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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

South Texas Project
Unit 2
Docket No. STN 50-499
Supplement to Special Report Regarding
Standby Diesel Generator 23 Valid Failure on November 26, 1990

Pursuant to South Texas Project (STP) Technical Specifications 4.8.1.1.3 and 6.9.2, Houston Lighting & Power (HL&P) submitted, via letter dated December 26, 1990 (ST-HL-AE-3653), a Special Report regarding a Standby Diesel Generator (SDG) valid failure which occurred on November 26, 1990. The Special Report was supplemented via letter dated November 4, 1991 (ST-HL-AE-3903). Please find attached a supplement to those reports which outlines the plan of action which has been prepared to resolve the delivery valve holder cracking problem. Change bars have been added to highlight supplemental information.

Point of contact in this matter is either Mr. C. A. Ayala at (512) 972-8628 or me at (512) 972-7205.

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AMR/ag

Attachment: Supplement to Special Report Regarding a SDG Valid Failure on November 26, 1990

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L4/NRC/

DESCRIPTION OF EVENT:

On November 26, 1990, Unit 2 was in Mode 5 during a refueling outage. At approximately 0012, during performance of Standby Diesel 23 LOOP-ESF Actuation Test, SDG 23 was found to have a fuel leak at injection pump 1L. The plant operator noticed fuel oil spraying on the hot exhaust header and emergency-stopped SDG 23 at the local control panel.

The SDGs are provided with a shield designed to protect the fuel line from falling objects during a seismic event. This shield also protects the SDG exhaust from fuel leaks from the fuel oil lines. I the November 26 event, the plant operator noticed that sufficient fuel was spraying through a designed penetration in the shield onto the hot exhaust header to constitute a fire hazard.

Upon disassembly of the fuel lines, a crack was found across the threaded portion of the delivery valve holder. The delivery valve holder, located on top of the fuel injection pump, is the connection point for the high pressure fuel injection pump discharge line (see attached figure, item #3). The delivery valve holder, stop, and spring* were replaced, and post-maintenance testing was satisfactorily completed on November 27, 1990. SDG 23 was declared operable on November 27, 1990, at approximately 1144.

Other similar events have occurred at STP. During initial startup in Unit 1, cracks were found across the threads in the delivery valve holders. Following that event, a procedure for removal, presetting, and installation of Cooper-Bessemer high pressure fuel lines was included in the technical manual.

Three other events dealing with cracks in the injector or injection pump fuel line threaded connection have occurred in which the root cause was identified as overtorquing of the fuel line nuts. Approved procedures were not violated, and manufacturer specifications were not exceeded. When procedures for torquing fuel line nuts were first developed, torquing was not well-defined and addressed clearly in the SDG manufacturer's manual. Once cracks were discovered, proper procedures for torquing fuel line nuts were approved. Subsequently, the failure mode for the fuel lines was evaluated, and continued operation with potentially overtorqued connections was determined to be acceptable because it was unlikely that a leak caused by a cracked connection would spray. Non-spraying leaks do not constitute a substantial fire hazard and do not affect overall diesel operability.

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* The stop and spring are internal to the delivery valve holder and are not detailed on the attached figure.

DESCRIPTION OF EVENT (cont.):

A crack across the threads in the delivery valve holder for Unit 2 SDG 21 injection pump 4L was discovered on October 29, 1990, and injection pump 4L was replaced. The delivery valve holder was sent for failure analysis along with the failed SDG 23 component from the November 26 event.

An update on the results of the Cooper-Bessemer analysis was received in a letter dated February 5, 1991. Cooper-Bessemer found from metallurgy lab tests that the material (from the failed delivery valve holders) agrees with the manufacturer's specification, but the stress condition produced by tightening the tapered fitting into the holder is aggravated by the sulfide stringers present in the material.

In light of the history of failures at five of the seven member utilities, MPR Associates (the Cooper-Bessemer Owners Group (CBOG) Project Engineer) was assigned the task of performing further testing on delivery valve holders to evaluate fuel line assembly methods and their sensitivity to overtightening. A report, "Tests of Crack Development in Haynes Corporation Fuel Injection Pump Delivery Valve Holders," was issued on April 30, 1991. A sample of 12 delivery valve holders and 18 fuel line fittings was used to determine the effect of tubing seal (ferrule) presetting methods on the turn of the nut value and the corresponding installation torque required to cause cracking of the delivery valve holders. The principal findings from the tests are as follows: (1) The delivery valve holders are prone to cracking. Cracks were obtained in 11 out of the 12 delivery valve holders at torques ranging from about 60 to 200 foot-pounds (ft-lb). (2) In terms of nut turning, the failure torques would range from 1/4 to 3/4 turn. After testing delivery valve holders which used ferrule tubing seal assemblies preset with a shim, and testing assemblies which used the Cooper-Bessemer presetting tool (and the Cooper-Bessemer presetting installation procedure), it was found that the amount of overtightening required to cause cracking is sensitive to the ferrule presetting method. (3) Bottoming the fuel line into the delivery valve holder before presetting results in lower stresses and therefore greater cracking resistance. (4) Fuel lines purchased from Cooper-Bessemer with Cooper-Bessemer manufactured nuts and factory preset ferrules did not cause cracking in the delivery valve holders when the nuts were overtightened. However, based on HL&P's experience, these assemblies did not appear likely to be leak-tight in service.

DESCRIPTION OF EVENT (cont.):

In a May 1991 meeting, CBOG agreed that MPR would test a new 60 degree taper seat design being used on TransAmerica Delaval Inc. (TDI) Enterprise diesel generators and check for tendency to crack and leak during installation. In an August 1991 CBOG meeting, the results of the MPR Associates testing of the taper seat design was discussed. The tapered seat design was tested by tightening it from 36 ft-lb to 250 ft-lb with no evidence of cracking or leaking. Cooper-Bessemer considers the replacement of the current design with the new tapered seat design a pro-active approach to resolving the problem. The CBOG Technical Committee agreed that the new design was superior and recommended that the CBOG promote this design change. Cooper-Bessemer and MPR presented this design change at a CBOG Steering Committee meeting on October 24 and 25, 1991.

Cooper-Bessemer issued a Service News Bulletin on November 12, 1991, concerning the new upgraded high pressure fuel line system which was used on the TDI Enterprise Engines. The upgrade was discussed and approved by the CBOG at the January 1992 Technical Committee Meeting. The new design incorporates a swaged-end tube and 60 degree angle seat on the delivery valve and nozzle holder. The change-out to the swaged design has three advantages: (1) a proven record which has been developed through the Enterprise Engines, (2) the swaged design precludes occurrences of bad surfaces due to misapplication of ferrules, and (3) Cooper-Bessemer has stated that the new delivery valve holder will be made from stronger metal.

HL&P decided in January 1992 to send STP nozzle injector assemblies back to Cooper-Bessemer for installation of a new nozzle holder, procure high pressure fuel lines and delivery valve holders, and install the new delivery valve holders on the SDGs. Installation of the new design will be completed no later than the next refueling outage for each Unit.

Modification of the high pressure SDG injection fuel line involves replacement and rework of the fuel line and connections at the nozzle holder and injection pump where the swaged end of the pipe engages the mating part with a 60 degree seat. The connection seals without the use of a separate ferrule on the outside of the pipe. Therefore, there is no pre-setting procedure required; assembly is accomplished using a relatively low torque on the connecting nuts. Low torque connection results in reduced stress levels in the mating parts, and rigid fuel line connections will minimize leaky fuel line fittings. Replacement and rework parts will be tested using NDE methods at the factory; an in-service leak test will also be performed by HL&P upon installation.

CAUSE OF EVENT:

The cause of the event is a less than adequate design of the delivery valve holder which is prone to cracking. Overtorquing of the fuel line nuts was identified as a root cause for cracks previously found on delivery valve holders. Failure of the SDG manufacturer to clearly address the issues concerning torquing of fuel line nuts caused inappropriate torque values to be implemented. After maintenance procedures were changed, however, no wholesale replacement of potentially affected components was performed because non-destructive testing did not detect cracks, and the likelihood of oil spraying as a result of the leak is very small.

ANALYSIS OF EVENT:

Due to the fuel oil spraying on the hot exhaust header, continued operation of SDG 23 would have constituted a fire hazard. SDG 23 would have responded to a test or emergency start signal, but a fire hazard caused this event to be classified as a valid failure. In previous events, fuel leaks did not spray (atomize) towards hot surfaces and were judged to not be significant fire hazards. Therefore, they were not classified as valid failures.

CORRECTIVE ACTIONS:

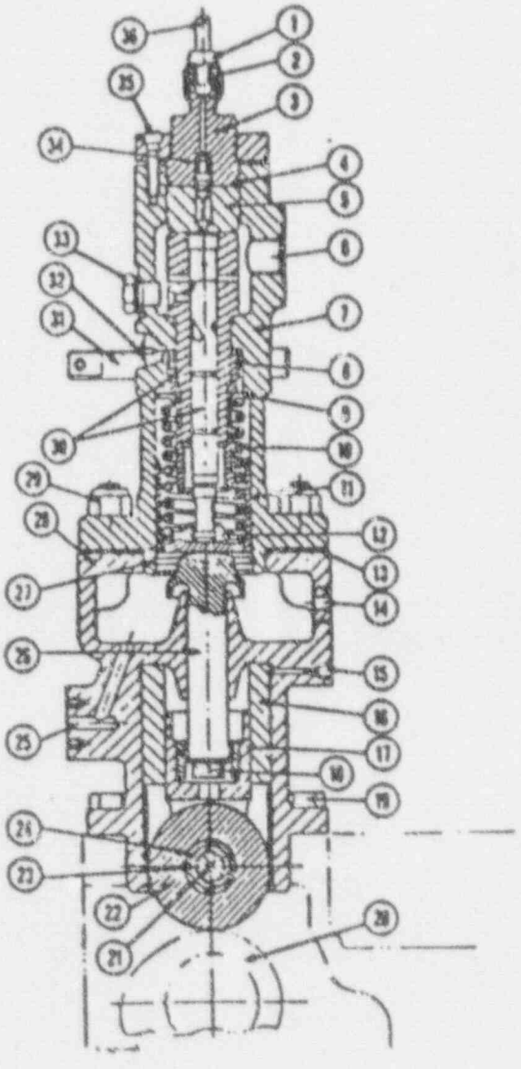
1. The injection pump 1L delivery valve, delivery valve holder, and delivery valve spring were replaced on November 27, 1990.

2. STP has prepared a plan of action for implementing recommendations of the CBOG for resolving the delivery valve holder cracking problem. Installation of the new design will be completed on Unit 1 SDGs no later than its fourth refueling outage (scheduled for Fall 1992), and on Unit 2 SDGs no later than its third refueling outage (scheduled for Spring 1993).

ADDITIONAL INFORMATION:

The injection pump is a Bendix model FDX-22. The delivery valve holder is a component of the injector pump.

At the time of the event, there had been two valid failures in the last 20 valid tests of SDG 23 and the number of valid failures in the last 100 valid tests was less than four. Therefore, per STP Technical Specification 3.8.1.2, the testing frequency for SDG 23 was once per 7 days.



1. Tubing Nut
2. Tubing Seal
3. Delivery Valve Holder and Flange
4. Packing
5. Delivery Valve Assembly
6. Fuel Supply
7. Pump Housing
8. Control Sleeve
9. Spring Plate
10. Spring
11. Plunger Follower
12. Spring Plate
13. Shim
14. Fuel Drain from Nozzle
15. Lube Oil Inlet
16. Bushing
17. Crosshead
18. Bearing
19. Bolt
20. Cam
21. Pin
22. Roller
23. Bushing Collar
24. Bushing
25. Fuel Drain
26. Push Rod
27. Snap Ring
28. Pump Pedestal
29. Locknut
30. Plunger and Barrel Assembly
31. Control Rack
32. Shim, Indicator and Screw
33. Flowing Vent Connection
34. Delivery Valve
35. Screw
36. Fuel Discharge Line

Fig. 8-4 Fuel Injection Pump and Pedestal