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JAMES P. McGAUGHY, JR.
VICE PRESIDENT

J. 7 5, 1983

Office of Inspection & Enforcement
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, N.W.
Suite 3100
Atlanta, Georgia 30303

Attention: Mr. J. P. O'Reilly, Regional Administrator

Dear Mr. O'Reilly:

SUBJECT: Grand Gulf Nuclear Station
Units 1 and 2
License No. NPF-13
Docket Nos. 50-416/417
File 0260/15525/15526/16694.4
PRD-82/14, Final Report - Unit
1, Interim Report #1 - Unit 2,
Sheared Bolts on Diesel
Generator Rear Crankcase Cover
AECM-83/0386

References: AECM-82/176, 4/21/82
AECM-82/283, 6/25/82
AECM-82/380, 9/7/82
AECM-82/521, 11/8/82
AECM-83/0070, 1/31/83
AECM-83/0321, 6/1/83

On March 22, 1982, Mississippi Power & Light Company notified Mr. R. Butcher, of your office, of a Potentially Reportable Deficiency (PRD) at the Grand Gulf Nuclear Station (GGNS) construction site. The deficiency concerns sheared bolts on the rear crankcase cover of the Delaval diesel generators.

As previously reported, MP&L has evaluated this deficiency and determined that it was reportable under the provisions of 10CFR50.55(e) and 10CFR21 for the Unit 1, Division II Diesel Generator. There are no apparent problems on the bolts from the Unit 1, Division I Diesel Generator. Therefore, for Unit 1, MP&L considers PRD-82/14 closed. LER 82-080 will remain open to track any further investigations decided necessary by MP&L.

It remains indeterminate as to whether this deficiency is applicable to the Unit 2, Division I and II Diesel Generators.

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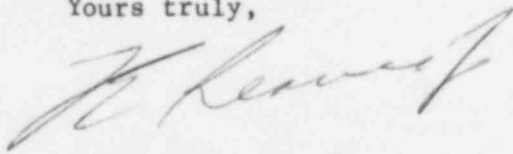
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Mr. J. P. O'Reilly
NRC

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Details, concerning this deficiency for Unit 1, are provided in the attached Final Report. MP&L expects to submit a Final Report for Unit 2 by January 30, 1985.

Yours truly,



for J. P. McGaughy, Jr.

ACP:dr

cc: Mr. J. B. Richard
Mr. R. B. McGehee
Mr. T. B. Conner

Mr. Richard C. DeYoung, Director
Office of Inspection & Enforcement
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. G. B. Taylor
South Miss. Electric Power Association
P. O. Box 1589
Hattiesburg, MS 39401

FINAL REPORT (UNIT 1), INTERIM REPORT #1 (UNIT 2) FOR PRD-82/14

1. Name and address of the individual informing the commission:

J. P. McGaughy, Jr.
Vice-President, Nuclear
P.O. Box 1640
Jackson, Mississippi 39205

2. Identification of the facility which contains a deficiency:

Grand Gulf Nuclear Station (GGNS Unit 1)
Port Gibson, Mississippi 39150

NOTE: 10CFR21 is not applicable for Unit 2 as the diesel generators have not been turned over to MP&L.

3. Identification of the firm supplying the basic component which contains a deficiency:

The Diesel Generators were manufactured by Transamerica Delaval, Inc., Oakland, California and supplied to Grand Gulf by Bechtel Power Corporation, Gaithersburg, Maryland.

4. Nature of the deficiency and the safety hazard which could be created by such a deficiency:

A. Description of the Deficiency

During the performance of a 24 hour run test, the Unit 1, Division II diesel generator manufactured by Transamerica Delaval, Inc. tripped on a "Generator Differential" which was accompanied by an observed electrical arcing flash inside the generator. In a subsequent inspection of the generator, it was found that the stator insulation had been damaged and that a 15/16" bolt head from a 5/8 NC X 1-3/4" long bolt was embedded in the stator. The degraded stator insulation resulted in a phase to phase short in the stator that damaged the generator. It was determined that the bolt head was from a bolt on the diesel's rear crankcase cover. The bolt had sheared off and entered the generator through the air gap on the end of the generator.

All rear crankcase cover bolts from the Unit 1, Division I and II diesels were replaced with new bolts. An analyses of 42 bolts, that were removed, was performed. A review of the results produced the conclusion that the failure mode of the failed bolt was due to a low-stress fatigue front expanding from an initial small crack. The capscrew was then subjected to low level vibrational fatigue stresses from the crankcase cover which caused the expansion of the microcracks across the section and the subsequent failure of the bolt.

This laboratory testing also revealed significant cracks in other bolts and general degradation of strength in the Division II bolts but no apparent problems on the bolts from Division I.

A maintenance work order (MWO) was initiated on October 4, 1982 to re-check the rear crankcase cover capscrews for the correct tightness (60 ft-lbs). Three of the capscrews on the Unit 1, Division II diesel generator were found to be less than 60 ft-lbs (20, 23, and 35 ft.-lbs). The work order instructed that any capscrew not within 2 ft-lbs of the 60 ft-lbs be torqued within the acceptable range. When the capscrew that was found at 20 ft-lbs was tightened, it sheared off approximately one inch from the bottom side of the head before reaching 60 ft-lbs. The capscrews on the Unit 1, Division II Diesel Generator were removed and replaced with new replacement capscrews and torqued to 60 ft-lbs. A re-check of the torque on the Unit 1 Division I Diesel Generator capscrews revealed no subsequent problems with the Division I Diesel Generator due to torquing valves.

B. Analysis of Safety Implications

Failure of the rear crankcase cover bolts could result in the nonavailability of the diesel generator. The diesel generators supply power to systems that are required to shutdown and cool the reactor and to maintain the reactor in this condition during a loss of off-site power.

5. The date on which the information of such deficiency was obtained.

Mississippi Power and Light received information of the deficiency on March 15, 1982. We reported this as a potentially reportable deficiency to Mr. R. Butcher, of your office, on March 22, 1982. Since that date MP&L has filed six (6) Interim Reports to inform the Commission of the progress and status of this deficiency. An evaluation for Part 21 has been completed for Unit 1 and the MP&L "Responsible Officer," Mr. J. P. McGaughy, Jr., has been notified.

6. In the case of the basic component the number and location of all such components.

MP&L does not have knowledge of the location of other diesel generators besides the four (4) (two (2) for each Unit) located at Grand Gulf.

7. The corrective action which has been taken, the name of the individual responsible for the action, and the length of time that has been taken to complete the action.

A. Corrective Actions Taken

1. The Unit 1, Division II generator was replaced with a generator from Unit 2.

2. Design Change Package (DCP)-82/0039 was also issued to install protective screens on the generator air gaps. The protective screens were installed and DCP-82/0039 was closed out on 6/8/83.
3. The damaged generator has been dispositioned to be returned to the vendor.
4. The original bolts removed from the Unit 1, Divisions I and II, diesel's rear crankcase covers were sent to an independent laboratory for failure analysis.
5. A program was developed to instrument the Unit 1, Division II diesel generator and collect data during a test run. Delaval had indicated that the cause of the bolt failures was vibration of the cover plate induced by the firing of the rear cylinder.
6. A design change (DCP-82/4183) was issued on 12/7/82 and higher strength, SA-540, Grade B24 (4340-Mod) capscrews were installed in the crankcase cover of the Division I and II diesel generators. The design change specified 100 ft-lb torque for the capscrews, as per Delaval's suggested disposition; however, a preliminary review of the test data in 5. above did not indicate a need for the higher torque value and Change Notice P75-5 to DCP-82/4183 Rev. 0, was issued on May 16, 1983, reducing the torque value to 60 ft-lb.
7. Our Architect/Engineer has issued QAR-F-397 to track this deficiency for the Unit 2 diesel generators.

B. Responsible Individual

Unit 1
C. K. McCoy
Nuclear Plant Manager
Mississippi Power & Light Co.
Port Gibson, Mississippi

Unit 2
T. H. Cloninger
Unit 2 Project Manager
Mississippi Power & Light Co.
Port Gibson, Mississippi

C. Length of Time to Complete Actions

Nutech Testing Service was retained to instrument the Division II diesel generator. The results of this testing indicated that the failure mode was high cycle fatigue which propagated initial quench cracks in the carbon steel bolts that were used as original equipment on the Diesel Generator and as the initial replacements. The yield strength of these bolts was approximately 21,000 psi for the original bolts and approximately 50,000 psi for the initial replacement bolts. These bolts were carbon steel bolts which exhibited evidence of improper heat treatment causing surface decarburization. This left micro-cracks on the surface of the bolts and under vibrational fatigue propagated the cracks leading to ultimate failure of the bolts. MP&L decided to specify an alloy-steel bolt with proper heat treatment records. The yield strength of these bolts is approximately 150,000 psi.

The measured stresses on the bolts for bending and tensile stresses were approximately 3000 psi for the top bolts during normal operation. The stresses measured were approximately 6000 psi during startup and shutdown of the diesel generator. Using a concentration factor of 3.85 to account for the sharp thread roots on the bolts, failure can be predicted for both the original and the first replacement carbon-steel bolts. However, due to the increased strength of the alloy steel bolts, these stresses would fall within the infinite range of the fatigue life curve for this material. (From "Deformation and Fracture Mechanics of Engineering Materials", by Richard W. Hertzberg).

Close inspection of the failed bolts from both failures shows no indication of impact loading on the bolts from the cover plate as suggested by Nutech. Accelerometers were placed on several cylinders, including both rear cylinders, to see if the rear cylinders had a different vibration than any of the others. This was done to verify the Delaval suggestion that the stresses were a result of the rear cylinder firing loads. There were no observable differences in the accelerometer readings or transfer functions between cylinders.

The protective screening on the generators will preclude the possibility of any foreign material entering the generators and causing damage again.

For these reasons MP&L considers PRD-82/14 closed. LER 82-080 will remain open to track further inspections and investigations decided necessary by MP&L.

8. Any advice related to the deficiency that has been, is being, or will be given to purchasers or licensees:

As the deficiency did not originate with MP&L, we have no advice to offer.