicated that the change would not exceed the capabilities of the equipment, and Form QP 3-2.2, "Final Design Review Guide," which indicated in three places that seismic qualification was not required. QP 3-2.2 indicated that the test switches involved in the modification were seismically qualified, but did not identify any other potential seismic interactions.

These modifications changed the configuration of the tie-breakers connecting the two redundant 4160-Vac safeguards busses in both units so that the breakers were no longer in the "operate" (connected) position, which was the configuration on which seismic qualification was based. The modified configuration was in the racked or withdrawn position within the cubicle, thus permitting the breaker to move within the cubicle. The team was concerned that no evaluation had been made of the acceptability of the new configuration with respect to seismic qualification, and that no special seismic constraints on the racked-out breaker had been considered. The team believed that the breaker could impact the switchgear structure and possibly disable safety-related components and circuits such as undervoltage relays and latching relays necessary to detect and initiate the safeguards loading sequence, as well as bus differential lockout relays. Also mounted on the hinged panel for each tie-breaker was a double-pole-double-throw (DPDT) knife switch that may be used for manual dead transfer of dc control power from the preferred dc bus to an alternate dc bus of the opposite train. Failure of the relays could disable the diesel load sequence. Failure of the knife switches could cause a loss of dc control power to the switchgear if the switch opened between poles.

WEPCO agreed that seismic qualification had not been considered. WEPCO was unable to qualify the present configuration during the inspection and, in response to the team's concern, completely removed the breakers from the cubicles. In addition, WEPCO will revise Operations Instruction OI-35 to reflect an 8-hour limit on the use of these breakers during maintenance. The team also noted that FSAR Section 8.2.3, page 8.2-13, does not reflect either the original modification or the modification made during the inspection.

The team asked WEPCO to confirm that this new configuration would not compromise any actions required by WEPCO's commitments to 10 CFR Part 50, Appendix R, since WEPCO indicated that it would be very difficult to reinstall the breaker because of an extremely tight fit requiring careful alignment. Pending this assurance and a commitment to update the FSAR, this item remains open.

Requirements and Commitments:

GDC 2, "Performance Standards," requires, in part, that systems and components essential to the prevention of accidents be designed to withstand the effects of earthquakes.

FSAR Section 7.2.1 (page 7.2-11) states the basis for seismic qualification of type DH circuit breakers used in the 4160-Vac safeguards switchgear.

WEPCO Quality Procedure QP 3-2.1, "Design Verification Notice," requires that design modifications be reviewed for their effect on analyzed or specified capabilities of any affected equipment. Quality Procedure QP 3-2.2, "Final Design Review Guide," requires an assessment of any need for seismic qualification, seismic Category II over I analysis, and failure modes and effects analysis. These procedures, as implemented for these modifications, did not identify or address these aspects of the modified breaker configuration.

Documents Reviewed:

1. NRC Information Notice 87-61, "Failure of Westinghouse W2-Type Circuit Breaker Cell Switches," December 7, 1987.
2. FSAR Section 7.2.1 (page 7.2-11), Revision 1, March 1987.
3. FSAR Section 8.2.3, p. 8.2-13, Revision 2, June 1986.
4. Modification MR-87-204 (Unit 1), "A05/A06 Bus Tie Breaker Single Failure Correction", May 26, 1988.
5. Modification MR-87-205 (Unit 2), "A05/A06 Bus Tie Breaker Single Failure Correction", October 13, 1988.
6. Quality Procedure (QP) 3-2.1, "Design Verification Notice", Revision 1.
7. QP 3-2.2, "Final Design Review Guide", Revision 0.
8. WE/Westinghouse Drawing 594F907, "1A05 4160 Volt Switchgear Unit 61 Internal Wiring Diagram," Revision 13.
9. WEPCO Night Order Book Form PBF-2015, notice that tie-breakers 1A52-61 and 2A52-72 had been removed from their cubicles, and revision of OI-35 to reflect an 8-hour limit on use of these breakers during maintenance, April 5, 1990.
10. Operations Instruction (OI) 35, "Electrical Equipment Operation."

DEFICIENCY 90-201-08

Deficiency Title: Single Failure of Safeguards 480-Vac Bus Tie-Breaker (Unresolved Item - Section 3.3.1.1)

Description of Condition:

The team identified a single failure, such as a short circuit between adjacent cables in a shared raceway, that could result in spurious closure of the 480-Vac safeguards bus tie-breaker when both safeguards busses are served by their respective diesel generators. This closure could then result in a loss of both safeguards power trains by connecting the diesel generator outputs when they are out of phase. Thus, a loss of all onsite ac power could result from a single event. The team identified at least one specific mechanism of this type by reviewing the cable routings for the circuits in question. Other problems with the cable routing that have more generic implications are separately identified in Deficiency 90-201-09.

In response to the team's finding, WEPCO evaluated two alternative corrective actions: (1) withdrawing the tie-breakers (one per unit) from the "operate" position and securing them within the compartment or (2) removing the control power fuses from the compartment control circuits. WEPCO considered the impact on the design and performed a review pursuant to 10 CFR Part 50.59 before implementing the corrective action. WEPCO's review of the second alternative (removing the control power fuses) included a failure modes and effects analysis of the remaining control circuitry in the compartment after the fuses had been removed. This analysis included postulated hot shorts and undetected ground faults of up to 500 ohms to ground (stated to be consistent with WEPCO's ground detection and management procedures). WEPCO concluded that removal of the fuses would eliminate any unacceptable effects of all credible single failures that could be postulated. It further concluded that removal of the fuses would be less disruptive of the current Appendix R scenario, which requires the manual local operation of this tie-breaker. According to WEPCO, since this scenario already assumed a loss of dc control power, removal of the fuses would not appreciably affect operator action during recovery from Appendix R events. WEPCO concluded that the other alternative (racking the breaker) would introduce an additional step for the Appendix R scenario, and would also require a seismic evaluation.

WEPCO issued a nonconformance report to remove the fuses and perform a failure modes and effects analysis and notified the operations department of the new operating condition. However, in this new configuration, breaker position would no longer be remotely monitored since control power had been removed. Consequently, the breaker could be closed manually at the switchgear, tying the busses together. This condition could remain undetected until a loss-of-offsite-power event, at which time both onsite sources would be connected and all 4160-Vac and 480-Vac power could be lost. This item remains open until WEPCO takes acceptable corrective action.

Finally, the team also noted that Modification MR 85-053 to the tie-breaker trip circuit had effectively corrected other single-failure deficiencies in the original circuit, but had not corrected this one. In that modification, WEPCO had added a redundant trip signal from the safeguards lockout relay.

Requirements and Commitments:

GDC 39, "Emergency Power for Engineered Safety Features," requires, in part, that each onsite and offsite power system shall independently provide adequate redundancy to permit the engineered safety features to function, assuming a failure of a single active component in each power system.

Documents Reviewed:

1. WE Elementary Wiring Diagram 499B466, Sheet 354, Revision 9, August 20, 1986.

2. WE Cable and Raceway Report for Elementary Wiring Diagram 499B466, Sheet 354, April 2, 1990.

3. WEPCO Nonconformance Report (unnumbered), "B03-B04 Bus Tie Breakers (1B52-16C and 2B52-40C)," April 4, 1990.

4. WE Night Order Book Form PBF-2015, notice that Unit 1 and 2 B03-B04 bus tie-breaker had 125-Vdc control power removed, April 5, 1990.

5. WEPCO Modification MR 85-053 (Unit 1), "B03-B04 Tie Breaker Trip Circuit," May 15, 1986.

DEFICIENCY 90-201-09

Deficiency Title: Incorrect Safety Classification and Nonconformance With Separation Criteria of Control Cabling for 480-Vac Bus Tie-Breakers
(Unresolved Item - Section 3.3.1.1)

Description of Condition:

In investigating the single-failure vulnerability identified in Deficiency 90-201-08, the team determined that two of the cables for the 480-Vac bus tie-breakers were incorrectly classified as not safety related and that the routing of the cables did not conform to the FSAR separation criteria. The two misclassified cables were not only functionally safety related but also connected train A 480-Vac switchgear (B03) to train B 480-Vac switchgear (B04). WEPCO's cable and raceway report indicated that the cables share common raceways for the entire route.

Appropriate corrective action taken by WEPCO for the single-failure deficiency identified in Deficiency 90-201-08 for this circuit would eliminate the immediate safety concern in regard to this finding. However, WEPCO should evaluate the extent and significance of the misclassification of cable and nonconformance with the separation criteria, particularly in light of the numerous nonconformances identified by the installation team (see Section 5.1.1 of the main report). This item remains open until WEPCO resolves this generic concern regarding cable classification, circuit separation, single failure, and integrity of the data in its cable and raceway management database.

Requirements and Commitments:

GDC 1, "Quality Standards," requires, in part, that structures, systems, and components important to safety be designed and tested to quality standards commensurate with the importance of the safety function being performed, and that quality records be maintained throughout the life of the unit.

GDC 39, "Emergency Power for Engineered Safety Features," requires, in part, that each onsite and offsite power system shall independently provide adequate redundancy to permit the functioning of the engineered safety features, assuming failure of a single active component in each power system.

FSAR Section 7.7 (page 7.7-14) states that all cables for mutually redundant safeguards systems are run in separate trays or conduits.

Documents Reviewed:

1. WEPCO Elementary Wiring Diagram 499B466, Sheet 354, Revision 9, August 20, 1986.

2. WEPCO Cable and Raceway Report for Elementary Wiring Diagram 499B466, Sheet 354, April 2, 1990.

3. WEPCO Nonconformance Report (unnumbered), "B03-B04 Bus Tie Breakers (1B52-16C and 2B52-40C)," April 4, 1990.

4. WEPCO Night Order Book Form PBF-2015, April 5, 1990, notice that Unit 1 and 2 B03-B04 bus tie-breakers had 125-Vdc control power removed.

5. WEPCO Modification MR 85-053 (Unit 1), "B03-B04 Tie Breaker Trip Circuit," May 15, 1986.

DEFICIENCY 90-201-10

Deficiency Title: Nonconformance with FSAR Separation Criteria, and Potential for Consequential Common-Mode Failure of Both Trains of the Component Cooling Water Pumps
(Unresolved Item - Section 3.3.1.2)

Description of Condition:

The team's review of elementary wiring diagrams and cable and raceway routing reports indicated that portions of 125-Vdc control wiring for train A and train B component cooling water (CCW) pumps shared the same raceway. The wiring shared vertical riser R82 connecting miscellaneous relay rack (MRR) 1C158 to the raceway systems serving main control board panel 1C03 and other destinations. This was not in conformance with the FSAR requirements for train separation and also raised a safety concern relating to conformance with General Design Criteria 39 and 41 of 10 CFR Part 50, Appendix A.

A common line-to-line (+ to -) dc short may be postulated within R82 (from a fire, for example) that could simultaneously blow fuses in the control power for CCW pump breakers in both trains. Both trains would be effected because of the presence of both polarities of dc power from both battery trains, and the presence of both safety-related and (predominantly) nonsafety-related dc control conductors within the shared vertical riser. This event would require that operators recognize that the control circuits were disabled and that the switchgear fuses were the cause; identify, locate, and isolate the fault; replace the fuses; and return the pumps to service. Since the CCW pumps provide cooling to emergency core cooling system pumps, their continued operation must be ensured.

This item is open until WEPCO takes appropriate corrective action to resolve the FSAR nonconformance and adequately resolves the concern of common mode CCW pump failure.

Requirements and Commitments:

FSAR Section 7.7 (page 7.7-14) states that all cables for mutually redundant safeguards systems are run in separate trays or conduits.

GDC 39, "Emergency Power for Engineered Safety Features," requires, in part, that the onsite electrical power systems be capable of supporting the required safety functions, assuming failure of a single active component.

GDC 41, "Engineered Safety Features Components Capability," requires, in part, that engineered safety feature systems provide their required safety functions, assuming failure of a single active component.

Documents Reviewed:

1. FSAR Section 7.7, (page 7.7-14), Revision 1, June 1986.
2. WEPCO Elementary Wiring Diagram 499B466, Sheet 317, "Component Cooling Pumps 1-P11A and 1-P11B," Revision 7, December 19, 1980.

3. WEPCO Elementary Wiring Diagram 195A778, Sheet 420, "S/D Relay 1-PC-439-X," Revision 5, July 24, 1984.

4. WEPCO Cable and Raceway Report for Cables 1J312A, 1K3116A, D1609A, ZA1B10ac, ZB1B23BC, March 29, 1990.

DEFICIENCY 90-201-11

Deficiency Title: Use of Non-Qualified Components in Safeguards Bus Breaker Control Circuits
(Open Item - Section 3.3.1.2)

Description of Condition:

A common control relay in the miscellaneous relay rack (MRR) originally provided with the nuclear steam supply system was shared by both trains of component cooling water (CCW) pumps. The relay distributed a low CCW header pressure start signal to the CCW pump breaker close circuits in both CCW and safeguards bus trains. Postulated failure of this relay or its circuits as a result of a seismic event could impair the function of both CCW trains. The CCW pumps support operation of emergency core cooling system pumps. A related finding regarding inadequate cable separation involving these circuits is presented in Deficiency 90-201-10.

WEPCO was not able to retrieve documentation establishing that the MRR circuits that support the CCW pump breaker controls are included on the Q-list or are classified as safety related, and that the rack assembly and relay circuit in question are seismically qualified. The team believed that the original design basis for the MRR did not include seismic qualification. WEPCO stated that the MRR was qualified because it was similar in structure and configuration to the adjacent safeguards relay racks (SRRs); the SRRs were qualified as a part of the original design. The team tends to agree, on the basis of experience at other older plants and familiarity with the design. However, documentation must be available to certify this assumption, and the equipment in question must be classified and maintained as safety related. An ongoing industry study by the Seismic Qualification Utility Group also may resolve this issue. Pending these actions by WEPCO, this item is open.

Requirements and Commitments:

GDC 1, "Quality Standards," requires, in part, that structures, systems, and components important to safety be designed and tested to quality standards commensurate with the importance of the safety function being performed.

GDC 2, "Performance Standards," requires, in part, that structures, systems, and components important to safety be designed to withstand the effects of earthquakes.

Documents Reviewed:

1. WEPCO Elementary Wiring Diagram 499B466, Sheet 317, "Component Cooling Pumps 1-P11A and 1-P11B," Revision 7, December 19, 1980.

2. WEPCO Elementary Wiring Diagram 195A778, Sheet 420, "S/D Relay 1-PC-439-X," Revision 5, July 24, 1984.

ALLEGED DEFICIENCY 90-201-12

Deficiency Title: Vulnerability of Switchgear Control Power to Seismic Event That Opens Manual Transfer Switches (Unresolved Item - Section 3.3.1.3)

Description of Condition:

WEPCO was unable to produce analyses demonstrating the seismic qualification of knife switches used to connect alternate dc sources for switchgear control power. The knife switches were mounted on the vertical panels of the switchgear, were normally in the up position, and were only secured by the friction forces necessary to ensure sufficient electrical contact. If the switches shook loose, all dc control power would be lost to the switchgear busses, and all automatic and remote control would be disabled for safeguards and safe-shutdown loads. This would render both automatic and remote manual load sequencing inoperable.

It appeared that this change to the design was made by the architect/engineer after the equipment was seismically qualified. WEPCO was attempting to seismically qualify the knife switches by test and analysis, and had committed to any necessary corrective action. Although successful qualification by thorough and conclusive analysis and test with adequate margin is acceptable, it may be difficult to establish a repeatable and representative range of forces that would consistently disengage the various switches.

Requirement:

GDC 2, "Performance Standards," requires, in part, that structures, systems, and components important to safety be designed to withstand the effects of earthquakes.

Documents Reviewed:

WEPCO Elementary Wiring Diagram 499B466, Sheet 219, Revision 6, July 2, 1970.

DEFICIENCY 90-201-13

Deficiency Title: Nonconforming Diesel Generator Sequence Logic (Unresolved Item - Section 3.3.1.4)

Description of Condition:

FSAR Section 8.2.3 (page 8.2-11) requires that the emergency diesel generator (EDG) output breaker close automatically after the unit comes up to speed and voltage. WEPCO Emergency Generator Starting Logic Diagram 883D195, Sheet 6, also showed that the breaker is not to be closed until the alternator output voltage is up to an acceptable level. The team noted that this was typical practice for diesel generator breaker closing logic. The team reviewed Elementary Wiring Diagrams 499B466, Sheets 1509, 1508, and 263, and EDG vendor (General Motors Electromotive Division) Drawing 8413730. The team identified a deviation from the FSAR commitment in that the alternator output voltage interlock had not been provided in the breaker close circuit, as required.

The FSAR takes credit for the breaker closing only when rated voltage is available, thereby providing the assumed initial conditions for voltage drop and dynamic analysis of the safeguards bus and distribution system during the automatic loading sequence. These conditions begin with the initially connected loads of the safety injection pump (nominal 700 hp) and the station service transformer inrush and 480-Vac loads. A static analysis of the system was not available until late in the inspection, and it was the team's understanding that no dynamic analysis had been done.

Typical practice (and consistent with the FSAR) is to ensure the generator is ready for loading by providing an interlock with a voltage-sensing protective relay connected to the generator side of the breaker. No such device exists in the PBNP design. The PBNP design assumed that the generator is ready to accept load when the engine speed is 870 rpm (synchronous speed is 900 rpm) and there is no loss of field, the safeguards bus is isolated, and no overspeed trip or generator or bus lockouts exist. Whether the generator output is at rated voltage under these conditions will depend on several unknown factors including the dynamic response of the regulator, uncertainty in the speed measurement, and the dynamics of the machine. These factors may vary with time, so there is no assurance without conclusive analysis or testing that the diesel generators would be ready to automatically accept load under worst-case conditions following an accident. If the limiting initial voltage conditions were shown to be inadequate, neither safeguards bus could automatically accept load without offsite power.

In the absence of conclusive documentation, WEPCO committed to perform a representative test during the week of April 9, 1990, and to analyze the current design in consultation with the EDG vendor. Pending successful resolution by these means, and any necessary corrective action, this item is open.

Requirements and Commitments:

FSAR Section 8.2.3 (page 8.2-11) requires that the diesel generator output breaker close automatically after the unit comes up to speed and voltage.

WEPCO Emergency Generator Starting Logic Diagram 883D195, Sheet 6, Revision 7, shows that the breaker is not to be closed until the alternator output voltage is up to an acceptable level. The team noted that this was typical practice for diesel generator breaker closing logic.

Documents Reviewed:

1. FSAR Section 8.2.3 (page 8.2-11), Revision 2, June 1986.

2. WEPCO Emergency Generator Starting Logic Diagram 883D195, Sheet 6, Revision 7.

3. WEPCO Elementary Wiring Diagram 499B466, Sheet 1509, Revision 6.

4. WEPCO Elementary Wiring Diagram 499B466, Sheet 1508, Revision 7.

5. WEPCO Elementary Wiring Diagram 499B466, Sheet 263, Revision 14.

6. General Motors Electromotive Division Drawing 8413730, Revision 12, February 16, 1990.

7. WEPCO Procedure ORT-3, "Safety Injection Actuation With Loss of Engineered Safeguards AC, Unit 1," Revision 20, August 17, 1989.

8. WEPCO Operations Refueling Test, Loss of Engineered Safeguards AC Simultaneous With Safety Injection (Unit 1), February 7, 1974.

9. WEPCO Memorandum from R. Hoyt to F. T. Rhodes, "Loss of AC Test With Safety Injection Detailed Study," April 19, 1974.

DEFICIENCY 90-201-14

Deficiency Title: Excessive DC Voltage Applied to Equipment Terminals (Unresolved Item - Section 3.5.1)

Description of Condition:

Safety-related equipment powered by dc systems should have voltage ratings that correspond to the variations in battery terminal voltage and dc system bus voltage. In recognition of this general design requirement, Institute of Electrical and Electronics Engineers (IEEE) Standard 946-1985, Section 7.3, specifically addresses this issue and recommends that equipment maximum and minimum voltage ratings govern the allowable dc system voltage. With respect to excessive dc voltage applied to equipment, NRC Information Notice 83-08 notified the industry that certain safety-related components subjected to voltages above their rated design voltage may degrade as a result of such stress mechanisms as heating and embrittlement.

The team reviewed Calculation N-89-025, which determined the size of the new station battery (D-05) that was recently replaced under Modification Request MR 88-074. Battery D-05 consisted of 59 Exide type 2GN-23 cells. The Exide Battery Instruction Manual (Section 50, page 8, Figure 10) stated that the recommended float voltage per cell was 2.17 to 2.26 Vdc. Using the methodology in Section 6.1.1 of IEEE Standard 485-1983 and the maximum cell float voltage recommended by Exide (2.26 Vdc), the team determined that the maximum allowable battery voltage should be 133.3 Vdc. The team found that the actual float voltage (based on meter readings in the control room and at the battery charger) for battery D-05 was 135 Vdc. The team also found that Section 3.6.1 of Routine Maintenance Procedure RMP-46 allowed battery float voltages exceeding 135 Vdc based on a criterion of 2.38 Vdc per cell. Battery float voltages exceeding 133.3 Vdc are not consistent with the manufacturer's recommendations and the guidance provided by IEEE Standard 485-1983.

The team was concerned that high battery float voltages would exceed equipment design ratings. The team asked WEPCO to demonstrate that dc equipment ratings (for control components such as switchgear closing coils, trip coils, anti-pump relays, and Westinghouse type BFD and MG-6 relays) were within the maximum allowable battery voltage range. In response to the team's request, WEPCO provided product data sheets for some of the dc equipment. The data sheets showed that the device rating was 140 Vdc (4160-V switchgear trip coils, Agastat diesel generator load sequence timing relays, Westinghouse HFB-type circuit breakers, and Westinghouse inverters). WEPCO stated that the technical information for the remaining dc equipment was not available. However, the team was informed that Nonconformance Report (NCR) N-88-069 had previously shown that the voltage rating for the closing coil circuit in the Westinghouse 4-kV type DHP switchgear was only 90 to 130 Vdc. Since the batteries were floated at 133 Vdc and above, the switchgear closing circuit was supplied with control voltage above its specified rating.

NCR N-88-069 recommended that the battery float voltage be reduced after addition of a swing battery. The team noted that Internal Non-Routine Request for Services NRR-139 identified this concern pertaining to high float voltage and requested an evaluation of dc equipment ratings based on IE Information

Notice 83-08. However, the licensee did not perform a further engineering evaluation of other dc equipment because a third battery was purchased, and in Internal Correspondence PBM 89-0810 cancelled the evaluation.

Requirements and Commitments:

10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that measures be established to ensure that applicable bases 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 ensure that conditions adverse to quality, such as nonconformances, are promptly identified and corrected.

Documents Reviewed:

1. IEEE Standard 946, "Design of Safety Related DC Auxiliary Power Systems for Nuclear Power Generating Stations," 1985.

2. NRC IE Information Notice 83-08, "Component Failures Caused by Elevated DC Control Voltage," March 9, 1983.

3. Bechtel Drawing E-6, Sheet 1, "Single Line Diagram 125Vdc System," Revision 16, January 16, 1989.

4. WEPCO Calculation N-89-025, "Battery D05 Sizing," Revision 1, March 23, 1990.

5. IEEE Standard 485, "Sizing Large Lead Storage Batteries for Generating Stations and Substations," 1983.

6. Exide Battery Instruction Manual, Control No. 1384, Section 50, page 8, Figure 10, "Float Voltage per Cell."

7. IEEE Standard 450, "Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations," 1987.

8. WEPCO PBNP Routine Maintenance Procedure (RMP) 46, "Station Battery," Revision 5, October 25, 1989.

9. WEPCO Nonconformance Report N-88-069, "4160V Switchgear, 125Vdc Batteries," May 3, 1988.

10. WEPCO Internal Non-Routine Request for Services (NRR) 139, "Non-Routine Request for Services, 125Vdc System," March 3, 1989.

11. WEPCO Internal Correspondence PBM 89-0810, "NRR-139 Cancellation," August 11, 1989.

DEFICIENCY 90-201-15

Deficiency Title: Incomplete Fuel Oil System Seismic Category I Classification (Unresolved Item - Section 4.1.1)

Description of Condition:

The Technical Specifications and basis for availability of the emergency diesel generators (EDGs) require that 11,000 gallons of fuel oil be available. WEPCO committed during licensing that this amount would be available in a seismic Category I structure, the emergency storage tank. However, the fuel oil transfer system that transports the fuel oil from the emergency storage tank to the EDGs was only partially qualified as seismic Category I. WEPCO was in the process of analyzing the piping located in the fuel oil pumphouse. The preliminary results indicated that the piping stresses were above the allowable values specified in the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). WEPCO was planning to modify the system supports. No calculations were available for the team's review.

According to WEPCO the piping in the EDG rooms was installed using the methods for installing seismic small-bore piping specified in the architect/engineer handbook. WEPCO did not have any calculations to support the seismic adequacy of this piping. Therefore, the team's preliminary conclusion was that the functionality of the system could not be determined. Immediately following the inspection, WEPCO performed a detailed review of the seismic capabilities of the fuel oil system. As a result of that review, WEPCO determined the system was inoperable and modified the system supports before declaring the system operable.

Requirements and Commitments:

Point Beach Technical Specification 15.3.7 A.1.c requires that 11,000 gallons of fuel oil be available.

GDC 2, "Performance Standards," requires, in part, that systems and components essential to the prevention or mitigation of accidents be capable of withstanding the forces of earthquakes.

Documents Reviewed:

Preliminary Facility Description and Safety Analysis Report, Docket No. 50-301, January 11, 1968.

DEFICIENCY 90-201-16

Deficiency Title: Fuel Oil Cloud Point Substantially Higher Than Required (Unresolved Item - Section 4.1.2)

Description of Condition:

In a letter to the NRC dated March 24, 1980, WEPCO addressed the quality assurance requirements for the emergency diesel generator fuel oil system: "Fuel oil is purchased under the agreement which includes specific requirements for the fuel oil properties. These requirements are generally consistent with those specified in ANSI/ASTM American National Standards Institute/American Society for Testing and Materials Standard D975-78. (Regulatory Guide 1.137 endorses this standard.)" According to Regulatory Guide 1.137, the cloud point should be less than or equal to the minimum temperature at which the fuel oil will be maintained during the time it will be stored. For the winter months, this would be even more restrictive than the ANSI/ASTM D975 requirement for cloud point, which is 6 °C above the specified tenth percentile minimum ambient temperature.

The team reviewed the laboratory reports of the fuel oil test samples for the last few years and found that these reports did not always report the cloud point. Moreover, when the cloud point was reported, it was always higher by 12 to 22 °F than the maximum (-7 °F) recommended by ANSI/ASTM D975. In some instances, WEPCO had noted the high cloud point temperature in its files, but took no action. The high cloud point temperature was inconsistent with WEPCO's commitment as stated above. Nonconformance reports were not filed for these instances as required and safety evaluations were not performed.

WEPCO had addressed NRC Information Notice (IN) 87-04, "Diesel Generator Fails Test Because of Degraded Fuel." In a memorandum to files it stated, "PBNP fuel oil samples generally meet this standard [ANSI/ASTM D975-78] except for cloud point. This is due to the specification for oil procured by the company and has no real effect on the quality of the fuel oil." The team did not agree with this assessment for the following reasons:

- The fuel oil cloud point is significant because it is the temperature at which the fuel becomes cloudy as a result of the formation of wax crystals. This is accompanied by an increase in viscosity and, therefore, friction, as well as an increased likelihood that strainers, valves, and pipes would be clogged. It was the team's assessment that under extreme cold weather conditions, such as -10 to -15 °F, the "pour" point (temperature at which the fuel no longer flows) of the fuel oil might be reached. In this case, the flow would stop completely.

- Considering that both fuel oil storage tanks, and a good portion of the 6-inch piping attached to them, are above ground and exposed to the elements, the high cloud point could impair the following processes and scenarios:

- WEPCO's procedures pertaining to draining fuel oil by gravity to meet the requirements of 10 CFR Part 50, Appendix R, may not be satisfied because of the inability of an extremely viscous fuel oil to drain to the emergency diesel generator day tanks.

- Replenishing of the fuel oil in the emergency tank via gravity from the storage tanks under normal circumstances may not be feasible.

- The fuel oil transfer pumps of the gas turbine may not be able to pump the required flow to the gas turbine, or may stop completely. This turbine would be required to operate under station blackout conditions.

WEPCO stated that it had experienced some cold weather problems and that it was looking into ordering a fuel oil that would have a lower cloud point and would be compatible with all needs of the plant.

Finally, the team reviewed Instruction PBNP 4.12.22, "Fuel Oil Ordering, Receipt & Sample Disposition Instruction." By this instruction, WEPCO required, for emergency situations only, delivery of No. 1 grade fuel oil during the months of October through March. However, the existing agreement with the supplier was for No. 2 grade fuel oil only.

Requirements and Commitments:

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

ANSI/ASTM D975-78, "Standard Specification for Diesel Fuel Oils," which specifies fuel oil cloud points based on average ambient temperatures.

Documents Reviewed

1. WEPCO Letter from C. W. Fay to H. R. Denton, "Docket Nos. 50-266 and 50-301, QA Requirements for Diesel Generator Fuel Oil Point Beach Nuclear Plants Units 1 and 2," March 24, 1980.

2. NRC IE Information Notice 87-04, "Diesel Generator Fails Test Because of Degraded Fuel," January 16, 1987.

3. WEPCO Instruction PBNP 4.12.22, "Fuel Oil Ordering, Receipt & Sample Disposition Instruction," NNSR, Revision 13, October 30, 1989.

4. NRC Regulatory Guide 1.137, "Fuel-Oil Systems for Standby Diesel Generators," Revision 1, October 1979.

5. WEPCO Fuel Oil Purchase Order C-46320.

6. ANSI/ASTM D975-78, "Standard Specification for Diesel Fuel Oils."

DEFICIENCY 90-201-17

Deficiency Title: No Procedure to Control Upgrade of Fuel Oil System to Safety-Related Status
(Unresolved Item - Section 4.1.3)

Description of Condition:

WEPCO addressed several issues in its response to NRC Information Notice 89-50, "Inadequate Emergency Diesel Generator Fuel Supply," dated May 30, 1989. Those issues included the lack of a design basis for the fuel oil storage capacity and inconsistencies between the Technical Specifications and the FSAR. WEPCO determined that the following three issues had to be addressed:

- determination of the design basis for fuel oil capacity
- reconciliation against the available storage capacity
- revision of Technical Specifications and FSAR, based on the above findings

The Technical Specification basis indicated that the total onsite availability was a 10-day supply, but the FSAR indicated that it was only a 132-hour (5.5-day) supply. The team noted that the Atomic Energy Commission's safety evaluation report (SER) for the operating license of Point Beach Nuclear Plant states, "Onsite fuel storage capacity is sufficient for a minimum of seven days' operation of the required safety feature loads which is acceptable." The only common denominator for the Technical Specification basis, the FSAR commitments, and the SER acceptance was the availability of fuel in the non-seismically designed outdoor bulk fuel tanks.

The team determined that the fuel oil transfer system was originally classified as nonsafety-related. WEPCO provided the team with Point Beach Action Request (PBAR) 89-013, dated August 24, 1989, which initiated an evaluation of the fuel oil system for upgrading it to safety-related status. This PBAR evaluation would address, among other things, the above three issues. The PBAR replaced a previous Non-Routine Request (NRR) for Services No. 137, dated June 30, 1988, on the same subject. NRR-137 was written to address a concern resulting from a previous internal audit. The team observed that the PBAR was written more than a year after NRR-137 was issued.

WEPCO did not have a procedure for upgrading a nonsafety-related system to a safety-related system. The team's discussions with WEPCO indicated that the evaluation would involve a review of the present system configuration against criteria established in NUREG-0800. Differences between the PBNP system and NUREG-0800 criteria would be identified as a result of this review and recommendations for upgrading the system would be presented to the managers' supervisory staff for discussion and concurrence. WEPCO's scheduled the evaluation and the presentation for July 31, 1990.

WEPCO planned to use an approach for upgrading the fuel oil transfer system to safety-related status that was similar to the one used to upgrade the spent fuel pool. The team did not review the approach used to upgrade the spent fuel pool cooling system. However, as part of the future upgrading of the fuel oil system, WEPCO had formulated an inservice testing (IST) program. The first functional test of the fuel oil transfer system, WMTP 11.54, was performed in

February 1989 in response to Nonconformance Report (NCR) N-88-162. This NCR addressed deficiencies in the original functional test, K-11.0, performed more than 20 years ago in 1969. These deficiencies related to both the flow rate through the system and the automatic control functions of level transmitter LT-3932. The first quarterly test, IT-14, of the fuel oil transfer pumps and valves was conducted on March 27, 1990, during the team's inspection. Inlet pressure and flow instrumentation had not been installed. As such, IT-14 did not meet ASME Code Section XI requirements.

Finally, the team observed that since the fuel oil transfer system did not consist in its entirety of two independent redundant systems, WEPCO would have to address single-failure vulnerabilities during the upgrade.

Requirement:

10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," requires, in part, that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings of a type appropriate to the circumstances.

Documents Reviewed:

1. NRC Information Notice 89-50, "Inadequate Emergency Diesel Generator Fuel Supply," May 30, 1989.

2. NRC, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 9.5.4 "Emergency Diesel Engine Fuel Oil Storage and Transfer System," Revision 2, July 1981.

3. Safety Evaluation by the Division of Reactor Licensing, U.S. Atomic Energy Commission, in the Matter of Wisconsin Electric Power Company and Wisconsin Michigan Power Company, Point Beach Nuclear Plant Unit Nos. 1 and 2, Docket Nos. 50-266 and 50-301, July 15, 1970.

4. WEPCO Internal Correspondence from J. Z. LaPlante to J. J. Zach, June 21, 1989.

5. WEPCO Internal Correspondence from J. J. Zach to E. J. Lipke, "Non-Routine Request for Services 137," June 30, 1988.

6. WEPCO Internal Correspondence from V. E. Treague to J. C. Reisenbuechler, "Diesel Fuel Oil System - IST Program Review," December 12, 1989.

7. WEPCO Point Beach Action Request PBAR 89-013, "Evaluate Fuel Oil System for Upgrade to Safety-Related Status. Present Evaluation Results to MSS," August 24, 1989.

8. WEPCO Letter NEPB-87-29, from J. Z. LaPlante to J. J. Zach, "Evaluation of the Spent Fuel Pool Cooling System for Upgrading to Safety-Related Status," April 21, 1987.

9. WEPCO PBNP In-Service Test IT-14, "In-Service Test of Fuel Oil Pumps and Valves," Revision 0, March 27, 1990.

10. WEPCO Test Procedure K-11.0, "Fuel Oil Transfer System Functional Test," 1969.

11. WEPCO Work Maintenance Temporary Procedure (WMTP) 11.54, "Functional Test of Fuel Oil Transfer System," February 1989.

12. ASME Code Section XI, 1977/Summer 1979 Edition.

13. WEPCO Nonconformance Report N-88-162, "Fuel Oil Transfer System; P70A&B, MOV 3930."

14. PBNP Technical Specification, Section 15.3.7.A1.C.

DEFICIENCY 90-201-18

Deficiency Title: Undocumented Upgrade of Fuel Oil System to Quality Assurance (QA) Status
(Unresolved Item - Section 4.1.3)

Description of Condition:

Several modification packages for the fuel oil system had not been classified as QA. WEPCO stated that before about 1985, the only part of the fuel oil system that was classified as QA was the emergency diesel generator (EDG) day tanks and the associated piping connected to the EDGs. The classification of the modifications was consistent with the classification of this part of the fuel oil system.

WEPCO told the team that since about 1985, Revision 0 of the QA Policy Manual, which contained the "green line" diagrams of QA systems, identified the fuel oil system all the way back to the emergency fuel oil tank as falling within the QA scope. The team requested the documentation of the upgrade and was told that before QA Procedure QP 2-1, dated November 12, 1987, was promulgated no formal process existed for upgrading the QA status of a system.

As a means of checking the QA status of the fuel oil system, the team requested the documentation of the above modifications as well as WEPCO's assessment of the QA status of these modifications. Modification 704 was implemented in 1980 and was classified as non-QA. This modification rerouted underground fuel oil piping between the emergency storage tank and the day tanks. Bechtel, the plant's original architect/engineering company, evaluated the rerouting and found it acceptable. Bechtel's acceptance of the modification was documented in a July 28, 1980, memorandum. (However, the criteria for acceptability were not defined in the memorandum.) The team did find some evidence that piping and fittings were procured as QA-scope material. The documentation also referred to ANSI B31.1. Specification PB-98 was written for controlling the installation work. However, WEPCO was unable to produce any other quality assurance records for the installation.

Modification 82-51 was initiated and classified as non-QA in 1982. It again rerouted the underground piping that had been changed by Modification 704. Reference was made to Specification PB-98. Materials used were those left over from the previous modification as well as some supplied by the installation contractor. WEPCO again was unable to produce installation documentation for the modification.

Modification 83-150 was initiated and classified as QA in 1983 and involved the bypassing of the fuel oil transfer pumps. The work was done to address control room inaccessibility concerns as well as a fire in the fuel oil pumphouse, which could potentially incapacitate both pumps. Installation was performed by the site maintenance organization. The modification file did not include any material or installation documentation.

The team concluded that WEPCO did not have the documentation to support the upgrade of the system to QA-status.

Requirement:

10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," requires, in part, that activities affecting quality be prescribed by documented instructions or procedures.

Documents Reviewed:

1. WEPCO Procedure QP 2-1, "Upgrading of Non-QA Scope Systems or Components to QA-Scope Status," Revision 0, November 12, 1987.

2. WEPCO Letter from D. H. Clark to D. K. Porter, "Emergency Diesel Fuel Oil Line," July 28, 1980.

3. ANSI B31.1.0-1967, "USA Standard Code for Pressure Piping."

4. WEPCO Modification 704, "Reroute Fuel Oil Underground Piping HB-22."

5. WEPCO Modification 82-51, "Reroute Fuel Oil Line for Gatehouse."

6. WEPCO Modification 83-150, "Bypass Emergency Fuel Tank." (Note: The title was incorrect. The modification bypassed the fuel oil transfer pumps.)

DEFICIENCY 90-201-19

Deficiency Title: Procedure PBNP 4.12.22, Revision 13, Deficient for Delivering Fuel Oil Under Emergency Conditions (Unresolved Item - Section 4.1.4)

Description of Condition:

The Technical Specifications requirement for fuel oil inventory beyond the emergency diesel generator (EDG) day tanks and base (or sump) tanks was 11,000 gallons. The Technical Specifications basis showed that this amount provides for 48 hours of operation for one EDG only. This amount would provide for about 20 hours of operation for both EDGs and a supply of oil for the heating boilers.

Fuel oil delivery to the site under normal and emergency conditions was governed by Procedure PBNP 4.12.22, "Fuel Oil Ordering, Receipt & Sample Disposition Instruction," Revision 13, dated October 30, 1989. The team found several deficiencies in the procedure with regard to the ordering and delivery of fuel oil under emergency conditions:

- To supply the required quantity of fuel oil (equivalent to a 7-day consumption by EDGs), approximately 10 trucks will be required during a 7-day period with staggered delivery and operations to be accomplished within 1 to 2 hours. The latter is the time that it takes to empty the day tank and portion of the base tank, which may be at their half-full points.

- The delivery contract was with only one supplier. It obligated the supplier to provide 125,000 gallons of No. 2 grade fuel oil during a 1-year period. It was not clear to the team whether the quantity required for a 7-day delivery was available at the supplier's premises at all times. Such dependence was very restrictive and raised the potential for inability to respond in an emergency.

- The truck must be dispatched with a barreling nozzle and 150 feet of companion hose. If this hose and nozzle were unavailable or damaged during manipulations, fuel delivery could not be completed.

- It may not be possible to slip the barreling nozzle and companion hose through the bottom ventilation louver; this may create a fire hazard.

- No provision existed in the contract with the supplier for delivering the procedure required No. 1 grade fuel oil during the months of October through March.

Requirement:

PBNP Technical Specifications, Section 15.3.7, requires that a fuel supply of 11,000 gallons be available. The basis for Section 15.3.7 indicates that the source of these 11,000 gallons is the emergency fuel tank.

Document Reviewed:

WEPCO Procedure PBNP 4.12.22, "Fuel Oil Ordering, Receipt & Sample Disposition Instruction," Revision 13, October 30, 1989.

ALLEGED DEFICIENCY 90-201-20

Deficiency Title: Feasibility of Appendix R Scenario Inadequately Investigated by the Licensee
(Unresolved Item - Section 4.1.4)

Description of Condition:

WEPCO performed Calculation N-88-036 to determine the ability to drain fuel oil from the outside storage tanks to the emergency diesel generator (EDG) day tanks. This calculation addressed a modified (Modification 83-150) piping configuration that bypassed the fuel oil transfer pumps. Modification 83-150 was implemented to compensate for the potential loss of the control room or loss of both fuel transfer pumps because of fire. The team concluded that this calculation did not address the most limiting conditions and may not be conservative. The team had the following concerns:

- The calculation used a single density and viscosity for the whole system. The viscosity and density of fuel would vary significantly in the piping because part of the system was exposed to atmospheric conditions, a substantial part was buried under ground, one section was located above the frost line, and a part was in the pumphouse.

- The calculation considered flow to only one EDG day tank and no flow to the other EDG day tank or diesel-driven fire pump day tank.

- Under very low temperatures (-15 °F) the fuel would not drain because of the high cloud point of the fuel oil in the storage tanks and the above-ground piping. Moreover, the calculation showed that the minimum average temperature at which fuel could drain to one EDG day tank was only 0 °F.

- The team could not adequately review the geometry of the system because isometric drawings for the fuel oil transfer system were not available. In addition, a design calculation for the normal flow of the system did not exist.

- The gravity drain process could not provide fuel oil to the heating boiler day tanks. Although WEPCO indicated to the team that under certain conditions the heater boilers may be required, it had not evaluated the significance of the boilers being unavailable.

WEPCO performed a test, Work Maintenance Temporary Procedure (WMTP) 9.23, to verify that the outside storage tanks could drain into the EDG day tanks. The test, which ran for about 15 minutes in warm weather, indicated that sufficient drainage by gravity could be established and could potentially provide adequate fuel oil to both EDGs. However, the test did not demonstrate flow under conditions of extremely cold weather. WEPCO then used the flows that were inferred from WMTP 9.23 in Calculation N-88-036 to adjust the pressure drop through the system so that the analysis matched the test results. The adjusted value of pressure drop through the fuel oil transfer system was one-fourth the originally calculated value. However, the team was unable to verify the calculation and basis for the pressure-drop adjustments. Considering the magnitude of the adjustment, the team recommended that the licensee review N-88-036 for accuracy.

Moreover, there were three calculations that addressed the same topic. These calculations were 5.12.1 dated September 13, 1983, 85-009 dated July 18, 1985, and N-88-036 dated June 21, 1988. There was no indication that the first two had been superseded by the last.

The team had additional concerns about the gravity drain process regarding the feasibility of realigning the system for gravity drain within 2 to 3 hours before the EDGs are starved of fuel.

- O System alignment required the manual opening of the emergency fuel oil tank fill valve CV-3923 and manual line up of the cross-connect valves F074, F075, F076 and F077 in the fuel oil transfer pump room. Following a fire in the fuel oil pumphouse, access to the valves would require use of a portable pump, which was stored at elevation 26 feet in the turbine building. The location and use of the pump were not documented in the associated procedures.

- O The gravity drain process would require continuity of the fuel oil; that is a siphon effect needs to be established. Establishing the siphon would require, among other things, that the emergency storage tank first be filled up completely. This in turn would require that the emergency storage tank be leak tight, a condition not normally required for the tank.

Requirement:

10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that measures be established for the selection and review for suitability of processes that are essential to the safety-related functions of systems and components.

Documents Reviewed:

1. WEPCO Calculation N-88-036, "Diesel Generator Day Tank Gravity Fill," June 21, 1988.

2. WEPCO Calculation 85-009, "Gravity Flow and Seismic Support Fuel Oil Transfer Piping," Revision 0, July 18, 1985.

3. WEPCO Calculation File No. 5.12.1, September 13, 1983.

4. WEPCO Procedure AOP-10A, "Control Room Inaccessibility," Revision 9, August 17, 1989.

5. WEPCO Work Maintenance Temporary Procedure 9.23, "Diesel Generator Day Tank Fill by Gravity, Modification Request 83-150," August 17, 1989.

6. WEPCO Drawing Change Notice for M-219, March 28, 1990.

ALLEGED DEFICIENCY 90-201-21

Deficiency Title: Nonconservative Calculation for Emergency Diesel Generator Room Temperature
(Unresolved Item - Section 4.3.2)

Description of Condition:

The team reviewed WEPCO's evaluation of NRC Information Notice 87-09, "Emergency Diesel Generator (EDG) Room Cooling Design Deficiency." In the evaluation, which was documented in Letter NEPB-87-536, dated June 29, 1987, WEPCO identified several deficiencies with the installation at Point Beach and made six recommendations. The evaluation showed that the maximum temperature of 122 °F permitted in the EDG room would be exceeded by 6 degrees, but WEPCO considered this deviation acceptable. However, a subsequent internal audit by WEPCO showed that this higher temperature was unacceptable, since it could degrade the performance of the diesel generators.

WEPCO performed Work Maintenance Temporary Procedure (WMTP) 9.22 on May 25, 1988, to more accurately define some parameters in the original room temperature calculations: EDG heat radiation rates and flow rates for air exhausted from the rooms under various conditions. WEPCO performed Calculation N-88-034, "EDG Room Ventilation Test Evaluation," and using the results of WMTP 9.22, derived heat losses for the diesel generators under various conditions. WEPCO then used the minimum diesel generator heat losses determined by Calculation N-88-034 and calculated the maximum room temperature in Calculation N-88-040. The maximum calculated temperature was 118 °F, which was only 4 degrees below the diesel manufacturer's recommended maximum temperature of 122 °F.

The team noted that the room conditions - only one fan operating - assumed in Calculation N-88-040 was not a condition considered in Calculation N-88-034. The minimum diesel generator losses chosen by WEPCO to reflect the low diesel generator (radiation) losses at high room temperatures, were approximately one-third the losses recommended by the diesel manufacturer. Because of lack of time, the team was unable to verify the justification for WEPCO's choice of minimum diesel generator losses. However, the team noted that this choice was not conservative and resulted in a lower ambient temperature for the diesel generato. room. Because the loading of the diesel generators was marginal and because operating the diesel generators in an ambient temperature that was above the recommended maximum could reduce the diesel generators' capacity, this item remains open pending further review by the NRC.

Requirement:

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

Documents Reviewed:

1. WEPCO Letter NEPB-87-536, June 29, 1987.
2. Work Maintenance Temporary Procedure 9.22, "Emergency Diesel Generator Room Ventilation Test," Revision 0, May 25, 1988.

3. WEPCO Calculation N-88-034, "EDG Room Ventilation Test Evaluation," June 10, 1988.

4. WEPCO Calculation N-88-040, "Diesel Generator Room Ventilation," July 7, 1988.

DEFICIENCY 90-201-22

Deficiency Title: Inadequate Physical Independence of Redundant Class 1E Cables
(Unresolved Item - Section 5.1.1)

Description of Condition:

During its review of electrical distribution system cable installations, the team determined that numerous Class 1E cables had been routed in violation of PBNP licensing requirements. Sections 7.2 and 8.2 of the FSAR prohibit the routing of redundant Class 1E cable in a common raceway. The technical basis for this restriction is given in GDC 20 and 23 of 10 CFR Part 50, Appendix A. These criteria limit the potential for a single failure to compromise reliable operation of both divisions of vital system cabling.

Contrary to this requirement, a physical examination of cable installations and subsequent review of the PBNP cable database disclosed approximately 25 raceways that contained Class 1E cables of redundant engineered safety features and reactor protection system divisions. These deficiencies represented a direct violation of PBNP licensing requirements and may impair safe and reliable operation of vital plant systems.

Requirements and Commitments:

GDC 20, "Protection Systems Redundancy and Independence," requires, in part, that redundancy and independence designed into protection systems shall be sufficient to ensure that no single failure or removal from service of any component or channel of a system will result in loss of the protective function.

GDC 23, "Protection Against Multiple Disability for Protection Systems," requires, in part, that the effects of adverse conditions to which redundant channels or protection systems might be exposed in common, either under normal conditions or those of an accident, shall not result in loss of the protective function or shall be acceptable on some other basis.

Documents Reviewed:

1. FSAR Section 7.2, "Protective Systems."

2. FSAR Section 8.2.3, "Station Emergency Power."

DEFICIENCY 90-201-23

Deficiency Title: Potential Common-Mode Failure of Turbine-Driven Auxiliary Feedwater Pump Automatic Start Circuitry (Unresolved Item - Section 5.1.1)

Description of Condition:

The team's review of Elementary Diagram 499B466, Sheet 1532, indicated that cables ZC2NA012D and ZD2NA012B perform redundant functions associated with the automatic start circuit for the Unit 2 turbine-driven auxiliary feedwater pump. This circuit senses an undervoltage condition on 4160-Vac busses 2-A01 and 2-A02 through relays 2-272X1 and 2-272X2, respectively. An Agastat time-delay relay then initiates an automatic start signal to steam supply valves 2-2019 and 2-2020. The cables in question were routed through a common conduit. Thus, a single failure of any cable within the conduit could affect redundant control functions and defeat the undervoltage automatic start signal for the auxiliary feedwater pump.

As a result of this finding, WEPCO issued Nonconformance Report N-90-058 to document and correct the condition noted. Additionally, Unit 2 was placed in a Technical Specifications limiting condition for operation status pending resolution of this deficiency.

Requirements and Commitments:

GDC 20, "Protection Systems Redundancy and Independence," requires, in part, that redundancy and independence designed into protection systems shall be sufficient to ensure that no single failure or removal from service of any component or channel of a system will result in loss of the protective function.

GDC 23, "Protection Against Multiple Disability for Protection Systems," requires, in part, that the effects of adverse conditions to which redundant channels or protection systems might be exposed in common, either under normal conditions or those of an accident, shall not result in loss of the protective function or shall be acceptable on some other basis.

Documents reviewed:

1. FSAR Section 8.2.3, "Station Emergency Power."

2. FSAR Section 7.2, "Protective Systems."

DEFICIENCY 90-201-24

Deficiency Title: Venting Steam on Safety-Related Cables
(Unresolved Item - Section 5.1.2)

Description of Condition:

The team observed that a condensate receiver tank vent was venting steam onto safety-related cable trays JE06, JE07, FV12, and FV13. The team inspected the cables in the affected trays and noted that the jackets of a number of single conductor cables showed signs of deterioration and, in one case, the jacket had peeled back exposing the inner insulation. Other cables in the trays were discolored. The team questioned WEPCO and found that WEPCO was aware of the venting steam and that the condition had existed for many years. However, WEPCO had not investigated the effect of the steam on the safety-related cables. After further investigation, the team determined that the venting steam was the result of an earlier modification. The modification had configured this section of the condensate system so that higher pressure condensate and steam were feeding into a low-pressure header. The configuration resulted in a higher than normal pressure in the receiver tank and an abnormal amount of steam venting below the safety-related cables.

A deterioration of safety-related cables could result in cable faults and could prevent the end devices connected to the affected cables from performing their intended safety functions.

As a result of this finding, WEPCO inspected the cables and determined that the most severely damaged cables were connected to nonsafety-related loads. WEPCO also stated that the remaining cables were safety related and were within one train. WEPCO issued Nonconformance Report 90-056 to evaluate the cables and determine what action was necessary. In the interim, WEPCO intended to wrap the affected cables in an effort to compensate for insulation damage and to minimize any further effects from the steam. After further discussion with WEPCO, the team noted that a modification package was being developed to correct an overpressurization problem of the same condensate system. The modification could correct the venting-steam condition.

Requirements and Commitments:

WEPCO Quality Assurance Manual, Chapter 19-1, Revision 0, "Environmental Qualification of Electrical Equipment," requires that any modification request that involves the installation or relocation of equipment that could potentially change area temperature, pressure, or radiation exposure must be evaluated for the effect on the qualified status of existing environmentally qualified equipment.

WEPCO Quality Procedures Manual, Chapter 15.1.5, "Guidance for the Issuance of Nonconformance Reports (NCRs)," requires that an NCR be written when a nonconforming condition is discovered during performance of work. Section 15.1.5 gives examples of some nonconforming conditions: incorrect use of an item, incorrect installation, inadequate design, and faulty maintenance. Furthermore, Section 15.1.5 requires that an NCR be initiated when the assignment of quality assurance scope, EQ applicability, safety-related status, or similar scoping is improper or in question.

10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," requires that measures be established to ensure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances, are promptly identified and corrected.

Document Reviewed:

WEPCO Nonconformance Report 90-056, March 30, 1990.

DEFICIENCY 90-201-25

Deficiency Title: Inadequate Program for Calibration of Protective Relays (Unresolved Item - Section 5.2.2)

Description of Condition:

The team found that all protective (i.e., undervoltage, differential, and overcurrent) relays at Point Beach were periodically calibrated by a WEPCO relay group from an office in Appleton, Wisconsin.

This group was not part of the Nuclear Engineering Department or of the site staff and, therefore, was not subject to typical nuclear quality assurance (QA) requirements. As a result, the team determined that PBNP's safety-related protective relays were being calibrated by a group that was not under WEPCO's approved QA program. The following specific deficiencies were identified with respect to the calibration work.

- No specific work procedures existed for performing the calibrations. The relays were purportedly calibrated in accordance with instructions contained in the manufacturer's manuals or leaflets.

- The setpoint document that contains the settings for all protective relays did not include tolerance bands. As a result, it was unclear how much deviation from the setpoints is acceptable before recalibration is required. WEPCO told the team that relays were reset if they were out of tolerance by more than 3 percent; however, this number was not documented in any procedure nor had an evaluation been performed to ensure its acceptability.

- No program or procedures existed for trending or evaluating settings that were found to be out of calibration. The establishment of proper calibration intervals requires the trending and evaluation of these data.

- No program existed for evaluating previously calibrated relays when the test equipment used to perform the calibrations was found to be out of calibration.

- Relays apparently had been repaired with parts procured by the relay group in Appleton. This work was not performed in accordance with work procedures that apply at the nuclear plant. In addition, the parts were not purchased to nuclear requirements and were not subjected to a commercial-grade dedication program.

Requirements and Commitments:

10 CFR Part 50, Appendix B, Criterion IV, "Procurement Document Control," requires, in part, that measures be established for ensuring that appropriate design and regulatory requirements are included in procurement documents.

10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," requires, in part, that activities affecting quality be prescribed by documented instructions and procedures.

10 CFR Part 50, Appendix B, Criterion XI, "Test Control," requires, in part, a test program that includes written test procedures that include acceptance criteria.

Document Reviewed:

Wisconsin Electric Point Beach Setpoint Document, Section 21.0.

DEFICIENCY 90-201-26

Deficiency Title: Inadequate Surveillance Procedure for Elgar Inverters (Unresolved Item - Section 5.2.3)

Description of Condition:

During its review of Routine Maintenance Procedure (RMP) 45 for the Elgar inverters, the team found the procedure did not include a check of the setting of the inverter's low-voltage shutdown circuit. This circuit shuts off the invertor when the dc input falls to some predetermined value. The circuit is adjustable and if improperly set could disconnect essential safety-related loads before the times assumed in the plant's design basis. To function properly, the circuit must not actuate until the battery cutout voltage reaches the value assumed in the battery design calculations. Additional voltage drops for cable losses and setting tolerances also need to be considered and factored into the setpoint.

WEPCO was unable to confirm the exact setting of this circuit or that it had been tested since it was originally installed. Discrepancies in the setting of this circuit had been addressed by Southern California Edison in Licensee Event Report 88-027, which reported the premature shutdown of the inverters at an input of 115 V instead of the required 105 V.

Requirement:

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

Document Reviewed:

WEPCO Routine Maintenance Procedure 45, "Station Battery," Revision 5, October 25, 1989.

DEFICIENCY 90-201-27

Deficiency Title: No Acceptance Criteria in Routine Maintenance Procedure 46 for Locating Grounds
(Unresolved Item - Section 5.2.5)

Description of Condition:

Routine Maintenance Procedure (RMP) 46, "Station Battery," was performed monthly to verify that the station batteries were in accordance with Technical Specification requirements. The team noted that Step 3.6.5 of the procedure required that ground resistance measurements be taken on each battery bus. Although the procedure gave guidance on how to measure and calculate this resistance, no specific acceptance criteria were given. Consequently, once the ground resistance was calculated, no further evaluation or trending was performed.

The battery chargers have a ground detection light as well as a relay that sends an annunciation signal to the control room. On battery chargers D-07, D-08, and D-09, this indication and relay were set at 500 ohms, and on chargers D-107, D-108, and D-109, they were set between 18,000 and 19,000 ohms. WEPCO provided no basis for the alarm setpoints.

Requirement:

10 CFR Part 50, Appendix B, Criterion XI, "Test Control," requires, in part, that test procedures incorporate the requirements and acceptance limits contained in applicable design documents and that tests be evaluated to ensure that test requirements have been satisfied.

Documents Reviewed:

1. NRC Information Notice 88-86, "Operating with Multiple Grounds in Direct Current Distribution Systems," October 21, 1988, and Supplement 1, March 31, 1989.

2. WEPCO Routine Maintenance Procedure 46, "Station Battery," Revision 5, October 25, 1989.

APPENDIX B

PERSONS CONTACTED

Wisconsin Electric Power Company Personnel

J. Anthony, Quality Assurance Section
D. Bell, Nuclear Systems Engineering and Analysis
*S. Cartwright, Nuclear Systems Engineering and Analysis
*C. W. Fay, Vice President
*G. Frieling, Superintendent Systems Engineering
W. Fromm, PBNP
*R. Heiden, Superintendent Nuclear QA
W. Hennig, PBNP
W. Herrman, PBNP
*D. Johnson, Superintendent Nuclear Regulation
*P. Katers, Nuclear System Engineering and Analysis
*G. Krieser, General Superintendent, QAS
*E. Lipke, General Superintendent, NPERS
*J. McNamara, Nuclear Systems Engineering and Analysis
*S. Mayer, Nuclear Systems Engineering and Analysis
J. Meyer, PBNP
R. Mitchell, CHAMPS Coordinator
E. Mours, PBNP
*R. Newton, General Superintendent, NSEAS
C. Olson, PBNP
G. Poletto, Impell Corporation
*T. Pridgeon, Nuclear Engineering Projects
J. Roberts, PBNP
*T. Rodgers, OSRC
*S. Schellin, Superintendent, NEPD
*R. Seizert, Regulatory Engineer
*B. Susman, NSE
*J. Zach, Plant Manager
*E. Ziller, PBNP

Nuclear Regulatory Commission

*J. Gadzala, Region III
*R. Gardner, Region III
*B. Grimes, NRR/DRIS
*S. Guthrie, NRR/DRIS
*N. Jackiw, Region III
*T. Martin, Region III
*S. Stein, NRR/DRIS
*W. Swenson, NRR/PD33
*R. Westberg, Region III

*Attended the exit meeting on April 17, 1990.