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DUKE POWER

October 4, 1994

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

Subject: Catawba Nuclear Station, Unit 2
Docket No. 50-413
Special Report
Valid Failure of Diesel Generator (D/G) 1A

Pursuant to Catawba Technical Specification 4.8.1.1.3 and 6.9.2, please find attached a Special Report concerning the valid failure of D/G 1A which occurred on September 8, 1994.

Very truly yours,

A handwritten signature in dark ink, appearing to read 'D L Rehn'.

D. L. Rehn

DT/

Attachment

xc: Mr. S. D. Ebnetter
Regional Administrator, Region II

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Mr. R. J. Freudenberger
NRC Resident Inspector
Catawba Nuclear Station

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SPECIAL REPORT
CATAWBA NUCLEAR STATION
DIESEL GENERATOR 1A VALID FAILURE
DUE TO AIR START VALVE STICKING OPEN

A valid failure of Diesel Generator 1A (DG 1A) occurred on 9/8/94 at 0920 hours due to an air start valve sticking open. The failure was caused by debris in the valve piston cap assembly that caused the valve to stick open which prevented the engine from reaching the required speed for combustion on the failed start attempt. DG 1A was being run for its required monthly operability test when the failure occurred (start # 1021). There have been 2 valid failures (VF) in the last 20 and 100 start attempts. The 1A DG is now on an accelerated weekly test frequency. The 1A DG was successfully started, run, and declared operable on 9/11/94 at 1430 hours (Start # 1026). The DG was unavailable for 37.42 hrs due to the failure.

The Unit 1A Diesel Generator failed to start during the monthly run at 0920 hrs on 9/08/94. The start was an emergency start, therefore, jumpers were placed by IAE to provide the emergency start signal. When the signal was initiated the air start solenoid valves opened but the engine did not start.

Background Information

The 1A Diesel Generator was being run per the required monthly operability procedure PT/1/A/4350/02A, on 9/8/94, when the engine failed to start due to an air start valve sticking open. Refer to the Operability Evaluation for this PIP for the root cause determination.

The starting air system for the diesel engines is comprised of two starting air tanks that are maintained at 250 psig, four starting air solenoid valves, two air start distributors, and an air start valve in each cylinder (16 total). On an engine start signal the solenoid valves get a signal to open and pressurize the starting air header. Air is also admitted to the cam driven air start distributor. The distributor sends a 60 psi pilot signal to the individual air cylinder start valves to cause the valves to open and allow air to enter the respective cylinder from the air header in the correct firing order. As discussed in the Operability Evaluation for this PIP, the root cause for the failure was that one of the air start valves stuck open during the start attempt.

The purpose of the starting air valves is to allow air from the starting air header to enter the cylinder when required and prevent the air from entering when not required. The valves get the signal to open from the air distributor. When the open signal is present, pressurized air from the header flows directly to the cylinder causing the engine to rotate. If fuel oil is present, the engine will fire during the rotation and thereby start and run under its own compression. With an air start valve stuck open, the engine will not rotate or rotate slower than required for combustion to occur but yet bleed the starting air pressure down to the 150 psig lockout setpoint.

With a starting air valve stuck open, when air is admitted on the start signal the cylinder with the stuck open valve will oppose the motion of the opposite cylinder resulting in the engine rocking instead of turning or rotating slower than required for engine combustion. This occurs as the cylinder with the stuck valve is going from bottom to top dead center on the compression stroke it will have to overcome starting air pressure flowing through the valve. The opposing cylinder that is going from top to bottom dead center will end up having to overcome the force of the cylinder with the stuck valve, therefore the engine will either not roll or roll slower than required for engine combustion. During this condition the starting air tanks will drain through the cylinders and out through the intake/exhaust headers.

Following the start failure, the engine was rolled on air four times prior to the following successful start. During the air rolls, the engine was determined not to have a mechanical binding or fuel pump problem. The engine was successfully started and loaded at 1403 on 9/8/94 (start # 1022).

Per the engine manufacturer a stuck starting air cylinder valve can correct itself on subsequent engine rolls. Therefore, on the engine air rolls prior to the successful engine start, the stuck open starting air valve reseated thus allowing the engine to start.

EVALUATION

The starting air valves on the 1A DG were removed and inspected by the engine manufacturer representative. His inspection revealed debris which could impede valve movement thereby causing the valve to stick open. Based on the data we provided and his observations of the air start valves, in his opinion it was highly probable that the 1A DG failure was due to an air start valve sticking in the open position.

The 1A DG was successfully started four times prior to the operability run. After inspection of the sixteen air start valves, it was determined that the use of NEO Lube 2 is not required on the air tubing fitting. The lubricant tends to build up in the valve and can lead to valve binding. Maintenance Procedure MP/0/A/7650/99 has been revised to reflect this information. Also, the piston assembly for the valves are going to be replaced with the latest model revision which includes a new material and dimension. The material will prevent the possibility of thermal binding and the dimension will increase the clearance between the piston and cap assembly. The pistons will be replaced on all the DGs. Furthermore, the air start valves on all four DGs have been tested per an air pop test and verified to be working properly.

Prior to the start failure, Operation noticed that the air roll did not sound normal. It was an inconsistent air roll and did not come to a smooth stop. This is the characterization of one of the air start valves being stuck open because as stated above the stuck open valve will oppose engine rotation. After discussion with the personnel present for the air rolls on the 1A DG following the previous successful start attempt, they noticed no problems with these air rolls. The engine rolled normally and came to a smooth stop. Therefore, the air start valve stuck open on the air roll just before the start failure. Therefore, a new air roll criteria has been developed and incorporated in the operating procedures to ensure air start valve performance will be detected during engine air rolls.

The sixteen starting air valves have been replaced and the new valves verified to operate. The engine was been successfully started three times with the new starting air valves prior to declaring the engine operable. The air start valves on the remaining DGs have also been verified to be operating normally. As stated above, all the valves will be upgraded with the new piston assembly.

The 1A DG valid failure, was due to debris in the air start valves from the rebuild process which was compounded by not having the latest valve revision installed. The valves that are currently installed are within the required tolerances but are on the lower end. This failure will be prevented from occurring in the future by procedure enhancements and valve upgrades.