APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-498/93-44
50-499/93-44

Licenses: NPF-76
NPF-80

Licensee: Houston Lighting & Power Company
P.O. Box 1700
Houston, Texas

Facility Name: South Texas Project Electric Generating Station, Units 1 and 2

Inspection At: Matagorda County, Texas

Inspection Conducted: November 8-13, December 13-17, and December 23, 1993

Inspectors: P. A. Goldberg, Reactor Inspector, Division of Reactor Safety
V. G. Gaddy, Reactor Inspector, Division of Reactor Safety
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Approved: T. F. Westerman 1-12-94
T. F. Westerman, Chief, Engineering Branch Date

Inspection Summary

Areas Inspected (Units 1 and 2): Routine, announced inspection to determine the effectiveness of the licensee's actions to improve reliability of the diesel generators.

Results (Units 1 and 2):

- Based on this inspection, it was determined that sufficient improvements have been accomplished for the Unit 1 standby diesel generators (SDGs) that the restart issues identified in NRC Inspection Report 50-498/93-31;50-499/93-31 are considered closed (Section 2).

- In addition to responding to the NRC Diagnostic Evaluation Team (DET) Report and the restart issues identified in NRC Inspection Report 50-498/93-31;50-499/93-31, the licensee had performed three independent assessments and a self assessment of SDG reliability. Recommendations from these assessments are being tracked by system engineering. Some of

the recommendations are classified by the licensee as restart restraints (Section 4).

- Closure of startup restraints issues as identified in the South Texas Project Operational Closure Package #11 remains open and licensee disposition of these issues will be inspected prior to restart of Unit 1 (Section 4).

- The licensee has taken action to implement all Cooper-Bessemer Owners Group (CBOG) recommendations and is an active supporter. It was observed that not all cognizant SDG personnel are routed the minutes of the CBOG Technical Committee for review (Section 3.4).

- Based on the inspectors' observation during a walkdown of the Unit 1 SDGs, their condition and appearance were generally good. Lock wires were observed to be missing from the air receiver ASME code relief valves on SDG 13. The emergency fill valves on the SDG building roof were found to be in a rusty degraded condition due to a lack of preventive maintenance (Section 3.5).

- Licensee's actions to resolve licensee identified restart restraints were found to be progressing satisfactorily (Section 4.5).

- Staff action to review SDG operability with 18/19 of 20 cylinders operating remains open until it can be determined why the engine cylinder peak firing pressures are erratic and the condition is corrected, or it is otherwise determined that this is normal. Further information is needed to interpret analyzer data and to demonstrate proper engine balance. This issue remains as a separate open NRC staff action and is not considered a restart restraint (Section 4.6).

- Current licensee management has responded in an aggressive manner to the problems identified with the SDGs. The performance of three independent assessments and a self assessment to improve SDG reliability exemplifies managements efforts. The long term implementation of the assessment recommendations and other licensee corrective actions is key to the continued improvement of SDG reliability (Section 7.0).

Summary of Inspection Findings:

- IFI 498;499/9331-08 was closed for Restart Issue 11 only (Section 5.1).

- IFI 498;499/9331-09 was closed for Restart Issue 11 only (Section 5.2).

- IFI 498;499/9331-11 was closed (Section 5.3).

- IFI 498;499/9331-12 was closed for Restart Issue 11 only (Section 5.4).

- IFI 498;499/9331-13 was closed for Restart Issue 11 only (Section 5.5).

- IFI 498;499/9331-18 was closed for Restart Issue 11 only (Section 5.6).
- IFI 498;499/9331-19 was closed for Restart Issue 11 only (Section 5.7)
- IFI 498;499/9331-28 was closed for Restart Issue 11 only (Section 5.8).
- Violation 498/9305-II.A/B/C was closed (Section 5.9).
- Licensee Event Report 9305, Unit 1, was closed (Section 5.10).
- IFI 498;499/9214-03 was closed (Section 5.11).
- IFI 498;499/9221-03 was closed (Section 5.12).
- IFI 498;499/9344-01 was opened (Section 6.1).
- IFI 498;499/9344-02 was opened (Section 6.2).
- IFI 498;499/9344-03 was opened (Section 6.3).
- IFI 498;499/9344-04 was opened (Section 6.4).

Attachments:

- Attachment 1 - Persons Contacted and Exit Meeting

DETAILS

1 BACKGROUND

Both units at STPEGS were shut down in early February 1993, and remain shutdown as a result of numerous broad scope problems identified by the NRC and the licensee.

NRC Inspection Report 50-498/93-31; 50-499/93-31, issued on October 15, 1993, identified 16 restart issues that required resolution prior to the restart of Unit 1. In addition to these restart issues, a number of items related to these restart issues were identified. The purpose of this inspection was to determine the licensee's effectiveness in resolving Restart Issue No. 11, "Standby Diesel Generator Reliability," and to establish a basis for concluding that this restart issue has been adequately resolved by the licensee.

2 ACTIVITIES ASSOCIATED WITH IMPROVING STANDBY DIESEL GENERATOR RELIABILITY IDENTIFIED IN DET REPORT, NRC INSPECTION REPORT 50-498/93-31;50-499/93-31, AND OTHER REPORTS AND LERS

2.1 SDG Rocker Arm Modification

This item was identified during the diagnostic evaluation as follows: "While installing SDG rocker arms with a modified design, the licensee failed to included specific Cooper-Bessemer service bulletin requirements for torquing and installing the modified parts, which could have caused the replaced rocker arms to function improperly. Once alerted to the bulletin requirements, installation of the rocker arms was still not completed correctly, i.e., the requirement to replace both the intake and exhaust rocker arms as a set was not accomplished. The licensee also had to resort to hand searches of service requests to locate where the modified rocker arms were installed."

The modification was being conducted based on a recommendation from engineering. The recommendation was based on possible SDG damage which could result from improperly torqued retainer clips on the rocker arms.

In response to this issue, the licensee identified that Maintenance Drawing 4041-00297-DEC/8041-00308-DCE, Rev. 7, "Inlet and Exhaust Rocker & Push Rod," dated June 30, 1993, did not cross reference Vendor Manual 4041/8041-01010. The licensee added a note to their maintenance drawing to reference Cooper-Bessemer Service Bulletin 686 whenever this modification was necessary. The Service Bulletin provided installation instructions and torquing requirements for the retainer nuts. Additionally, the licensee initiated a vendor manual update effort. The inspector was informed that the electrical and mechanical vendor manuals are to be combined into one manual for ease of reference by January 30, 1994. This effort is part of the larger vendor equipment technical information program (VETIP) effort. One attribute of the program addresses the cross reference of vendor documents. The licensee also issued

Design Change Notice (DCN) 2814 to their drawing. The DCN added instructions to the drawing for addressing the differences in the valve lever rocker arms.

The licensee also inspected all SDGs to identify which diesels had the modification installed. For those that had the modification installed, the retainers were retorqued to the correct vendor recommended values.

The licensee stated that the reason they had to resort to hand searches to locate service requests was that not all requests had been entered in the database due to a backlog. In response to this, a preventive maintenance/service request reduction plan was initiated. This action is included as part of the HL&P business plan and is projected to be completed by December 1993.

The issue regarding the replacement of the intake and exhaust rocker as a set was investigated. The inspector determined that the licensee had contacted the vendor regarding this issue. The vendor stated that there was not a requirement to replace the intake and exhaust rocker arms as a set. The intake and exhaust rockers were totally independent of each other and both are not required to be replaced as part of this modification. Both rocker arms are replaced if the hydraulic lifter is replaced.

The inspectors determined the actions taken by the licensee in updating their maintenance drawing to reference the vendor service bulletin and in verifying rocker arm retainer torque of the affected SDGs were sufficient to close this issue.

2.2 Configuration Control and Engineering Communication for the SDG Hold Down Bolts

This item was described during the diagnostic evaluation as follows: "Several SDG failures resulted from broken fuel oil injector pump hold down bolts, many of which were installed using a different stud driver tool designed by the system engineer. The system engineer failed to consult design engineering or the SDG vendor while designing the tool."

The licensee determined that a contributor to the continued hold down bolt failures was inadequate torque applied to the bolts or fasteners which led to failure of the hold down bolts. On August 24, 1990, Procedure OPMP04-DG-0019, Revision 6, "SBDG Fuel Injection Pump and Nozzle Assembly Maintenance," was issued. This revision incorporated the use of a special tool for torquing hold down bolts. Additionally, this procedure governing the use of the special tool did not provide sufficient guidance to prevent improper use of the special tool. The special tool was designed by system engineering.

Additional failures occurred after the special tool was used to install hold down bolts. The licensee attributed the failures to over torquing. The root cause also stated that a contributor to the failures was the design and method in which the special tool torqued the bolts. Licensee personnel stated that they had discovered from interviews of personnel involved that design

engineering and the diesel generator vendor had been contacted during fabrication of the special tool, but that there was no formal documentation. Licensee personnel stated that the fabrication of the tool was considered to have been an error in technical judgement. Misapplication may also have led to the bolts being over stressed and resulted in their eventual failure. Procedure OPMP04-DG-0019, which governs the use of the special tool for installation of the hold down bolts, was revised to delete the use of the tool. This was completed in January 1991. The hold down bolts are now installed hand tight with Locktite applied to the lower threads. The licensee's action to hand tighten the hold down bolts was considered by the inspector to preclude over torquing during installation.

Also, the licensee issued Procedure OPGP03-ZO-0039, "Operations Configuration Management." This procedure consolidated and expanded two other procedures; Procedure OPGP03-ZO-0039, "Equipment Clearance;" and "OPGP03-ZO-0001, "Configuration Management." This updated procedure established the administrative controls necessary to manage equipment configuration changes that deviated from the plant baseline configuration. Procedure OPGP03-ZA-0109, "Configuration Management Program," Revision 0, dated December 1, 1992, was also in effect. This procedure ensured changes to hardware and documentation were fully evaluated to determine their impact on other hardware and that the changes were reviewed and approved by management. These procedures had also been incorporated as part of the required reading for the Diesel Generator System Engineer Qualification Record.

By making the configuration management procedures part of the system engineer qualification card, the licensee ensured that they were aware of the processes and procedures that were required for equipment configuration changes.

2.3 SDG Jacket Water Issue

This item was identified during the diagnostic evaluation as follows: "A SDG jacket water leak took four attempts to correct. The first two repair efforts were unsuccessful because maintenance personnel installed the wrong size of gasket. In a third repair attempt, the gasket was made on site with material not suited for that application."

On March 23, 1993, the licensee initiated Service Request DG-1-163009 to repair a water leak at SDG 13 header to the 7L cylinder connector. Initially, the manifold gasket was replaced. The jacket water system was refilled and cylinder 9L, 4L, and 2L began to immediately leak. The flanges on 4L and 2L were tightened and the leakage was reduced. Jacket water cylinder 9L continued to leak at a high rate. The system was again drained and the gasket for the cylinder was replaced. The jacket water system was filled again but the leak at cylinder 9L continued. The jacket water system had to be drained once again. During disassembly of the header, it was discovered that the present gasket did not cover the jacket water port as designed. Since no other gasket could be located, the mechanical maintenance supervisor initiated Plant Change Notice 163009-A, dated March 27, 1993, to have a gasket fabricated on site from a substitute material. Field Change Request DM-00149,

dated April 26, 1986, allowed the licensee to fabricate gaskets from substitute material.

The gasket was fabricated in accordance with the PCN using Permetex #2. Once fabricated and installed, the gasket still failed. The gasket failed because it was manufactured to the wrong specifications.

The licensee then conducted an investigation and found the cause for the gasket failures and why the substitute gasket had been manufactured to the wrong specifications. The licensee determined that prior to beginning the initial gasket replacement on March 23, 1993, the maintenance supervisor lined through the correct part number on SR DG-1-163009 and wrote in the incorrect part number because he thought the original part number was incorrect. Revision 7 of Procedure OPGP03-ZA-0090, "Work Process Program," dated August 24, 1993, allowed supervisors to make changes to work packages as long as the change did not alter the scope or intent of work activities.

Once the licensee determined why the situation occurred, Revision 1 to SR DG-1-163009 was issued. This SR replaced all jacket water system inlet flange gaskets with the correct type gasket.

The licensee determined that a lack of craft knowledge regarding the proper gasket usage permitted the problem to escalate. The licensee also indicated that the lack of understanding of the corrective action process in conjunction with a perceived sense of urgency to complete the gasket fabrication resulted in the failure to properly control the issue.

The licensee identified that the root cause of the event was an error made by the maintenance supervisor when he changed the part number on the work package. Part of the corrective action included dedicating five to ten mechanical maintenance technicians to only perform work on the SDG. This action was intended to develop familiarity with the diesels and assure consistency and conformity in completed tasks.

By telephone call on December 23, 1993, the licensee informed the inspector that training for all cognizant personnel was completed on December 21, 1993. All affected personnel were made aware of the contributing factors leading to this incident. Retraining was also conducted for the individuals directly involved in the incident.

Licensee action on this item is considered complete.

2.4 SDG Hold Down Bolt Troubleshooting and Corrective Actions

This item was described during the diagnostic evaluation as follows: "Standby diesel generator (SDG) injector pump hold down studs failed on nine separate occasions. The root cause analysis was shallow and corrective actions were insufficient to preclude recurrence. The licensee did not perform a more detailed analysis of the stud failures until the team became involved."

The hold down bolts were hollow and designed to anchor the fuel injection pump to the SDG. The hollow design was intended to protect the SDG cam shaft. In the event of a fuel injector pump seizure, the hold down bolts fail to protect the cam shaft.

The first failure occurred during pre-operational testing on May 28, 1987. The failure occurred when the No. 2 left cylinder fuel injection pump for SDG 12 broke loose from the pump pedestal. All four hold down bolts were broken during this incident. The failed bolts were failure analyzed by Southwest Research Institute. Analysis results concluded that the bolts failed due to nonconformance of material to the design specification, loss of preload during operation, and inadequate fatigue strength for the cyclic loading condition. The corrective action initiated by the licensee was to establish a surveillance program to periodically check the torque on the hold down bolts.

On August 10, 1988, Cylinder 8L of SDG 22 experienced a fuel injection pump mounting bolt failure. The four hold down bolts anchoring the pump failed. The bolts were failure analyzed by Bechtel National, Inc. The analysis concluded that two studs failed to carry the load due to improper torquing. Bechtel was unable to determine whether the bolts were over or under torqued, since either would cause breakage. The licensee's corrective action was to retorque the bolts to the manufacturer's recommendation and verify the torque on all engine bolts at 100 run hours intervals or every refueling outage, whichever came first.

On January 3, 1990, SDG 22 failed during a 24 hour load test when the No. 4L fuel injection pump seized. In this event, only one hold down bolt failed, while the other three studs remained intact and torqued as required. No failure analysis was performed on the failed bolt because the failure was attributed to a pump seizure. Once the failed bolt was replaced, the licensee successfully completed testing SDG 22 on January 10, 1990. The actions taken by the licensee in response to this event were to revise maintenance procedures to require that all hold down bolts be replaced each time a pump was replaced. However, the licensee failed to replace the remaining three bolts, even though they were most likely weakened by excess stress during the pump seizure event. This may be due to the fact that the maintenance procedures were not updated until August 24, 1990.

On November 20, 1990, during a 24-hour load test, Injection Pump 5L of SDG 23 separated from the engine. The separation was caused by the failure of the hold down bolts. The bolts were analyzed by the licensee. The licensee's analysis concluded that two bolts failed due to fatigue and the remaining two bolts failed due to tensile overload. The licensee had removed injector pumps 5R, 5L, 1R, and 3R on November 18, 1990, to adjust their timing. All four hold down studs and nuts for each of the injector pumps were replaced and torqued as required by the procedure. During post maintenance testing on November 22, 1990, Injection Pump 5R separated from the engine.

After this failure, the licensee inspected all hold down bolts. The results of the inspection indicated that one hold down nut on pump 1R and two hold down nuts on Pump 3R had less torque than required by the procedures. All hold down studs and nuts for these two pumps were again replaced and torqued as required by the procedure. Upon completion of a one hour run, the hold down nuts on each of the affected pumps were verified and found to be satisfactorily torqued. The engine then completed its 24-hour load test.

The licensee sought guidance from the vendor regarding their hold down bolts in 1990. The vendor referred the licensee to Cooper-Bessemer's Engineering Standard 123 issued November 12, 1973 (provided in the vendor manual). This standard indicated that lubrication (Lubriplate) should be applied to the studs and lock nuts prior to installation. The vendor also recommended that a sufficient run down torque be applied to the lock nuts to account for the nylon insert in the nuts. The inspector questioned the licensee as to why the recommendations had not been followed. The licensee stated that at the time it was believed that the bolts were failing due to their installation practices and the recommendations were not implemented. The inspector also found that a vendor service bulletin issued in October 1987 also recommended lubrication of the stud and fastener, but was not received on site until 1992.

On January 30, 1991, during a 24-hour load test, all four hold down bolts for Injection Pump 2L of SDG 13 sheared. The licensee conducted failure analysis and concluded that two of the bolts failed due to bending tensile overload. The remaining two bolts failed due to bending fatigue. The licensee's root cause analysis concluded that the failures were caused by overtorquing. The design and method in which the special tool was used may have over stressed the studs leading to their eventual failure. The licensee implemented a series of corrective actions. The licensee deleted the requirement governing the use of the special tool developed by system engineering from the maintenance procedure. The licensee sent the results of their analysis to Cooper Bessemer for further design review. Also, the licensee revised the technical manual for the SDG (14926-4041-01010-CE) to reduce the torque requirements for the hold down bolts to finger tight and changed the torque on the nut to 50 (0,-5) foot-pounds (see Section 2.2).

On November 23, 1991, the licensee discovered that the fuel injection pump for Cylinder 10L of SDG 22 was loose. In analyzing the bolts, the licensee determined that the failure was initiated by fatigue originating at the root of an external thread. The licensee concluded that their torque verification practice could possibly have induced additional stresses in the bolts and contributed to the failure. The failure was determined to be random and no additional actions were taken by the licensee. The licensee also conducted an evaluation to determine if the torque verification practice should be continued.

On March 6, 1993, while performing torque verifications on the bolts, the licensee discovered that one of the bolts on the Injection Pump 8L was broken. The licensee did not perform any failure analysis, but concluded that the root

cause of the stud failure was inadequate preload which caused loosening of the bolts, leading to their eventual failure. For corrective action, the licensee replaced all four bolts.

On March 27, 1993, while performing a 24-hour load test, the Injection Pump 5L of SDG 22 came loose from the engine. The licensee performed an analysis and concluded that two of the four bolts failed due to ductile tensile overload and the remaining two bolts failed due to fatigue. Based on a calculational analysis performed by a consulting organization, the licensee determined the root cause to be inadequate preload on the bolts which caused the bolts to loosen and eventually fail. In response to this failure and based on the consultant's recommendations, the licensee implemented the recommendations outlined by Cooper-Bessemer Engineering Standard 123 for all SDGs. Cooper-Bessemer originally recommended these actions to the licensee in 1990. This same guidance had been provided in a service bulletin in 1987, but the licensee indicated it had not reached the site until 1992. The recommendations included lubrication of the bolts and bearing surface of the nuts prior to installation, and adding the run down torque for the lock nuts to the total torque. Lubrication reduces the torque lost due to friction. The vendor stated that the other utilities that had followed these recommendations had not experienced significant hold down bolt failures. All bolts and locking nuts have been replaced in accordance with Cooper-Bessemer Engineering Standard 123 recommendations. These actions are currently complete for all SDGs. The licensee found by survey of other owners that there had been two other failures, both associated with fasteners that had not been lubricated. As a result of these actions, all the SDGs will be in the originally installed configuration. The licensee also deleted the torque verification procedure.

The inspector concluded that the licensee has determined an appropriate root cause and has taken appropriate corrective action that allows closure of this issue.

2.5 SDG Inoperability Due to Painting and Failure to Perform Post Maintenance Testing

This item was described during the diagnostic evaluation as follows: "SDG 13 was inoperable for 2 weeks because of the failure to perform adequate PMT after painting activities. The correct PMTA {post maintenance test activities} had been specified in the work package, but was inappropriately cancelled due to a concern over excessive SDG starts."

On December 29, 1992, contract painters had started to repaint SDG 13. They finished two days later. On January 20, 1993, SDG 13 failed to start during a monthly surveillance test due to paint which had been applied to the fuel injection pumps. The paint had run into the fuel metering rod ports which caused binding of the fuel metering rods. SDG 13 had been inoperable for 24 days following the painting. While SDG 13 was inoperable, SDG 12 was taken out of service for 61 hours. In addition, post maintenance testing (PMT) had not been performed after painting, which would have shown that the diesel was

inoperable. Additionally, post maintenance testing was not performed on a SDG output breaker after a fuel injector pump was replaced. During the maintenance activity, the output breaker was racked out to support work on the pump and then later incorrectly racked in. For the post maintenance test, the diesel was started, but the breaker was not tested. During a later surveillance test, the SDG output would not close on the bus.

Licensee Event Report 93-05 for Unit 1, Violation 9305-II.A/B/C, and Inspection Followup Item 9331-13 from the diagnostic evaluation documented the problems with painting and lack of post-maintenance testing.

The licensee determined that the root cause of the inoperable diesel due to improper painting was the lack of the application of proper work process controls. The licensee considered the painting procedure to be inadequate. Mandatory in-process controls and maintenance tests were not required when painting safety related equipment. In addition, an inappropriate decision was made to delete the post maintenance test requirement and an inadequate pre-job briefing was held. The licensee determined that the root cause of the lack of testing of the breaker was poor maintenance by unlicensed operators and weak PMT that did not account for the breaker being racked out.

The licensee's immediate corrective action for clogged fuel metering rods was to clean and lubricate them. SDG 13 was successfully tested and returned to service on January 22, 1993. The inspectors reviewed the PMT Reference Manual, Revision 8 which was revised September 17, 1993. The manual was revised to require PMT to be performed following painting. The inspectors also reviewed Procedure OPMP06-ZD-0001, "Paints and Coatings," which was revised to include requirements for performing a pre-job briefing and an operational impact assessment. The procedure also added an attachment for the diesel for additional controls which included manually operating the fuel racks at least once per 24 hours during painting, and declaring the SDGs inoperable but functional.

As part of the corrective action, the licensee performed a communications case study of the SDG event, "Inappropriate voiding of a post maintenance test for an SDG," dated July 19, 1993. The case study described the events leading up to the painting and the failure of the diesel due to binding of the fuel metering rods. The NRC violations and corrective actions were discussed during the training. This training was presented to shift supervisors and maintenance planners in their continuing training programs in July and August of 1993. Training for the system engineers in the SDG 13 Communications Case Study was completed by September 30, 1993.

The licensee was in the process of formulating a corrective action plan which would assure that contractors would be properly trained and knowledgeable of the job requirements. The licensee stated that their plan for contractor control will include a technically knowledgeable contract technical manager and contract technical coordinator who would assume ownership of the contract. These STP employees would be responsible for preparing an oversight plan which would be tailored to the size of the activity and the work to be performed.

The licensee believed that this oversight plan will insure adequate supervision by STP.

The corrective actions for the breaker included racking in the breaker and verifying that it was functional. The non-licensed operators who had failed to correctly rack in the breaker were counseled by management. The inspectors reviewed the PMT Reference Manual, Revision 8, dated September 17, 1993. The manual was revised to require that breakers which had been racked out were tested.

The inspectors concluded that corrective actions were appropriate and had been completed by the licensee.

2.6 SDGs Tripping During Cooldown Cycle

Section 6.3 of NRC Inspection Report 50-499/92-14;50-499/92-14 addresses trips of Unit 2 SDGs during the automatic 5 minute cooldown cycle following a test run. The licensee isolated the cause of SDG trips during the cooldown cycle. It was determined that the root cause was loss of air pressure to the nonsafety trip switches during the cooldown cycle. When the SDG control switch is placed in the STOP position, the automatic 5 minute cooldown cycle is initiated. At the same time, air pressure in the air shutdown system header is vented and makeup air is discontinued. Air pressure on the nonsafety trip switches is maintained by check valves. However, it has been determined that the check valves leaked. This, in turn, caused a loss of air pressure to the trip switches which caused an SDG trip.

Following root cause determination, the licensee considered multiple actions to address the problem. The action selected was a design change which would maintain air pressure to the shutdown air header at all times instead of just when the SDG is operating. With this change, the nonsafety trip switches have adequate air pressure at all times, thereby eliminating trips during the cooldown cycle. The change added the advantage of eliminating nonvalid trips that have occurred when the SDG is transferred from emergency mode to test mode following a start for test purposes. The design change also included deletion of nonsafety oil pressure trips which duplicate the functional safety-related oil pressure switches. This deletion made the SDG control system less complex and, therefore, more reliable. In addition, maintaining the SDG pneumatic control system pressurized at all times will address the concern regarding moisture in the pneumatic controls raised by the Assessment Team in the "Independent Review of Emergency Diesel Generator Reliability."

The above design changes have been reviewed by Sargant & Lundy, Engineers, as well as the SDG vendor. The changes were found to be acceptable and have been implemented in accordance with Modification Packages 92-M-0028 and 92-M-0029. The inspector conducted a review of the licensee's corrective actions and found them to be responsive to the original inspection report concerns; i.e., SDG availability will not be impacted [illegible] times during the cooldown cycle. The corrective actions are consider[illegible] riate and this item is closed.

2.7 SDGs Had a High Level of Unavailability Relative to Compliance With the Station Blackout Rule

Section 4.5.2 of Inspection Report 50-498/92-21;50-499/92-21 questioned the higher than expected unavailability of the SDGs for Units 1 and 2, relative to compliance with the Station Blackout Rule (10 CFR 50.63).

The inspector found that SPR 92-0197 had been issued by the licensee on May 19, 1992, to identify that the SDG unavailability factor was 0.039 for Unit 1 and 0.043 for Unit 2 as compared to the target of 0.025 selected by the station. The inspector found that the unavailability data provided by the licensee indicated a general decrease in unavailability for the SDGs in both units. The unavailability factor at the end of 1992 was 0.025 for Unit 1 and 0.026 for Unit 2. With both units shutdown in early 1993, the unavailability data for 1993 was not considered by the inspector to be a valid indicator.

The inspector concurred with the licensee's conclusion that while unavailability is a measure of downtime, the blackout rule relates to reliability factors which are a measure of valid failures as defined in Nuclear Management and Resources Council (NUMARC) 87-00, Revision 1, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactor." In accordance with Section 3.2.4 of NUMARC 87-00, the licensee has selected a reliability targeted at 0.975 for determining their required station blackout coping duration. Specific actions and trigger values are established based on 20, 50, and 100 SDG demand totals for each unit. Remedial actions are required for individual failures and exceeding one or more trigger values. Trigger values are 3 failures in 20 demands, 4 failures in 50 demands, and 5 failures in 100 demands. Failure data provided by the licensee for Unit 1 recorded two valid failures in 1992 and two valid failures in 1993. The inspector found from a review of the data that no trigger values were exceeded in that time period. The failure data provided by the licensee for Unit 2 recorded no failures in 1992 and one failure in 1993. Considering the stud bolt failures as valid failures adds one more failure to Unit 2 for 1993, but no trigger values were exceeded. As a result of SPR 92-0197, the licensee has changed from a standard four limiting condition for operations (LCO) outages to two LCO outages per year to reduce unavailability. Personnel have also been directed to coordinate diesel work activities for optimum diesel outage utilization.

There currently is one outstanding SPR 93-3154 to assure that there is adequate procedural guidance to meet the Station Blackout Rule. This SPR is identified in the operation readiness closure package as a restart restraint.

2.8 Conclusion

The inspectors found that sufficient improvements have been accomplished for the Unit 1 SDGs, that the restart issues identified in Inspection Report 50-498/93-31;50-499/93-31 are considered closed.

3 OTHER ACTIVITIES ASSOCIATED WITH SDG RELIABILITY

3.1 SDG Spurious Starts

On October 11, 1993, after completion of a modification to maintain air pressure to the air shutdown system, and prior to beginning the PMT, SDG 12 received a spurious start signal; however, the engine did not roll. During troubleshooting, the licensee tested various components in the start circuitry located on fiber optic Board D. The fiber optic board provided the interface between safety and non-safety circuitry. Analysis of the component data indicated that this circuitry generated the start signal. The board was subsequently replaced. After the board was replaced, on October 13, 1993, the diesel received another spurious start signal. The licensee then replaced fiber optic Board B. The fiber optic boards were identical in function and were utilized to provide redundancy in the starting circuitry.

During temperature testing of the board, the licensee noted that an output transistor on the board conducted (turned on) at approximately 107° F. Conduction of this transistor would have generated the start signal. The normal temperature rating of the transistor is 150° F. Further testing of additional components on the board revealed that three varistors were degraded. In this application, varistors were used to disperse stored energy in the control circuitry, particularly that of the solenoid. Since the varistors were degraded, the stored magnetic field energy in the solenoid and/or relays was not dispersed. This caused voltage spikes in the control circuitry. The licensee concluded that these voltage spikes were sufficient enough to change the operating characteristics of the transistors with respect to temperature and voltage sensitivity. The licensee's troubleshooting report for this incident indicated that voltage spikes with a magnitude of several kilo-volts were transmitted instantaneously to the transistor.

On October 19, 1993, SDG 12 successfully passed a test run conducted in accordance with operating procedure OPOP02-DG-0002, "Emergency Diesel Generator 12(22)."

In October 19, 1993, while in auto standby, SDG 22 started, inadvertently. This event was documented in Preliminary Station Problem Report 933005, dated October 19, 1993, and also in Preliminary LER 93-015, dated November 18, 1993. The diesel was immediately placed in cooldown and the sequencer reset. After a complete cooldown, the diesel's handswitch was placed in the "Pull to Stop" position. During troubleshooting, excessive voltage spikes were detected in the control circuitry of fiber optic Board B. Since the preliminary failure indications were similar to those experience by SDG 12, thirteen varistors were removed and tested. Of the thirteen, ten were outside the manufacturers tolerances. The board was then temperature tested. As seen during testing of SDG 12, the board's output transistor operated at 107° F. The licensee then replaced all varistors and transistors on the board.

In assessing the significance of the event, the licensee concluded in a preliminary copy of SPR 933005, that failure of the varistors and transistors

did not affect emergency operation of the SDGs. The varistors and transistors which were part of the test mode circuitry (fiber optic Boards B and D) were nonsafety related and did not affect emergency diesel starts. During accident conditions, the SDGs are automatically started in the Emergency Mode. Emergency Mode circuitry was relay based and did not contain the varistors and transistors included in the test mode circuitry.

Since the events are still under investigation, the licensee has the following corrective actions planned:

- Complete their engineering evaluation to determine the cause of the varistor degradation. Industry has not experienced significant varistor failures.
- Establish PMs for the varistors.
- The control circuitry vendor and the varistor vendor have been requested to conduct independent reviews of the failures.

The licensee has completed the following actions which the inspector concluded will correct the spurious start problem for both units for the near term operation of the SDGs:

- Identify and replace the affected varistors and transistors during the simulated testing.
- Incorporate performance characteristics of the varistors into the SDG vendor manual.
- Install ventilation fans in all SDG's control cabinets.

Since this issue is still under investigation, the inspectors identified review of the licensee's corrective actions as Inspection Followup Item 498;499/9344-01.

3.2 SDG Incorrect Fuse Installations

During trouble shooting of SDG 12, the licensee found discrepancies between actual installed fuses F-D19 and F-D20 and vendor drawing requirements. The vendor drawing showed a requirement for three amp fuses. The actual installed fuses were 2 amp. This could result in early failure of the fuses and a decrease in SDG reliability. SDG 11 and 13 circuits were checked and had 3 amp fuses installed. The licensee prepared SPR 932977, dated October 15, 1993, to address the problem. The licensee determined that the root cause of the problem was configuration control due to a repair/rework activity of replacing a part without verifying its suitability.

The licensee's immediate corrective action was to revise the existing service request to replace the 2-amp fuses with 3-amp fuses for SDG 12. In addition, SDGs 11 and 13 were walked down and 3-amp fuses were found installed.

For additional corrective action, the licensee has planned training for January 1994 for electrical and I&C personnel. The training will discuss SPR 932977 in general and will also include discussions on the method for determining the proper fuse replacement, the importance of providing accurate documentation when fuses are replaced, and the importance of maintaining configuration control.

The licensee has undertaken as a restart restraint, a walkdown of fuses for Units 1 and 2 which will be completed prior to entering Mode 2 for each unit. The licensee identified 27 systems for the walkdowns which were defined as safety significant, based on their core damage frequency contribution and potential for plant trip. The Units 1 and 2 SDGs were included in the 27 systems to be walked down. At the time of this inspection, Trains A and C of the Unit 1 SDGs were walked down. One incorrect fuse was found in each train.

The inspectors reviewed an office memorandum dated October 29, 1993, concerning in-plant fuse installation. The memorandum stated that only electrical and I&C personnel would be allowed to install fuses, like for like replacement of fuses would no longer be allowed, future fuse replacements would be done utilizing the controlled fuse list, and/or controlled electrical wiring diagrams and replacement fuses would be documented on control forms. This memorandum was an interim method of controlling fuses prior to the implementation of a long-term fuse control program.

The inspectors identified the review of the licensee's training scheduled for January 1994 and the completion of the Unit 1 Train B fuse walkdown as Inspection Followup Item 498;499/9344-02.

3.3 Absorbent Material Found in SDG 23 Cam Gallery

During the PM inspection of SDG 23, absorbent material was found on the right side of the cam gallery in two different locations. The licensee had this event under review. The inspector was informed that the last time the cam covers had been removed was by a contractor and that the new dedicated organization had not been involved. The licensee's disposition of this issue is identified as Inspection Follow Item 498;499/9344-03.

3.4 Implementation of Cooper-Bessemer Owners' Group Recommendations

The purpose of this part of the inspector's review was to assess the extent to which STPEGS has implemented the Cooper-Bessemer Owners' Group (CBOG) recommendations relating to SDG reliability. Utilization of industry experience available through the CBOG has been shown to be effective in increasing reliability of SDGs. The inspector's review consisted of interviews with cognizant STP personnel and a review of available data pertinent to this issue.

In general, the inspector found that the licensee has implemented or has formulated plans to implement all CBOG recommendations. The licensee also has available data pertaining to CBOG operating experience other than that covered by CBOG recommendations. This data is found in the minutes of the CBOG Technical Committee meetings, such as the minutes for the meeting held on August 31 through September 1, 1993. Some representative CBOG recommendations are listed below.

CBOG RECOMMENDATIONS	STPEGS ACTION
High pressure fuel line replacement	Implemented
Fuel injection nozzle tip purging/ replacement	Implemented
SDG governor upgrade	Scheduled for 1994
Changes to SDG inspection procedures	Implemented
Removal of piston pin caps and lower oil scraper ring	Implemented on individual pistons when they are removed
Replacement of rocker arm lube oil lines	Implemented
CBOG PUBLICATIONS	**INSPECTOR COMMENTS**
MPR-1399 Emergency Diesel Generator Lubricating Oil and Jacket Water Analysis Guidelines	Document provided both the academic perspective and good practical application guidelines
MPR (Un-numbered) Revision 2 Inspection Manual for Cooper-Bessemer Model KSV Diesel Engines	Document provided good practical application instructions
MPR-1376 Cooper-Bessemer Model KSV Emergency Diesel Generator Engine Analysis Guidelines	Good document from the academic perspective but lacks data for specific application to the Beta analyzer used at STPEGS (CBOG will address practical application in a later revision)
MPR-1403 Root Cause Evaluation of Lower Cylinder Liner Expansion Seal (Wrinkle Belly) in Cooper-Bessemer Model KSV Diesel Engines Preliminary, August 1993	Good historical document on seal problems, but lacks practical data on how seals should be installed to preclude stresses/damage (CBOG will address practical applications in later revisions)

In summary, the inspector concluded that the licensee has taken action to implement all CBOG recommendations and is an active supporter of the CBOG. The inspector further concluded that association with the CBOG has had and will continue to have a beneficial impact on SDG reliability. The inspector

did observe that not all cognizant SDG personnel are routed the minutes of the Technical Committee meetings for review to determine if any of the operating experience included has applicability to the SDGs and should be incorporated into appropriate STPEGS documents.

3.5 Inspector Walkdown of SDGs

The Inspectors performed a general walkdown of the Unit 1 SDGs. Observations are provided below.

- Diesel condition and appearance was generally good. Oil leakage was minimal. In some areas, paint would improve the appearance.

- The inspectors observed that the new cooling fans installed in the control panels had generally resolved the heating problem from internal energized components. The inspectors also observed the new varistors that had been installed to minimize voltage surges.

- The inspectors noted that a number of jerk pumps had been replaced. The licensee indicated these had been replaced in balancing the SDGs.

- The inspectors found that the lock wires for the blowdown adjustment port were missing from the two ASME code relief valves installed on the air receivers for SDG 13. The licensee stated that a SPR would be initiated.

- The inspectors noted that the emergency fill valves on the SDG building roof had not received any preventive maintenance and were generally in a rusty-degraded condition. Establishing proper equipment and procedures for emergency fill was currently identified by QA as restart restraint in the operation readiness closure package.

The inspectors inspected the Technical Support Center diesel. This diesel is located outside and subject to outside weather since it has only a roof. Several conduits into an outside junction box were observed to be unsealed. The licensee noted the inspectors observation for appropriate corrective action. The licensee indicated that plans are under way to enclose the diesel.

The inspectors observed the boroscopic examination in progress on SDG 23. The equipment utilized by the licensee provided excellent resolution and the process was all recorded on video tape. Quality control coverage was present throughout the examination.

4 LICENSEE OPERATIONAL READINESS CLOSURE PACKAGE FOR RESTART ISSUE No. 11

In response to the NRC Diagnostic Evaluation Team Report and NRC Inspection Report 50-498/93-31;50-499/93-31, which identified specific SDG restart issues as Restart Issue No. 11, the licensee prepared an "Operational Readiness

Closure Package No. 11, Standby Diesel Generator Reliability," dated December 3, 1993. Section 5 of this report provided the status of the restart issues identified in NRC Inspection Report 50-498/93-31;50-499/93-31.

In addition to responding to the NRC SDG restart issues discussed above, the licensee performed three independent assessments and a self assessment. The first of the independent assessments was performed by QA in March 1993, the second was performed by a group of industry and station personnel in October 1993, and the third was performed by the Chief Control Design Engineer of Cooper Bessemer on October 27, 1993, and December 16, 1993. The self-assessment was conducted by system engineering, based on all actions that have been taken and included as part of the Restart Issue No. 11 closure package. Each of these assessments was reviewed by the inspectors, as discussed below. Implementation of the recommendations resulting from these assessments has been identified by the licensee as either startup restraints or longer term actions.

The licensee has also completed simulated testing for all SDGs and corrective actions have been identified. The licensee closure report also addressed the staff action on SDG inoperable cylinders as discussed below. All issues in the closure package are being entered into the system engineering computer tracking system. Some have resulted in station problem reports, but will also be separately tracked. The disposition of all the open issues identified by the licensee will be reviewed by the inspectors prior to startup of Unit 1. The licensee stated that any additional SDG issues which occur will also be classified and entered into the tracking system. Followup of the licensee's tracking and disposition of all open issues identified in the closure package is identified as Inspection Followup Item 498;499/9344-04.

4.1 Quality Assurance Report of Standby Diesel Generator Review

The inspector was informed that this was an assessment conducted in March-April 1993 by 18-20 personnel from the QA organization over approximately a two-week period. There was a lead for each of the areas assessed (procedure/design, maintenance, and corrective action) and an overall coordinator. Weaknesses were identified in procedures, evaluation and implementation of industry information, configuration control during the conduct of maintenance, corrective actions, and training of station personnel. Each of these issues have been addressed by station problem reports and are being separately tracked by QA for closure. Also, 31 items were identified by QA as noteworthy and are identified as startup restraints in the SDG startup closure report. Among these items was the failure to have provided the hoses and procedures necessary for emergency fill from the SDG building roof. There was also a category called "other issues," which QA was tracking.

The inspector considered the assessment to be of good quality. Tracking and disposition of the assessment recommendations will be reviewed by the inspector prior to restart of Unit 2 (see paragraph 4.0).

4.2 Independent Review of Emergency Diesel Generator Reliability

This independent review was conducted by four personnel from industry and one licensee person. All had emergency diesel generator experience and expertise. The group was chartered to assess the adequacy of the SDGs and support systems to perform their design functions and to provide recommendations for areas of improvement. Their review included system performance and operating history, station practices and procedures, material conditions, service requests and station problem reports, reliability information, failure trends, root causes, testing practices, design basis documents, and technical specifications. Most of the recommendations from this review (35 of 40) are not identified as restart restraints, but are considered as longer term actions. The inspector found this to be acceptable.

Overall, the assessment was found to be objective. The inspector took exception to the summary statement regarding capability of the SDGs to operate for 7 days, when in fact the SDGs should be capable of long term operation. The report does state that the recommendations included in the report were intended to improve overall reliability of the SDGs and that no safety concerns were identified.

The inspector had the following observations on selected recommendations in the assessment.

- Testing Practices

  In general, the inspector found the recommendations made in this section of the report to be acceptable. However, the recommendation regarding changing the STPEGS selected SDG reliability value from 0.975 to some lesser value was questioned. This value was established as a function of the STPEGS Station Blackout Coping Analysis which considers the offsite power configuration. Changing this value will require another coping analysis.

  With respect to SDG testing frequency and methodology, the inspector discussed with the licensee's staff proposed changes to STPEGS Technical Specifications (TS) which are planned to reduce stresses imposed on SDGs by testing. TS changes discussed include limiting fuel rack settings during surveillance starts, a load range for surveillance testing to eliminate overloading, reduction or elimination of accelerated testing, slow loading, and engine prelube. Some TS changes have already been submitted for approval, and others will be submitted in the near future.

- Design - Moisture in Air Intake System

  The inspector considers the assessment team recommendations to initiate a design change to provide automatic temperature control of intake combustion air at the earliest opportunity to be an important

improvement in reducing excessive intake moisture. In the interim, the inspector discussed with the licensee the implementation of some form of manual throttling of the cooling water to the intercooler to minimize problems associated with low temperature combustion air moisture.

- Organization

  The inspector found the assessment team recommendations for assignment of dedicated personnel to provide for improved support of SDG related activities. This included assignment of dedicated maintenance personnel.

- Design Issue - Controls

  The inspector found that a complete design review of SDG control circuitry has been completed as recommended by the assessment team. Enhancements to both the electronic and pneumatic portions of the circuitry have been implemented. These changes have been reviewed by the vendor and found to be acceptable. Additional cooling has been added to the control cabinets, and STPEGS is planning to change SDG governors from the Woodward 2301 to a 2301A or 701 series governor. The inspector concluded that all these actions were significant improvements.

- Design Issue - Generator Synchronization

  The inspector considers that the assessment team recommendation to install a synchronizing check system will provide improved protection against SDG damage caused by paralleling with the grid out of phase.

- Spare Parts

  The inspector observed that the assessment team recommendations may duplicate the generic recommendations for spare parts which is being addressed by the CBOG.

- Material Condition

  The inspector concurred with the concept of trending NPRDS SDG failure data as recommended by the assessment team. The inspector also discussed the use of such data as an input to a reliability centered maintenance (RCM) program to support minimizing "open and inspect" activities and as a means of determining SDG "health" and maximizing SDG reliability.

- Station Procedures

  The inspector concurred with the observation that there were limited SDG procedures for maintenance activities. The inspector observed that the

recommendation for a qualified individual to review all developed procedures to ensure compatibility with vendor recommendations and appropriate craft practices was significant based the past history of procedure inadequacies.

- Emergency Diesel Generator Trending

  The inspector concurred with the assessment team recommendation that the trending program be resumed. Trending is identified in the restart readiness report as a restart restraint. The inspector discussed with the licensee the use of SDG trending data in a RCM program.

- Crankshaft Web Deflection Measurement

  The inspector concurred with the assessment team recommendations to perform web deflection measurements to assure that crankshaft alignment is maintained. The inspector discussed the implementation of deflection measurements as a part of their planned RCM program wherein inspection requirements and frequency are determined as a function of vendor recommendations and operating experience.

- Starting Air Systems - Dew Points

  The inspector concurred that the assessment team is correct with respect to moisture in pneumatic controls causing problems. However, the inspector observed that the failure to perform dew point checks on a frequent enough basis may not be the cause of moisture collecting in pneumatic controls. The pneumatic control systems for the SDGs were designed to be depressurized when the SDGs are not operating. With the pneumatic control systems depressurized at all times, except for brief periods during SDG surveillance testing, moisture from the atmosphere may enter the system via venting orifices and condense. This problem has recently been solved by a design change to the pneumatic control systems which includes provisions for maintaining the systems pressurized with dry air at all times.

  Tracking and the disposition of the assessment recommendations will be reviewed by an inspector prior to restart of Unit 1. Only five were classified as restart restraints (see Section 4.0).

4.3 Chief Design Control Engineer of Cooper-Bessemer Assessment of the SDG Control System

This assessment was initiated on October 27, 1993. It was not completed pending revision to vendor drawings to include the large number of outstanding changes that have not been incorporated into the drawings. The initial review did result in a number of findings, including the identification of a ground wire which had been added to the speed monitor case ground termination case on four of the SDGs, which could have prevented an SDG emergency start with a

proper ground fault; the potential for heat problems in the control panels; the jumpering of circuits rather than removal of the circuits; and additional relays without varistors for surge protection.

The assessment was completed on December 16, 1993, following the incorporation of outstanding changes into the vendor drawings. It was concluded that no control panel modifications were found which would have prevented the SDGs from performing their safety related functions. It was recommended that a thorough check of the drawings be performed. The licensee has indicated that they are considering further checks of the drawings during system engineer walkdowns.

The inspector observed that this assessment was an important step in demonstrating the overall adequacy of the SDG controls.

Tracking and disposition of the assessment recommendations will be reviewed by the inspector prior to restart of Unit 1 (see Section 4.0).

4.4 System Engineering Self Assessment

The self assessment concluded that the completion of the recent three train outages to perform maintenance, including the use of simulated testing to verify control board function (being incorporated into the PMT program); and the completion of the three independent assessments provided a high level of assurance that the SDGs will perform in a reliable manner.

Areas categorized as strengths include:

- Assignment of a dedicated project manager, planner, and maintenance teams
- Establishment of a new SDG system engineering section (five engineers assigned)
- Licensee design engineer is chairman of the Cooper-Bessemer Owners Group
- Development of a simulated test capability
- New vendor manual to combine electrical and mechanical sections (1/30/94)
- Establishment of new work control process and plant change program
- Establishment of system readiness review committee

Areas categorized as weaknesses (restart restraints pending completion of corrective action)

- Failure to maintain SDG system trending program

- Failure to update design drawings

- Failure to evaluate I&C maintenance training

The assessment also discussed action in progress to improve reliability including the completion of all open items identified by the system readiness review. The establishment of a RCM program was discussed by the inspector with the licensee. The licensee has indicated the present proposed program is considered preliminary and will require major review and rework.

Tracking and the disposition of assessment recommendations will be reviewed by the inspector prior to restart of Unit 1 (see Section 4.0).

4.5 Licensee Identified Restart Restraints

The inspectors selected a sample of the licensee's "Operational Readiness Closure Package 11 for SDG Reliability," dated December 3, 1993, identified restraints for review.

- Station Problem Report (SPR) 932244.

  SPR 932244, dated July 19, 1993, was prepared to describe a problem with low lubricating oil in a SDG 13 bearing. Preventive maintenance (PM) had been performed to change the lubricating oil in the bearing in July 1993. Nine days later, a plant operator discovered the oil level to be low for this bearing. The licensee determined that the cause of the event was that the PM work instruction did not agree with the vendor manual concerning the height to fill the bearing.

  The licensee revised PM 91000011 to be in agreement with the vendor manual and to require an independent verification to assure the oil level was satisfactory.

  The inspectors concluded that the licensee's corrective actions were appropriate to resolve this problem.

- SPR 931221

  SPR 931221, dated April 4, 1993, was initiated as a result of the licensee discovering that the seat plate gasket and seat plate spring had been identified as missing during a disassembly of the fuel oil filters of SDG 22. The licensee determined that the root cause was the omission of relevant information from procedure work instructions. The licensee found that surveillance procedure OPSP04-DG-0001 did not identify the washer or gasket.

  The licensee's immediate corrective action was to replace the missing washers. In addition, the inspectors reviewed procedure OPSP04-DG-0001, "SDG 18 Month Surveillance Test," Revision 9, which had been revised to

include all fuel oil filter and strainer parts including the order in which they were to be disassembled and assembled.

The inspectors concluded that the licensee's corrective actions were satisfactory.

- SPR 932822

The inspector reviewed SPR 932822, dated September 28, 1993. This SPR was initiated because the licensee found that the end cover gasket on SDG 12 turbocharger intercooler was loose in one area and bowed. The licensee determined that the essential cooling water pressure had bowed the gasket and raised an area that could have broken loose and possibly plugged the intercooler tubes. The licensee discovered that DCN MM 1312 had amended the Cooper Bessemer maintenance manual by providing an incorrect sketch for making gaskets for the end covers.

The licensee determined the cause of the incorrect gasket was incorrect information in the design documents and failure of reviewers to find the error during the review cycle.

Corrective actions included reviewing the maintenance manual and determining that other heat exchanger gaskets had not been altered. In addition, the licensee corrected the maintenance manual and inspected each SDG intercooler to insure the correct gasket application. The inspectors concluded the licensee's corrective actions were satisfactory.

- Plant Change Form (PCF) 171531-A

The inspector reviewed PCF 171531-A, dated November 4, 1992, which was prepared to replace the SDG 12 fuel oil tank narrow range level instrument. The narrow range level instrument was replaced with a MTS sensor and an Incon level monitor. The modification was performed because the original sensors and monitors were difficult to calibrate and would maintain calibration for only a short time.

The inspector concluded that the modification package and the work instructions were thorough.

- PCF 213161-A

The inspector reviewed PCF 213161-A, dated September 25, 1993, which added sampling lines with isolation valves to the lube oil system. The sampling lines were added to the pressure indicator tubing just outside the root valve from the six-inch engine driven pump discharge line and the inlet of the lube oil filter. This modification was prepared because the original sampling line was too far away from the main line to obtain a representative sample.

The inspector walked down the modification and found that the documentation and the actual installation were in agreement.

- Design Change 89-M-0045

The inspector reviewed design change 89-M-0045, initiated December 18, 1989, and closed April 30, 1993. This modification was prepared to reduce the SDG fuel oil line pressure from the fuel oil booster pump to the injection pump from 52 psig to 35 psig to conform to original design parameters. The purpose for reducing the pressure was to reduce the fuel oil leakage at all the connections.

The reduction in pressure was accomplished by replacing a pressure relief valve with a relieving pressure of 52 psig with a pressure relief valve, modified to be a pressure regulator, with a relieving pressure of 35 psig. The replacement valve was designed to allow small amounts of process fluid to leak by when in the closed position to prevent the valve from chattering.

The inspector walked down the modification and determined that the installation was in agreement with the design change package. The inspector concluded that the licensee's actions to resolve the licensee-identified restart restraint items were progressing satisfactorily.

4.6 SDG Inoperable Cylinders (NRR Request; ST-HS-26309)

The licensee has classified some failures of SDGs at STPEGS that are associated with failure of injector (jerk) pump hold down bolts as being nonvalid failures because the SDGs remained operable. The basis for this position is (1) all stud failures have occurred when the SDGs were running, and (2) once they are running, the SDG can carry design rated load (5500 kW) on 18 of 20 cylinders without excessively stressing the engines. Item (2), in turn, is based on data provided by the vendor, Cooper Industries. The following is the inspectors review of the licensee/vendor positions as concurred in by NRR.

The SDG engines at STPEGS are Cooper-Bessemer Model KSV-20-T, 20 cylinder, turbocharged/intercooled, four-stroke diesel engines. Per the vendor, the design brake mean effective pressure (BMEP) for these engines at 5500 Kw is 214 psi. BMEP is calculated from the brake horsepower (BHP). BHP is the horsepower an engine is capable of producing under increasing load at a set speed without a reduction in speed. The engines are also designed for a 10 percent overload for 2 hours out of an average 24 hours. This equates to a BMEP of 236 psi. The vendor has also stated that the KSV series of engines has been successfully tested at 250 psi BMEP.

In light of the above, it can be concluded that the licensee's position is conceptually valid; i.e., the BMEP at 5500 Kw on 18 cylinders would be 236 psi. Assuming worst case accident conditions, the SDGs would, in concept,

be able to carry accident loads without excessive engine stresses. However, the above could only be accomplished if (a) the diesel engines are balanced (each cylinder carries an equal load), and (b) the hold down stud failures on two cylinders occur only after all accident loads have been sequenced on and are operating at maximum output; i.e., the SDGs would not be required to accept and accelerate any large loads with less than 20 cylinders operating.

The inspectors reviewed available data to determine if conditions (a) and (b) above had been adequately addressed. The following are the results of the inspectors' review which has been concurred in by NRR:

- Engine analyzer data showed that engine operation is extremely erratic, with cylinder peak firing pressures varying as much as 130 psi on a single cylinder. Since engine balance is established using peak firing pressures, this erratic operation made it impossible to determine if the engines are balanced. In light of this, there is no valid conclusion that can be reached at this time with regard the licensee's position regarding SDG operability with less than 20 cylinders operating.

- The inspectors did not determine if Condition (b) had been addressed pending further discussion with the licensee.

This item will remain as a separate open NRR staff action until it can be determined why the engine peak cylinder firing pressures are so erratic and the condition is corrected, or it is determined that this is normal. Further information is needed to interpret analyzer data and to demonstrate proper engine balance. This issue is not considered to be a restart restraint.

5 STATUS OF ITEMS RELATED TO RESTART ISSUE 11 AS IDENTIFIED IN 498;499/9331

5.1 (Open) Inspection Followup Item 498;499/9331-08: Ineffective Corrective and Weak Preventive Maintenance Significantly Contributed To Poor Equipment Performance

Based on the licensee's corrective action described in Section 2.3 of this report, this item is closed for Restart Issue 11.

5.2 (Open) Inspection Followup Item 498;499/9331-09: Ineffective Corrective Maintenance, Caused By Inadequate Root Cause Analysis, Poor Prioritization of Work, and Poor Craft Performance, Adversely Affected Safety-related Equipment Performance

Based on the licensee's corrective action described in Section 2.4 of this report, this item is closed for Restart Issue 11.

5.3 (Closed) Inspection Followup Item 498;499/9331-11: Standby Diesel Generator (SDG) Injector Pump Hold Down Bolts Failed On Nine Separate Occasions

Based on the licensee's corrective action described in Section 2.4 of this report this item is closed.

5.4 (Open) Inspection Followup Item 498;499/9331-12: SDG Fuel Oil Injector Pump Hold Down Stud Failures Due To a Deficient Stud Driver Tool Designed By the System Engineer

Based on the licensee's corrective action described in Section 2.2 of this report, this item is closed for Restart Issue 11.

5.5 (Open) Inspection Followup Item 498;499/9331-13: PMT Program Implementation Weaknesses.

Based on the licensee's corrective action described in Section 2.5 of this report, this item is closed for Restart Issue 11.

5.6 (Open) Inspection Followup Item 498;499/9331-18: The Engineering Departments Gave Weak Support in Resolving Plant Problems

Based on the licensee's corrective action described in Section 2.4 of this report, this item is closed for Restart Item 11.

5.7 (Open) Inspection Followup Item 498;499/9331-19: Configuration Control Weaknesses Which Adversely Affected Safety-related Plant Equipment Were Noted in SDGs Rocker Arms

Based on the licensee's corrective action described in Section 2.1 of this report, this item is closed for Restart Issue 11.

5.8 (Open) Inspection Followup Item 498;499/9331-28: An Example of Inadequate Root Cause Analysis Was the Licensee's Failure to Identify the Root Cause Of Repeated Failures Of SDG Fuel Injector Hollow Hold-down Bolts

Based on the licensee's corrective action described in Section 2.4 of this report, this item is closed for Restart Issue 11.

5.9 (Closed) Violation 498/9305-II.A/B/C: SDG 13 Declared Inoperable Due To Improper Painting and No PMT

This item is closed based on the licensee's corrective actions described in Section 2.5 of this report.

5.10 (Closed) LER 9305, Unit 1: Failure of SDG To Start Due To Improper Painting and No PMT

This item is closed based on the licensee's corrective actions described in Section 2.5 of this report.

5.11 (Closed) Inspection Followup Item 498;499/9214-03: SDG Tripped During Cooldown Cycle Several Times

This item is closed for Restart Issue 11 based on the licensee's corrective actions described in Section 2.6 of this report.

5.12 (Closed) Inspection Followup Item 498;499/9221-03: SDG Unavailability Relative To Station Blackout Rule

This item is closed for Restart Issue 11 based on the licensee's corrective actions described in Section 2.7 of this report.

6 NEW ITEMS RELATED TO SDG RELIABILITY

6.1 (Open) Inspection Followup Item 498;499/9344-01: SDG Spurious Starts

This item is open pending completion and review of licensee's corrective actions described in Section 3.1 of this report.

6.2 (Open) Inspection Followup Item 498;499/9344-02: SDG Incorrect Fuse Installations

This item is open pending completion and review of licensee's corrective actions described in Section 3.2 of this report.

6.3 (Open) Inspection Followup Item 498;499/9344-03: Absorbent Material Found in SDG 23 Cam Gallery

This item is open pending completion and review of licensee's corrective action described in Section 3.3 of this report.

6.4 (Open) Inspection Followup Item 498;499/9344-04: Tracking and Disposition Of All Open Issues Identified the Licensee's Closure Package

This item is open pending inspection of licensee's action relative to open issues described Section 4.

7 ASSESSMENT OF MANAGEMENTS RECEPTIVENESS TO IDENTIFYING AND CORRECTING PLANT PROBLEMS

The inspector determined that the current licensee management had responded in a aggressive manner to the problems identified with the standby diesel generators. The performance of three independent assessments and a self assessment to improve SDG reliability exemplifies management's efforts. The

assessment to improve SDG reliability exemplifies management's efforts. The long term implementation of the assessment recommendations and other licensee corrective actions was determined by the inspectors to be the key to the continued improvement in SDG reliability.

ATTACHMENT 1

1 PERSONS CONTACTED

1.1 Licensee Personnel

*M. Berg, Manager, Design Support, HL&P
*H. Butterworth, Unit 1, Operations Manager, HL&P
*T. Cloninger, Vice President Nuclear Engineering, HL&P
*K. Coates, Unit 2 Manager, HL&P Maintenance
*J. Conly, Licensing Engineer, HL&P
*W. Cottle, Group Vice President Nuclear, HL&P
*F. Cumeaux, Consultant Engineer
*P. Dahl, Consultant
*D. Daniels, Administrator Corrective Action Group
*R. Ferguson, Consultant/Licensing Engineer, HL&P
*D. Fisher, Spur Engineering Specialist, HL&P
*J. Groth, Vice President, Nuclear, HL&P
*R. Helton, Unit 1 Manager Assistant, HL&P
*J. Johnson, Supervisor Quality Assurance, HL&P
*T. Jordan, Manager, Systems Engineering, HL&P
*W. Jump, Director, Regulatory, HL&P
*B. MacKenzie, Senior Consulting Engineer, HL&P
*A. McIntyre, Manager, Engineering Support, HL&P
*M. Pacy, Manager, Engineering Program, HL&P
*P. Parrish, Senior Specialist, HL&P
*S. Parthasarathy, Support Engineer, HL&P
*R. Rehkugler, Manager Quality Control/Maintenance, HL&P
*D. Rencurrel, Unit 2 Maintenance Manger Assistant, HL&P
*M. Selman, Consultant, HL&P
*J. Sheppard, General Manager, Nuclear Licensing, HL&P
*M. Smith, Senior Consultant, HL&P
*J. Soward, Nuclear Assessment Support, HL&P
*C. Stephenson, Consultant/Licensing Engineering, HL&P
*D. Stonestreet, Outage Manager, HL&P/Outage
*K. Tapplett, Manager, Nuclear Safety and Quality Concerns Program, HL&P
*S. Thomas, Manager, Design Engineering Department, HL&P
*D. Towler, Quality Assurance Operations Supervisor, HL&P
*T. Underwood, Support Manager, HL&P
*L. Walker, Licensing Engineer, HL&P
*J. Wittman, Work Control Supervisor, HL&P

In addition to the personnel listed above, the inspectors contacted other personnel during this inspection period.

1.2 NRC Personnel

*W. Johnson, Chief, Project Section A, Division of Reactor Projects
*J. Keeton, Resident Inspector
*D. Loveless, Senior Resident Inspector

*T. McKernon, Reactor Inspector, Division of Reactor Safety
*R. Vickrey, Reactor Inspector, Division of Reactor Safety
*T. Westerman, Chief, Engineering Branch, Division of Reactor Safety

*Denotes personnel attending the exit meeting.

2 EXIT MEETING

An exit meeting was conducted on December 17, 1993. During this meeting, the inspectors reviewed the scope and findings of this report. The licensee did not take exception to any of the inspection findings, and did not identify as proprietary any information provided to, or reviewed by, the inspectors.