ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

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Licensee:	Union Electric Company
Facility:	Callaway Plant
Location:	Junction Hwy. CC and Hwy. O Fulton, Missouri
Dates:	July 6-10, 1998
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ATTACHMENT: Supplemental Information

EXECUTIVE SUMMARY

Callaway Plant
NRC Inspection Report 50-483/98-15

An inspection was conducted using the guidance of Temporary Instruction 2515/137, "Inspection of Medium-Voltage and Low-Voltage Power Circuit Breakers," issued March 1998. The inspection team was comprised of Region IV and the Office of Nuclear Reactor Regulation personnel. The report covers a 1- week onsite inspection during the week of July 6, with an exit meeting conducted on July 10, 1998.

Maintenance

- The switchgear and surrounding areas were in good visual material condition with no deficiencies identified (Section M2.1).

- Recent power circuit breaker functional failures indicated that refurbishment of the safety-related 4160 V and 480 V breakers should be performed on an aggressive schedule (Section M2.2).

- In most areas, the preventive maintenance procedures included appropriate qualitative and quantitative acceptance criteria. An evaluation for consistency of test parameter values and acceptance criteria with the latest industry practice was in-process (Section M3.1).

- With few exceptions, the low-voltage circuit breakers had not been overhauled, but an action plan had been generated to accommodate overhauls in the future (Section M3.1).

- The licensee's functional determination of the safety-related GE Magne-Blast breakers was acceptable; however, breakers were overdue for overhaul or refurbishment. The licensee's action plans for overhauling and upgrading safety-related breakers were adequate and deviations from vendor recommendations were adequately justified. The licensee's preventive maintenance for Magne-Blast breakers was generally acceptable (Section M3.2).

- Equipment and maintenance records for six safety-related power circuit breakers indicated that the maintenance program had generally been satisfactorily implemented (Section M3.3).

- The licensee's root-cause determinations and corrective actions for the medium- and low-voltage power circuit breaker failures over the last 3 years met regulatory requirements (Section M4.1).

- The licensee was complying with 10 CFR 50.65, "Maintenance Rule," with regard to treatment of safety-related medium- and low-voltage power circuit breakers (Section M4.2).

- With some exceptions, the resolution of circuit breaker issues expressed in NRC generic communications, industry operating experience reports, and vendor letters was marginal. Seven service advice letters and two information notices were incorrectly reviewed for plant applicability (Section M6.1).

- Procedures and communication paths for informing the licensee's staff about operating experience and vendor-supplied information were not appear consistently applied. The team determined that this shortcoming was conducive to less than optimum coordination, duplication of effort for communications dealing with the same subject but from different sources, and an obstacle for important information to reach the appropriate or cognizant staff (Section M6.1).

- The implementation of the dedication program, particularly that portion of it which supported breaker maintenance, was adequate with some minor procedural deficiencies (Section M8.1).

- The calculation of direct current control circuits' voltage drop lacked the normal rigor involving design inputs for safety-related calculations. The team was assured by a preliminary calculation that all equipment associated with the breaker close and trip circuits would have voltage above the required minimum-allowed voltage (Section M8.2).

Report Details

Summary of Plant Status

During the onsite inspection week, the plant operated at full power.

The focus of the inspection was to verify the adequacy of licensee programs, procedures, training, equipment and supporting documentation for the maintenance of medium- and low-voltage power circuit breakers. The overall scope of the inspection was defined in Temporary Instruction 2515/137, "Inspection of Medium-Voltage and Low-Voltage Power Circuit Breakers," Revision 1, issued March 1998.

II. Maintenance

M2 Maintenance and Material Condition of Facilities and Equipment

M2.1 Walkdown of Switchgear Areas, Shops, and Training Facility

a. Inspection Scope

The team performed a walkdown inspection of the switchgear areas. The inspection included the safety-related and nonsafety-related, medium (4160 Vac) and low (480 Vac) voltage switchgear. At the team's request, the licensee opened a few breaker compartment doors to allow viewing the interior compartments with the installed power circuit breakers.

The team inspected the maintenance shop areas where breakers were taken when the required maintenance activities could not be readily accomplished in the switchgear area. The team inspected the electrical equipment maintenance training lab in the training annex building to assess its suitability to support breaker maintenance training.

b. Observations and Findings

The team found the switchgear and surrounding areas were well maintained, with no broken or missing parts observed, and painted surfaces in good condition. The team observed no deficiency tags.

The team noted that the removal of a breaker to the maintenance shop would normally be necessary only for major maintenance involving substantial disassembly and repair of a breaker. The team observed that the plant location of the maintenance shop areas provided reasonable access for all breakers, except those breakers that could not be moved into the normal shop areas for radiological control reasons. The maintenance shop areas were found to be clean, organized, well lit, ventilated, and equipped with ample work benches, storage, machine tools, and basic test equipment. The team noted no breaker maintenance in progress in the shop areas at the time of the inspection.

The team found that the electrical equipment maintenance training lab was clean, well lit, and well equipped. In particular, the team noted that the lab had both 4160 Vac and 480 Vac training breakers and cubicle mockup stands to facilitate student access, with readily accessible test equipment.

c. Conclusions

The switchgear and surrounding areas were found in good visible material condition with no deficiencies identified. Although the team did not directly observe breaker maintenance in progress in the shop, the team was able to determine on the basis of observed conditions and equipment in the area, that the breaker maintenance shop provided a suitable environment for breaker maintenance. Similarly, the team concluded that the electrical equipment maintenance training lab provided an adequate environment to facilitate breaker maintenance training consistent with the knowledge and skill levels required by current approved procedures.

M2.2 Material Condition of Circuit Breakers

a. Inspection Scope

The team evaluated the material condition of the medium- (4160 Vac) and low- (480 Vac) voltage power circuit breakers.

b. Observations and Findings

The licensee planned to refurbish some selected safety-related, 4160 Vac and 480 Vac circuit breakers in their facility, and had ordered the necessary material, but a schedule for this work was not established. Since a formal refurbishment plan was not established, and past functional failures had occurred, the team reviewed the existing overall maintenance program and surveillance testing to provide reasonable assurance that the breakers were maintained in an operable condition. The team determined that because of the seven recently documented circuit breaker functional failures under the Maintenance Rule program that circuit breaker refurbishment should be initiated in an aggressive manner.

c. Conclusions

The team concluded that the power circuit breakers were maintained in an operable condition, however, recent circuit breaker functional failures indicated that refurbishment of the safety-related, 4160 Vac and 480 Vac breakers should be performed on an aggressive schedule.

M3 Maintenance Procedures and Documentation

M3.1 Maintenance Procedures for Low-Voltage Power Circuit Breakers

a. Inspection Scope

The team reviewed the preventive maintenance procedures for the low-voltage power circuit breakers. The procedures were compared to the maintenance section of the manufacturer's instruction manuals and to the recommendations in Electric Power Research Institute (EPRI)/Nuclear Maintenance Applications Center (NMAC) Publication NP-7410, Volume 1, "Low-voltage Circuit Breaker Maintenance," Part 2, "GE AK and AKR Models," and Part 4, "Westinghouse DS Models" (for reactor trip breakers). The procedures were reviewed for good industry practice involving breaker maintenance, and the specific guidance provided in Temporary Instruction 2515/137. The ultimate acceptance criterion applied by the team was that the procedures should be of a type appropriate to the circumstances and included appropriate qualitative and quantitative acceptance criteria, as stated in 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures and Drawings."

b. Observations and Findings

The team observed that the maintenance procedures were clear, detailed, incorporated sign-offs on individual steps by craft personnel and supervisor approval, and included appropriate quality control hold points. The team observed that data sheets provided a good record of the results of all measurements made and breaker conditions at time of maintenance, however, breaker closing and tripping operation at the minimum calculated voltages were not performed.

The procedures utilized for low-voltage circuit breakers were: (1) MSE- ZZ-QS002, "480 V Circuit Breaker Preventive Maintenance and Inspection," Revision 13; (2) MPE-ZZ-QS008, "Cleaning and Inspection of GE 480 Volt Load Centers," Revision 7; and (3) MSE-SB-QS001, "Cleaning, Inspection, and Lubrication of Reactor Trip Switchgear," Revision 12. In general, the breaker maintenance was performed at 3-year intervals. Breakers used for containment penetration protection or located in harsh environment were inspected every 18 months in accordance with technical specification requirements.

The team noted that the Procedure MSE-ZZ-QS002 was modified to incorporate industry experience, but failed to provide specific guidance regarding the lubrication of breakers. The team noted that Suggestion Occurrence Solution (SOS) Report 98-2965 was written to incorporate vendor recommendations for lubrication into the appropriate preventive maintenance procedure.

The team found that Procedure MSE-ZZ-QS002 references an outdated Revision B of the AKR 30/50 maintenance manual (GEK-64459B) in lieu of the most recent Revision D of the maintenance manual. The team noted that Request for Revision 19118 was initiated to address this discrepancy.

The team observed that resistance measurement test results (megger) during maintenance activities were documented as >50 mega ohms, which coincides with the acceptance criteria. The team noted that specific values (such as 2000 mega ohms) were provided as data results during the performance of some maintenance activities and should provide more beneficial information, since the result indicated a decline from previous results. The licensee's representatives agreed with the team's observation and subsequently initiated SOS Report 98-2968 to record the megger test values.

Additionally, the team reviewed a sample of actual tests performed in accordance with Procedure MSE-ZZ-QS002, and identified minor discrepancies for which the licensee staff's wrote SOS Report 98-2970 to address these observations.

The team noted that Procedure MSE-ZZ-QS001 included the maintenance and testing requirements from the associated vendor's manual and NP-7410, "Circuit Breaker Maintenance," Volume 1, "Low-Voltage Circuit Breakers," Part 4, "Westinghouse DS Breakers." The team observed that Procedure MSE-ZZ-QS001 failed to include specific guidance on lubrication of the associated breakers. As a result, SOS Report 98-2965 was written to incorporate vendor recommendations for lubrication into the affected preventive maintenance procedure. The team observed that Procedure MSE-ZZ-QS001 did not consider or reference an applicable Westinghouse Manual "Maintenance Program Manual for Safety-Related Type DS Low-Voltage Metal enclosed Switchgear." The licensee's representative stated that a copy of the applicable manual had never been received.

In general, the team observed that the licensee was receptive to the above comments on the maintenance procedures and prepared appropriate SOS reports to address the team findings. In addition, since the low-voltage circuit breakers (except a few) have not been overhauled, the licensee generated Action Plan 98-104 to perform future overhauls for the low-voltage power circuit breakers.

c Conclusions

In most areas, the preventive maintenance procedures included appropriate qualitative and quantitative acceptance criteria. An evaluation for consistency of test parameter values and acceptance criteria with the latest industry practice was in-process. With few exceptions, the low-voltage circuit breakers had not been overhauled, but an action plan had been generated to accommodate overhauls in the future.

M3.2 Medium-Voltage (Magne-Blast) Breaker Maintenance Procedures and Practices

a. Inspection Scope

The inspectors reviewed the licensee's 4160 Vac Magne-Blast maintenance procedures and other documentation related to history, status, and effectiveness of the maintenance program. The inspectors also interviewed cognizant licensee staff.

b. Observations and Findings

The team noted the overall condition of safety-related Magne-Blast breakers as operable, but overdue for overhaul or refurbishment. The team also noted that plans were in place to acquire onsite overhaul capability and commence overhauls as soon as possible. The team noted Service Advice Letter (SAL) 352.1 modifications and updates were under review, including, for example, the installation of aluminum-bronze prop bushings and torsion-type close latch reset springs.

The team found that the licensee had established a satisfactory 3-year preventive maintenance interval for the safety-related GE Magne-Blast breakers, and that general adherence to the schedule had been maintained.

The team observed that preventive maintenance procedures did not provide for reduced control voltage close and trip functional testing. However, the mechanical condition of Magne-Blast trip and close mechanisms had been determined by direct force measurements. The team determined that most recorded closing and tripping forces were consistent. The team noted that two breakers found with relatively high forces had spent a long time as nonsafety-related breakers in the turbine building, which is much hotter than the other areas where safety-related breakers are installed. Licensee representatives, however, stated that they had relubricated the tripping and closing mechanisms of suspect breakers and, subsequently, restored and maintained an acceptable level of performance.

To provide some assurance that the closing and trip coils, although not all tested directly, would be capable of initiating close and trip operations at the worst-case expected (calculated) available control voltage (90 Vdc closing and 70 Vdc tripping), the licensee had performed tests on sample coils. The licensee's representative contended that the sample coils were representative of coils on the breakers because of a relatively low number of operations on the breakers; no extended or sustained energizations on record; no degraded coil failure history for these breakers industry wide; no visible discoloration, distortion (swelling), or other signs of overheating; and sample winding resistance measurements were satisfactory. The results of the sample coil force tests, conducted in fixtures to simulate as closely as possible the installed conditions, indicated that the coils developed sufficient force (conservatively neglecting the hammer-blow effect of end-play and pretravel in the linkages) at minimum control voltage (70 and 90 Vdc) to envelop the highest measured breaker tripping and closing required forces, respectively (as-left forces in the case of the two outliers).

The inspectors also questioned some test values and acceptance criteria for breaker periodic electrical testing. For example, in the case of insulation resistance testing, the licensee had established the acceptance criterion for Magne-Blast (4.16 kV) insulation at 50 mega ohms. The basis for this criterion was from the booklet on insulation resistance published by Middle Instrument Company, "A Stitch in Time," which is well known and widely used in the industry. The booklet recommended that the number of required mega ohms be equal to the voltage rating divided by 1000 (i.e., 4 for 4 kV) plus one or 5 mega ohms, which the licensee then conservatively multiplied this figure by 10. However, if properly cleaned and free of cracks, Magne-Blast insulation had typically read higher than this (i.e., on the order of greater than 100 mega ohms). It was the system engineer's policy that technicians inform him of abnormal or unusual conditions, even if within specifications (which they had done on occasion).

c. Conclusions

The licensee's functional determination of safety-related GE Magne-Blast breakers was acceptable, however, breakers were overdue for overhaul or refurbishment. The licensee's action plans for overhauling and upgrading safety-related breakers were adequate and deviations from vendor recommendations were adequately justified. The licensee's preventive maintenance for Magne-Blast breakers was generally acceptable. In most areas, the preventive maintenance procedures included appropriate qualitative and quantitative acceptance criteria, and an evaluation for consistency of test parameter values and acceptance criteria with the latest industry practice was in-process.

M3 3 Review of Documentation to Confirm Implementation of the Maintenance Program

a. Inspection Scope

The team selected a sample of six safety-related power circuit breakers by load and function, and reviewed equipment maintenance records for the last 5 years. The records were reviewed to determine whether the licensee's program, in terms of the interval between maintenance and the scope of maintenance, was implemented.

b. Observations and Findings

Review of the maintenance records confirmed that the specific intervals between preventive maintenance was equal to or less than that specified by the licensee's program. For two of the selected breakers, scheduled preventive maintenance was not performed in December 1993, but an engineering evaluation had been performed to allow deferring the preventive maintenance until a later date.

The records reviewed as part of the selected sample were complete according to the procedures governing the Maintenance Rule program, and did not contain any anomalies. The Maintenance Rule procedures reviewed by the team included PDP-ZZ-00020, "Maintenance Rule Program," Revision 2, and EDP-ZZ-01128, "Maintenance Rule and EPIX Programs," Revision 1.

The licensee's assessment of the medium- and low-voltage breaker maintenance program performed from May 18 through June 24, 1998, identified that Breaker NG0304 had a 1994 failure that had not been evaluated as a potential functional failure. The licensee issued SOS Report 98-2862 to have this breaker failure evaluated as a potential function failure.

c. Conclusions

Equipment and maintenance records for six safety-related power circuit breakers indicated that the maintenance program had generally been satisfactory implemented.

M4 Maintenance Staff Knowledge and Performance

M4.1 Root-Cause Evaluation and Corrective Action for Circuit Breaker Failures

a. Inspection Scope

At the team's request, the licensee provided summaries of corrective action documents (SOS reports) and work documents issued on safety-related, medium- and low-voltage power circuit breakers since June 1, 1995. The licensee also provided a breaker data matrix for the safety-related, medium- and low-voltage breakers. The team reviewed the data matrix, summary reports, and discussed maintenance activities, failures, and corrective actions with the cognizant engineers.

b. Observations and Findings

From the licensee's summary of the SOS reports, the team selected 25 reports for review. The team's review found cause determinations and corrective action as documented on the selected SOS reports and associated documents to be satisfactory.

The team reviewed a summary of corrective maintenance activities performed in the last 5 years for safety-related, medium- and low-voltage circuit breakers. The total number of failures was not independently established by the team. At least three work requests representing failures were reviewed, and the root-cause determination and corrective actions were satisfactory. The list of breaker functional failures being maintained pursuant to the Maintenance Rule listed one functional failure of a medium-voltage circuit breaker and six functional failures of low-voltage circuit breakers.

c. Conclusions

The licensee's root-cause determinations and corrective actions for the medium- and low-voltage power circuit breaker failures over the last 3 years met regulatory requirements.

M4.2 Maintenance Rule Issues

a. Inspection Scope

The team reviewed the licensee's compliance with 10 CFR 50.65, Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants, with regard to safety-related, medium- (4160 Vac) and low-voltage (480 Vac) power circuit breakers.

b. Observations and Findings

The licensee defined an electrical distribution system for Maintenance Rule purposes, which included incoming and tie power circuit breakers. Load side breakers were monitored as part of the associated structures, systems, and components that they supported.

The team found that the licensee had performance measures for safety-related, medium- and low-voltage circuit breakers that were commensurate with safety. Safety-related, medium- and low-voltage circuit breakers were classified as Category (a)(2) status. No safety-related system was classified as Category (a)(1) status as a result of medium- or low-voltage power circuit breaker failures. The licensee maintained a list of circuit breaker functional failures, and had established performance measures for power circuit breakers that were commensurate with safety. The team found that this list was consistent with failures identified through review of corrective maintenance work requests. The team found that system engineers reviewed surveillance test results, preventive maintenance tasks, and corrective maintenance history records for trends to identify performance-related problems.

c. Conclusions

The licensee was complying with 10 CFR 50.65, "Maintenance Rule," with regard to the treatment of safety-related, medium- and low-voltage power circuit breakers.

M6 Maintenance Organization and Administration

M6.1 Review and Evaluation of Industry Operating Experience

a. Inspection Scope

To evaluate the licensee's vendor interface and operational experience review programs as they relate in particular to circuit breakers, the team reviewed procedures for maintaining vendor manuals; procedures for reviewing, evaluating and dispositioning industry operational experience information; and procedures for maintaining periodic contact with vendors of key safety-related equipment outside the Nuclear Steam Supply System scope. For historical background, the team reviewed the licensee's responses to NRC Generic Letter 83-28 (generic implications of the Salem Anticipated Transient Without Scram event), Item 2.2, Part 2 (non-Nuclear Steam Supply System vendor

interface), and to Generic Letter 90-03 (partial relaxation of Generic Letter 83-28 provisions) and its Supplement 1 (included safety-related switchgear and diesel generators among examples of key safety-related equipment). In addition, the team interviewed cognizant licensee staff.

To assess the licensee's effectiveness in implementing these programs for circuit breakers, the team examined the licensee's circuit breaker vendor manual binders in which the various vendor technical documents (e.g., technical manuals, technical bulletins, etc.) were filed. The team reviewed the licensee's periodic correspondence with breaker vendors to obtain the latest applicable technical information, and the licensee's evaluations for applicability to the facility, and disposition of, operational experience review documents, such as NRC and industry breaker-related generic communications, Part 21s, and vendor technical bulletins.

The team reviewed the licensee's breaker operation and maintenance procedures to determine whether relevant technical information, as mentioned above, had been appropriately incorporated into procedures.

b.1 Observations and Findings (Low-Voltage Breakers)

The team found the licensee's operating experience report review program and the associated corrective action to address events as marginal, with the following observations noted. The team noted that SOS Report 98-2972 was written to address the team's comments regarding the review of industry-related events and problems.

The team found that Information Notices 87-12 and 89-29 were not reviewed adequately for plant applicability. The team observed that Information Notice 87-12 was initially reviewed and determined as not applicable. After discussions with the team, the cognizant engineer agreed that it should have been applicable for lubrication and planned to revise the response accordingly. The team noted that Information Notice 89-29 was initially reviewed as not applicable due to an inaccurate response that K-line breakers were not in stock. After discussions with the team, the cognizant engineer agreed that it was applicable since K-line breakers were in stock. The team observed that Information Notices 96-44, Supplement 1, and 98-03 had not been reviewed to date.

The team noted that SALs 175-9.1, 9.2, 9.6, 9.7, 9.11, 9.17, and 073B-305.0, were not reviewed adequately for applicability.

The system engineer assured that the modification suggested in SAL 175-9.1 had been incorporated through a random check. The team noted that a plan to document the work in accordance with SAL 175-9.1 was not available, and that a work order was to be generated for 100 percent inspection.

The team found that Procedure MSE-ZZ-QS002 had not been revised to add the requirements addressed by SAL 175-9.2. The licensee's representative stated that Procedure MSE-ZZ-QS002 was to be revised to add the applicable recommendations.

The team found that the Procedure FOP-ZZ-02001, "Distribution/Review/Processing Generic Letter/Bulletin/Info Notices," Revision 3, did not include statements to review details for generic implications. The team noted that SOS Report 98-2962 was written to evaluate the need to incorporate a generic implication review and whether to provide additional training to address generic implications for industry-related information.

b.2 Observations and Findings (4160 Vac Medium-Voltage Breakers)

Vendor Interface

The team found that for safety-related, medium-voltage (4160 Vac) switchgear (GE vertical-lift AM-type Magne-Blast breakers), vendor technical bulletins comprised of Service Information Letters from GE Nuclear Energy in San Jose and SALs from the GE product department that manufactured Magne-Blast breakers from the GE Specialty Breaker Plant in Philadelphia. Additionally, the team noted that recent SALs relating to Magne-Blast breakers were published under the product department prefix for GE Electrical Distribution and Control, which manufactured AK- and AKR-type low-voltage switchgear. The team noted that for the facility's safety-related, low-voltage switchgear, including Westinghouse Type DS-416 reactor trip breakers, vendor technical bulletins consisted of Westinghouse technical bulletins and nuclear SALs published by the Westinghouse Nuclear Services Division and its predecessors.

Low-voltage switchgear was not included in the licensee's Vendor Equipment Technical Information Program (VETIP). The VETIP had been established using industry guidelines that had been developed in response to Generic Letter 83-28, Item 2.2, Part 2. In response to Generic Letter 90-03, the licensee had cited its VETIP, and also its intended participation in the newly established (but now defunct) Nuclear Plant Reliability Data System. The licensee could not offer a satisfactory explanation for omitting low-voltage breakers from the VETIP, but the licensee had identified this deficiency in its breaker maintenance audit/self assessment. The team noted that the licensee's documented intention to include low-voltage switchgear in the VETIP.

Breaker Audit Report SP 98-067 stated that the VETIP was "well established" for Magne-Blast breakers. The team concluded that this characterization was not accurate in view of the fact that GE SALs on low and medium-voltage switchgear were not being received through VETIP.

Some vendor manuals and/or their latest revisions were not in vendor manual binders. For example, the GE factory manual for AKR 30/50 breakers were not the latest revision. The Westinghouse factory instruction book for DS-416 breakers, IB 33-790-1 series, was also not the latest revision (-1G). The Westinghouse Nuclear Services Division's Maintenance Program Manual for Safety-Related type DS low-voltage metal enclosed switchgear was not in the reactor trip breaker binder (although the licensee did have the Westinghouse Owners Group MPM for DS breakers used as reactor trip breakers). Many GE manuals and updates had only recently been obtained in cooperation with another utility. Finally, the team noted that GE SALs were not being received by the plant though the VETIP; although they had been obtained by the

breaker system engineers though the GE breaker users' groups sponsored by the Nuclear Maintenance Applications Center of the Electric Power Research Institute.

The team found that the VETIP had been using form letters (with some followup phone calls) for periodic contact of breaker vendors to ensure receipt of all applicable technical information and manual revisions. This approach had not been fully effective for breakers, since appropriate personnel had not always been contacted, with one notable exception being an instance in which the Magne-Blast design engineer at the factory was contacted directly and he responded with the necessary information.

Operating Experience Review

The team noted that the licensee's medium-voltage system engineer had performed a comprehensive review of this area using a guide developed by the Magne-Blast users group in response to Temporary Instruction 2515/137. The team found this review to have been generally thorough and objective, with a couple of exceptions. For example, the review identified several NRC information notices for which the original evaluation of inapplicability to the facility needed to be revised. Most NRC applicable information notices were addressed in the medium-voltage system engineer's review document, except Information Notice 84-46 (on breaker position verification), which was generically applicable to breakers that can be racked out (or down in this case), but was not addressed by the review. However, the team determined that the recommended practice of functionally testing breakers once returned to the connected position (requires running the load) was required by licensee post-maintenance procedures and was routinely done by operations to restore system operability (by system operating procedures) after tagouts were cleared per applicable procedures.

The team found that the licensee had received almost all of the applicable information (with the notable of exception of SALs though the VETIP), as previously discussed. In most cases, the licensee had evaluated breaker-related operating experience review information for applicability to the facility appropriately, and had dispositioned it accordingly. For example, most of the modifications or upgrades to Magne-Blast breakers recommended by GE in SALs (obtained by various means other than the VETIP) had been accomplished (although some were accomplished at the factory due to the breaker's relatively recent vintage - about 15 years service). In general, among those not accomplished and for which the licensee did not intend to accomplish, adequate justification was documented and compensatory measures or alternate practices were proceduralized. For those that the licensee had not accomplished, but intended to accomplish, the licensee had developed an action plan for their accomplishment, typically in conjunction with planned overhauls.

c. Conclusions

With some exceptions, the resolution of circuit breaker issues expressed in NRC generic communications, industry operating experience reports, and vendor letters was marginal. Seven service advice letters and two information notices were incorrectly reviewed for plant applicability.

The past VETIP procedure and staff were not fully effective in ensuring the completeness of the licensee's vendor manuals and other vendor technical information.

Procedures and communication paths for informing the licensee's staff about operating experience and vendor-supplied information were not consistently applied. The team determined that this shortcoming was conducive to less than optimum coordination, duplication of effort for communications dealing with the same subject but from different sources, and an obstacle for important information to reach the appropriate or cognizant staff

M8 Miscellaneous Maintenance Issues

M8.1 Dedication of Commercial-Grade Items and/or Services in Support of Breaker Maintenance

a. Inspection Scope

The team reviewed the plant's commercial-grade dedication and applicable procurement procedures to evaluate program adequacy. To evaluate program implementation, the team reviewed the available breaker-related dedication files, i.e., breaker lubricant and Magne-blast closing spring charging motors. The team also interviewed cognizant licensee dedication staff and also those who performed supplier-quality audits and commercial-grade surveys.

b. Observations and Findings

b.1 Commercial-Grade Dedication Program

The team found that the licensee's commercial-grade Evaluation Procedure WEP-ZZ-00001, "Commercial Grade Evaluation," Revision 8, which hadn't been updated since 1991, contained a number of deficiencies.

The team found within Procedure WEP-ZZ-00001 that the licensee had made a distinction between critical characteristics for design, and critical characteristics for verification, which was not consistent with NRC's single definition of critical characteristics, as first promulgated in Generic Letter 91-05 and, subsequently, codified in 10 CFR Part 21 in 1995. The licensee had documented that the only critical characteristics that must be verified were described as a subset of critical characteristics for design that "Provide reasonable assurance that the item received is the item specified." The definitions of critical characteristics for design (except for use of the term "intended function" instead of "safety function") were consistent with the current 10 CFR Part 21 definition, but the procedure did not require all critical characteristics for design to be verified. The team noted that Procedure WEP-ZZ-00001 stated that critical characteristics for verification should be based on safety function, but it failed to require that all safety function-based (by definition) critical characteristics be verified.

The description of Electric Power Research Institute acceptance Method 4, Product and Supplier Performance History, included the restrictions on the use of this method alone, as promulgated in Generic Letter 89-02, but did not mention the Generic Letter 89-02 restrictions on the use (alone) of Method 2, Commercial Grade Surveys.

The team observed that Procedure WEP-ZZ-00001 referenced a commercial-grade survey procedure that was no longer effective (current procedures were under the Supplier Quality group). The team found that commercial-grade survey procedures (under Supplier Quality at the time of the inspection) addressed the implementation of suppliers' commercial-quality programs, but did not explicitly require they must be documented as stated in Generic Letter 89-02. However, regarding the Method 2 restrictions of Generic Letter 89-02, the single distributor used by the licensee that does handle products (not breaker-related) had been audited and surveyed and others were prohibited from handling products through procurement and receipt documents.

Procedure WEP-ZZ-00001 stated that if not all critical characteristics for verification can be verified by others (e.g., suppliers through surveys, or third-party dedicators) then the remaining ones must be verified by the licensee through other means (e.g., onsite testing and inspection or other outside contractors, etc.). The team noted that the dedication procedure specifically provided for use of combination of acceptance methods. The team noted that these provisions enhanced the program.

b.2 Breaker-Related Commercial Grade Dedication Package Review

The team found that the licensee purchased almost all materials and services related to maintenance of safety-related breakers from Appendix B-qualified suppliers, with two exceptions: breaker grease and closing spring charging motors.

The team reviewed the GE Magne-Blast closing spring charging motors dedication file, and determined that the licensee had classified breaker closing spring charging motors as safety-related, which was conservative since the motors' safety function was only to be performed in a design basis accident with delayed loss-of-offsite-power scenarios. The team determined that the scenario was credible, but typically not considered to be within a plant's design basis. The team considered the licensee's evaluation thorough and that all appropriate critical characteristics were verified even though the procedure did not require such.

The team observed that the licensee had expended extensive effort with detailed documentation to resolve the identification of GE specification D50HD38 red grease that had been used in GE low-voltage switchgear, and GE Specification D6A15A1 red grease that had been used in GE medium-voltage switchgear. The licensee's evaluation established that both of these were, in fact Mobil Grease 28 (Mobil Grease 28 stated by GE to "meet those specs" and was used by GE). The team noted that the dedication was thorough and included sample testing and batch spectrographic analysis.

c. Conclusions

The implementation of the dedication program, particularly that portion of it which supported breaker maintenance was adequate with some minor procedural deficiencies.

M8.2 Breaker Control Power Issue

a. Inspection Scope

The team inspected to establish whether breaker operation was assured at minimum operating voltage, as specified in the vendor's manual, or minimum calculated voltage, whichever is the lowest, as stated in the temporary instruction.

b. Observation and Findings

Calculation E-B-9, "DC Control Circuits Voltage Drops," Revision 1, dated January 23, 1983, was reviewed to verify that electrically operated breakers (both medium- and low-voltage) are operable at the calculated minimum available voltage at the closing and trip coils. The team determined that the design basis of the calculation was a loss of offsite power with loss of coolant accident. The licensee verified equipment operability assuming a battery voltage of 108.6 Vdc. The team observed that the calculation was performed to determine the maximum allowable control circuit length using # 14 AWG conductor in order to maintain minimum allowed voltage at different coils. The allowable minimum voltages are shown below:

Breaker Type	Close Coils	Trip Coils
GE Magne-Blast (4160V)	90 Vdc	70 Vdc
GE AKR (480V)	100 Vdc	70 Vdc

The team and the licensee noted minor discrepancies in the Calculation E-B-9. The licensee initiated SOS Report 98-2978 to address these observations.

The team observed that the calculation also assumed a minimum voltage under a worst-case scenario at the medium-voltage and low-voltage switchgear to be 103.75 Vdc. The team noted that when the installed circuit length exceeded the allowed length, a field modification was performed to reduce the excessive voltage drop by: (1) paralleling conductors, or (2) use of interposing relays. The team reviewed some of the applicable circuits for length verification and found them to be acceptable.

In response to the team's concern regarding maintaining the allowed minimum voltage at the switchgear, the licensee provided Calculation NK-10, "DC Voltage Drop," Revision 0, dated December 29, 1992. The team noted that this calculation determined the worst-case voltage at the 4160 Vac switchgear to be 103.78 Vdc and at the 480 Vac switchgear to be 105.81 Vdc. Therefore, based on battery terminal voltage of 106.7 Vdc, the calculation established a margin of 1.9 Vdc (108.6-106.7). The team

also noted a minor discrepancy in Calculation NK-10. The licensee initiated SOS Report 98-2977 to correct the discrepancy.

The team requested a document that could verify the minimum voltage at the close and trip coils. The licensee performed a preliminary calculation, and the results of this calculation are tabulated below. Based on the preliminary calculation results, the team concluded that the actual calculated minimum voltage at the close and trip coils were greater than allowable minimum voltage specified in vendor manuals.

4160 VOLT SWITCHGEAR

COIL	NO. OF BKRS.	CONTROL CKT. RESISTANCE (Ohms)	CALCULATED COIL VOLTAGE (Volts)	ALLOWED MIN. VOLTAGE (Volts)
Close Coil without interposing relay	21	3.055	90.436	90.0
Close Coil with interposing relay	9	8.552	103.458	75.0
Close Coil using parallel cables	2	2.817	91.347	90.0
Trip Coil	32	3.960	87.135	70.0

480 VOLT LOAD CENTERS

COIL	NO. OF BKRS.	CONTROL CKT. RESISTANCE (Ohms)	CALCULATED COIL VOLTAGE (Volts)	ALLOWED MIN. VOLTAGE (Volts)
Close Circuit X relay	13	2.528	103.208	90.0
Close coil	13	0.0620	105.254	100.00
Close Coil with interposing relay	3	3.458	105.336	90.0
Trip Coil	16	1.872	102.405	70.0

In response to the team's concern regarding the operability of the safety-related breakers at the calculated minimum voltage during a design basis condition, the licensee generated request for Resolution 19148. The licensee provided the following

basis for the operability of the safety-related breakers at the calculated minimum voltage:

1) Good operating experience history with safety-related breakers.

2) Performance problems that have been documented at Callaway, would most likely not have been identified by conducting a low-voltage test.

3) There was no requirement in the manufacturer's documentation to perform reduced-voltage testing to maintain a 40-year qualified life.

4) There was no firmly established guidance by the industry.

5) The breakers were located in a clean, cool environment, except some 480 Vac power breakers which were maintained every 18 months.

6) No adverse trend had been identified involving a lubrication problem with operating mechanisms or due to coil degradation.

7) Reduced-voltage calculations prove that voltage in excess of the manufacturer's minimum-required voltages will be present under the worst-case condition.

8) All safety-related, medium-voltage breakers were inspected to determine the internal condition of the mechanisms as a result of two nonsafety-related breakers failures due to lubrication degradation. Force measurements were taken on many breakers to verify there was not an excessive amount of force required to trip or close the breakers. These force measurements were then compared to data that was collected on two trip coils and one close coil that were removed from spare breakers. The coils were tested at 89.8 Vdc. These spare coils were considered to be representative of coils currently installed in safety-related applications because they were procured at the same time and were in service for approximately 10 years. This data provided reasonable assurance that the coils would generate sufficient force to trip and close the breakers in the worst-case scenario.

9) The low-voltage (AKR type) breakers were tested at 106 Vdc during preventive maintenance.

c. Conclusions

The calculation of direct current control circuits' voltage drop lacked the normal rigor involving design inputs for safety-related calculations. The team was assured by a preliminary calculation that all equipment associated with the breaker close and trip circuits would have voltage above the required minimum-allowed voltage.

V. Management Meetings

X1 Exit Meeting Summary

The team discussed the progress of the inspection on a daily basis and presented the inspection results to members of licensee management at the conclusion of the inspection on July 10, 1998. The licensee's management acknowledged the findings presented.

The team asked the licensee staff and management whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

ATTACHMENT

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee
T. Antweiler, Nuclear Engineering Technical Valve Program
H. Bond, Supervisor, Quality Assurance Engineering
D. Cornwell, General Supervisor, Maintenance
R. Glassner, Quality Assurance Engineer
J. Gloe, Superintendent Maintenance
M. Haag, Senior Design Engineer
R. Haines, Electrical Design Engineering
D. Heinlein, Supervisor, Engineering
J. Hogg, Supervisor, Nuclear Engineering Technical Valve Program
L. Kanuckel, Supervisor, Engineering Quality Assurance
J. McGraw, Acting Manager, Engineering
M. Reidmeyer, Quality Assurance Regulatory Support
T. Robertson, Senior Engineer, Quality Assurance
T. Stotlar, Supervisor, Engineering Materials
P. Thompson, System Engineering
D. Turley, System Engineering
D. Waller, Electrical Design Engineering
W. Witt, Superintendent, System Engineering

NRC
D. Passe[illegible]enior Resident Inspector
D. Powers, Chief, Maintenance Branch

INSPECTION PROCEDURES USED

TI-2515/137	"Inspection of Medium-Voltage and Low-Voltage Power Circuit Breakers," Revision 1

LIST OF PROCEDURES REVIEWED

APA-ZZ-00003	"Nuclear Engineering Organization and Responsibility," Revision 8
APA-ZZ-00030	"Conduct of Operations-Systems Engineering," Revision 12
APA-ZZ-00107	"Review of Current Industry Operating Experience," Revision 4
APA-ZZ-00303	"Classification of Systems," Revision 3
APA-ZZ-00320	"Processing Work Requests," Revision 23
APA-ZZ-00400	"Procurement of Parts, Supplies, Materials, and Services," Revision 22

APA-ZZ-00500	"Corrective Action Program," Revision 28
EDP-ZZ-01128	"Maintenance Rule and EPIX Programs," Revision 1
EDP-ZZ-04012	"Equipment Failure Trending and Analysis," Revision 10
EDP-ZZ-06000	"Vendor Equipment Technical Information Review Program," Revision 7
FDP-ZZ-02001	"Distribution Review, and Processing of Generic Letters, Bulletins, and Information Notices," Revision 3
JDP-ZZ-04100	"Operating Experience Review Procedure," Revision 8
MPE-ZZ-QS005	"Annual Cleaning, Inspection, and Lubrication of 4.16kV Breakers," Revision 14
MPE-ZZ-QS008	"Cleaning and Inspection of GE 480 Volt Load Centers," Revision 7
MSE-SB-QS001	"Cleaning, Inspection, and Lubrication of Reactor Trip Switchgear," Revision 12
MSE-ZZ-QS002	"480 V Circuit Breaker Preventive Maintenance and Inspection," Revision 13
PDP-ZZ-00003	"Work Document Processing," Revision 28
PDP-ZZ-00011	"Retest Development," Revision 3
PDP-ZZ-00020	"Maintenance Rule Program," Revision 2
WEP-ZZ-00001	"Commercial Grade Evaluation," Revision 8

LIST OF DOCUMENTS REVIEWED

Surveillance Report SP98-067	"Assessment of Callaway's Medium and Low Voltage Breaker Maintenance Program," dated July 1, 1998
Division Action Plan 98-103	"Circuit Breaker Maintenance Program (SOS 98-1191)," dated May 13, 1998
Division Action Plan 98-104	"480 VAC (AKR) Circuit Breaker Maintenance Program," dated June 1, 1998
OQC 98-049	"Mid-Refueling 9 SOS Trend Analysis Report," dated April 16, 1998
OQC 97-174	"Semiannual NMR Trend Analysis Report," dated October 23, 1997

SOS Reports

95-1363	95-1373	95-1609	96-0022	96-1633	96-1804
97-0270	97-1314	98-0159	98-0386	98-0837	98-0839
98-1191	98-1380	98-1401	98-1564	98-1570	98-1940
98-1983	98-2782	98-2862	98-2864	98-2870	98-2880
98-2915					

Work Requests

W5492265 (NB0104)
P552957 (NG0204)
G617694 (NG0205)