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

Subject: Catawba Nuclear Station, Unit 1
Docket No. 50-414
Special Report
Valid Failure of Diesel Generator 2B

Pursuant to Technical Specification 4.8.1.1.3 and 6.9.2, find attached a Special Report concerning the Unit 2 Diesel Generator (DG 2B) valid failure which occurred on December 14, 1995.

Sincerely,

WR McCollum / Bill Foster

W. R. McCollum

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Attachment

xc: SD Ebneter, Regional Administrator

RJ Freudenberger, SRI

RE Martin, ONRR

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SPECIAL REPORT

CATAWBA NUCLEAR STATION
DOCKET NO. 50-414
DIESEL GENERATOR 2B VALID FAILURE
DUE TO FUEL LINE FITTING FAILURE
PIP 2-C95-2394

A **valid failure** of the Unit 2B Diesel Generator (DG 2B) occurred at 2345 on 12/14/95. This failure occurred when a fuel line fitting backed off from the cyclinder head connection, which resulted in fuel oil leakage. DG 2B was being run for its required monthly operability test when the failure occurred (Start # 856). This the the first valid failure (VF) in the last 20 and the third in the last 100 start attempts. The DG 2B is now on a 31 day test frequency. DG 2B was successfully started, run, and declared operable on 12/15/95 (Start # 858). DG 2B was unavailable for 18 hours due to this failure.

Engineering evaluated the injector to tubing failure by performing the following items:

1) Visual on the exterior of the injector for any unusual conditions
2) An initial microscopic examination of the tubing to injector connector nut
3) A pressure pop test of 2R injector
4) A spray pattern test of 2R injector
5) An internal visual inspection

The results are as follows:

A visual inspection of the injector showed that the assembly nut had been placed under extremely high temperatures. The injector holder (nozzle end) was completely covered in carbon. Normally, these items are very clean with no evidence of heat in this area. This indicated that the seating of the injector to the cylinder head was deficient and blow-by from the cylinder was entering the upper nozzle area. The copper washer was carefully examined for any defects that could cause inappropriate seating. A small piece of debris was found to be embedded in the copper washer leaving a noticable indentation with a darkened blow-by area leading from the inside to outside diameter of the copper washer. This would create the necessary clearance between the cylinder head and injector to create the heating effects as evidenced to the injector.

The initial microscopic examination showed that the compression nut did not crack, however tops of the threads were slightly sheared. The shearing was very slight and did not contribute to the second failure of the connector. The shearing occurred due to the connector blowing off of the injector and not by a manufacturing defect to the threads. This is to be expected due to the failure mode. The tubing will be sent to the Met Lab for further analysis.

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The pressure pop test of the 2R injector showed very sporadic popping pressures. Only one pop was reproduced at the correct pressure of 3000 psi. Apparently, during D/G operation, heat buildup promoted excess friction to the internal parts due to expansion. This expansion caused the internal parts to make contact with the nozzle holder causing them to seize. Once the internal parts seized, no fuel oil outlet was available. With the fuel oil pump continuing to operate, pressure buildup occurred to the point of failure. This failure occurred at the weakest point in the system which is at the connector fitting. Upon removal of the injector for testing, the injector was in a cooled down static state which would allow the internals to once again operate. Wear damage was incurred to the internals which can be verified by all but one pop test being very low. (approximately 1800 psi) This indicates wear to the internals with the inability of the injector to build up pressures. Visual indications showed no obvious problems, however, these injectors operate under extreme close tolerences. Should these tolerences become greater, as indicated with this failure, popping pressures would be reduced and spray patterns could not be maintained. Several pop tests were performed which showed two popping pressures occurring at 1500 psi, two occurring at 2200 psi and only one at 3000 psi.

The spray pattern test showed that two of the eight nozzles were clogged, however, this is not believed to be a contributing factor in the failure. Many of the injectors that are removed will have several of the ports fully or partially clogged. This is due to the extreme temperatures and pressures along with constant carbon deposits within the cylinder head area. The injector ports are replaced every 18 months during routine diesel maintenance. Clogged injectors can easily be detected by reviewing exhaust temperatures or BETA analysis. The spray was not atomized as it should be, but exited the nozzle in droplet form. Once again, excessive clearances of the injector internals would not allow proper pressure build up to atomize the spray pattern.

The Met Lab completed their preliminary report on the connector nut and found the following:

1) Dimensional analysis showed that the failed nut was tapered for the full length of the thread. All other nuts utilize a straight profile and none are as large as the small tapered end of the failed nut.

2) No cracking was found and the correct materials were used.

An additional fuel oil injector line was sent to the Met Lab for comparison. This line was found to have the correct straight threads. Work orders have been initiated that will inspect these threads. Eight of sixteen random fuel injector lines have been inspected with no tapered threads encountered. Engineering feels that this particular connector was a localized defect and not an oveall manufacturing deficiency. A 10CFR Part 21 will not be required for this part. Engineering will contact Cooper Cameron concerning the part defect for further information.

Based on the above discussion, the cause for the tubing to injector failure was two fold. The injector was not properly seated to the cylinder head causing excessive heat build-up. This build-up of heat caused expansion of internal and external fuel injector parts resulting in seizure. Continual operation of the fuel oil pump with no fuel oil output from the injector resulted in a high pressure increase causing the nut to blow off of the injector. The pressure required to allow the failure of the connector was lower due to incorrect tapered threading. Had the threading been straight as designed, the probability of failure would still exist, however failure would occur at a higher pressure. Even though the connector nut had tapered threads, there was sufficient engagement to maintain integrity if the nut to injector had seen the normal 3000 psi pressure. This is based upon the extensive hours D/G 2B had experienced prior to this failure. The apparent cause of this failure is the incorrect seating between the cylinder head to injector causing blowby that resulted in internal malfunction of the injector. The malfunction of the injector allowed high pressure buildup to occur resulting in the connector failure.