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December 21, 1989

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

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)  
DOCKET NOS. 50-445 AND 50-446  
EDG AIR START VALVE  
SDAR: CP-89-028 (FINAL REPORT)

Gentlemen:

On October 18, 1989, TU Electric verbally notified the NRC of a deficiency discovered during testing of the Unit 1 Train B Emergency Diesel Generator (EDG) that resulted in a failure of the EDG to start. Our last report on this issue was logged TXX-89801 dated November 17, 1989. After further review, it has been concluded that this deficiency meets the criteria for reportability pursuant to 10CFR50.55(e), and the required information follows.

#### DESCRIPTION

The EDG units at CPSES are Transamerica Delaval Incorporated (TDI), 16 cylinder, 4 cycle diesels arranged in a Vee configuration. Each engine is equipped with redundant starting air systems, one operating on the left bank cylinders and one operating on the right bank cylinders. The major components in each starting air system consist of a compressor-charged air receiver tank, two parallel starting air admission solenoid valves (block valves), a starting air distributor and individual pilot operated air admission valves for each cylinder (air start valves). The starting air distributor generates pneumatic signals (pilot signals) to open the air start valves in a timed sequence causing engine rotation during starting.

In June 1989, subsequent to running of the Unit 1 Train B EDG, a procedurally required post-test air roll of the diesel was attempted to check for evidence of water in the cylinders and intake manifold. This roll was attempted with the left bank starting air system only. The redundant right bank starting air system was isolated for maintenance. During this attempt, the diesel failed to roll when starting air was admitted. Manual rotation (barring) of the diesel to a different crank angle was performed and the diesel was then successfully rolled. Following this event, a start attempt of the Unit 1 Train B EDG was made for testing purposes. Again, the EDG failed to roll when starting air was admitted.

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Subsequent to these two events, troubleshooting was performed to isolate the cause for the failure to roll. Based on the troubleshooting, it was concluded that certain air start valves were sticking open. This resulted in a departure from the timed and sequenced admission of air essential for reliable engine starting (rolling). Inspection of the air start valves identified two possible causes for valve sticking. The first was the accumulation of combustion products on the valve stem and lower guide. The second was narrow ring grooves in the lower guides of certain air start valves. After additional engineering and vendor review, it was concluded that the accumulation of combustion products caused valve sticking and the failure of the Unit 1 Train B EDG to roll. Further, this accumulation of combustion products is believed to be related to a specific installation deficiency associated with the Unit 1 Train B EDG and Unit 2 Train A EDG at CPSES.

TDI design drawings show an open 1/4 inch drain line off the bottom of the air start header downstream of the solenoid operated block valves. The function of this line is not clearly indicated, however, this drain would ensure complete depressurization of the air start header downstream of the block valves following an EDG start. These lines were not installed on either the Unit 1 Train B EDG or the Unit 2 Train A EDG. In addition, the solenoid operated block valves were leaking by their seats. The missing drain line on the air start header, in combination with block valve leakage, resulted in continuous pressurization of the header whether the machine was running or in standby. This would permit entrance of combustion products into the stem and lower guide area of the air start valves. TU Electric believes that this is the mechanism that led to sticking of the air start valves and the subsequent failure of the Unit 1 Train B EDG to roll. It was concluded that narrow ring grooves on the lower guide could accelerate the tendency to stick due to accumulation of carbon deposits. However, it is not believed that the narrow ring grooves would singularly cause valve sticking under normal service conditions. It was demonstrated by sticking air start valve 6L that even valves containing proper ring clearance could eventually stick if they were inadvertently cycled during normal engine running.

The reason the 1/4 inch drain line was not installed could not be established. The absence of the drain line was noted (independently of the Unit 1 Train B EDG failure to roll) during implementation of a TDI Owner's Group recommendation involving maintenance and surveillance. The recommendation required a check of the air start manifold drain line on a monthly basis to ensure it was unobstructed. This recommendation was incorporated into the EDG System Operating Procedure, and the missing drain line was discovered during attempts to comply with the revised procedure. This condition was documented on a non-conformance report that was in the process of being resolved when the failure to roll occurred.

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In summary, this event was caused by a unique combination of circumstances peculiar to the EDG's. The 1/4 inch drain line was not emphasized in vendor literature regarding function and importance. Even with the drain omitted, an additional deficiency was required (leaking air admission solenoid valves) before a combination of circumstances was created that resulted in a failure to start.

Notwithstanding the above, TU Electric has recognized that the design of the air start system for the TDI EDG's at CPSES is such that a single failure of a starting air admission solenoid block valve to close after starting of a diesel could duplicate the circumstances that led to a failure to start of the Unit 1 Train B EDG. Failure of one of the two parallel block valves to close after a successful diesel start would permit starting air at full pressure to continue being supplied to the air header on that side of the diesel. The installed 1/4 inch drain line has no effect on starting air pressure when the valve is full open. This failure could go undetected for as long as the diesel remains running and could result in continued cycling of the air start valves during this time. This could potentially result in degradation of that side of the redundant starting air system, and reduced reliability during subsequent start attempts.

#### SAFETY SIGNIFICANCE

The Emergency Diesel Generators are relied upon for dependable power supplies during accident and safe shutdown conditions when off-site power is unavailable. Failure of a diesel generator to start when required could adversely affect the safety of plant operations. As a result, the absence of an open drain line on the Unit 1 Train B and Unit 2 Train A EDG's is a reportable construction deficiency pursuant to 10CFR50.55(e).

#### CORRECTIVE ACTION

All four EDG's at CPSES Units 1 and 2 have been inspected for the existence of the 1/4 inch drain line. Unit 1 Train B and Unit 2 Train A EDG's did not have the drain line on either air start header. Installation of the drain lines on the Unit 1 Train B EDG has been completed and will be completed on Unit 2 Train A EDG prior to future operation of the engine. Procedure changes requiring that the drain lines be periodically checked for unobstructed flow are in effect.

All sixteen (16) air start valves on the Unit 1 Train B EDG have been removed and replaced with new valves. The removed valves will be inspected, cleaned and if serviceable, returned to stores. Lower guides with narrow ring grooves have been scrapped.

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To preclude the potential for fouling of air start valves due to failure of an air start solenoid valve to shut following an EDG start, the 1/4 inch drain line on each starting air header will be checked for air flow during every planned engine run. Procedure changes necessary to implement this check will be in effect prior to Unit 1 fuel load.

TU Electric has committed to remove and inspect the air start valves on each EDG at every other refueling outage. Combined with the actions discussed above, this will significantly reduce the probability of a degraded EDG starting air system due to sticking air start valves.

Sincerely,

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