Carolina Power & Light Company

Raleigh, North Carolina 27602

April 7, 1971

Dr. Peter A. Morris
Division of Reactor Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

FACILITY LICENSE NO. DPR-23
DOCKET NO. 50-261

Dear Dr. Morris:

On March 14, 1971 at approximately 2:55 P.M. an incident occurred at the H. B. Robinson Unit No. 2 that led to the failure of the turbine. After a reactor trip and subsequent turbine trip, lubricating oil flow was lost to the turbine and generator bearings. The rotor came to rest in the abnormally short time of approximately 17 minutes and seized in several failed bearings.

Assessment of the damage indicated that all eight turbine and generator bearings had suffered some damage. Bearings 4 and 5, between the two low pressure turbines, failed to the extent that molten babbit flowed through the bearings. As a result, the No. 1 low pressure turbine rotor dropped sufficiently to cause rubbing between the rotor and the shell. Damage in the turbine was limited to failure of some steam seal strips and cracking of three shroud segments on the No. 6 wheel nearest No. 4 bearing. The most serious damage to the No. 1 rotor was surface hardening of the rotor material on the oil seal adjacent to the No. 4 bearing. The rotor was removed to the Westinghouse turbine shop in Charlotte, North Carolina, for a complete inspection. The "hard spot" was removed by machining.

The No. 1 low pressure rotor was removed from the shell and inspected thoroughly at the plant. Magna-flux readings were taken on all critical areas. No damage was indicated on the No. 2 rotor or shell and that unit is being re-assembled.

During the reactor shutdown, seal flow was interrupted to two reactor coolant pumps for approximately one minute. Subsequent investigation indicated the shaft for "A" reactor coolant pump may have been distorted by uneven heating. This pump has been disassembled and a new shaft is being installed. The seal on "C" reactor coolant pump will be disassembled for inspection before the unit is returned to service.

SEQUENCE OF EVENTS:

The unit was on the line carrying a load of 615 MWe as directed by the system load dispatcher. All plant conditions were normal. The operating staff was conducting the weekly routine checkoff of plant equipment.

8:30 A.M. Auxiliary Operator checked battery room and noted all indications normal in process of completing the shift Auxiliary Operator check-off list.

10:30 A.M. Auxiliary Operator started DC emergency oil pump, fed from "A" battery bus, for routine two (2) hour test run. This pump was not stopped as planned at 12:30 P.M. because the Auxiliary Operator became involved in other routine duties. All conditions remained normal until shortly before the reactor trip. One momentary alarm was received on "B" battery charger trouble annunciator. The alarm cleared immediately and no further trouble was experienced on "B" battery or battery charger.

2:49 P.M. The plant computer failed. Subsequent investigation indicated the failure was due to low DC voltage fed from battery bus "A".

2:50 P.M. The Control Operator observed reactor trip breaker "A" indication light was out and the Shift Foreman was notified. The bulb was changed with no success. Several other lights on RTGB were observed to be out. The Shift Foreman and Control Operator suspected instrument bus (AC) trouble. I & C technician assistance was summoned and Shift Foreman proceeded to check out MCC-5 and MCC-6 and all instrument busses for failure.

2:5[illegible] P.M. Received reactor coolant pumps thermal barrier cooling water low flow alarm. Outlet isolation valve 735 (air operated) closed on low DC control voltage. RTGB valve position indication also lost.

2:55 P.M. Received reactor trip due to low voltage on DC trip coils on reactor trip breakers. Reactor trip initiated turbine trip. No battery charger alarms were received.

2:56 P.M. Received generator lockout (one minute time delay) due to OCB closed and stop valves closed. A portion of the control room lights were lost. 4KV bus 4 switched to start-up transformer properly leaving 4KV bus 3 and 4 on start-up transformer. 4KV busses 1 and 2 were lost because DC control voltage on "A" battery was too low to close breaker

52/12 and put these busses on the start-up transformer. "A" diesel started properly due to loss of E-1 bus voltage. Diesel supply breaker 17B to E-1 bus did not close because of low DC control voltage from "A" battery.

The Shift Foreman and several other individuals while checking on 4KV voltage found no DC control voltage on several breakers. The batteries were checked immediately and "A" battery was found with 60 volts and "0" amps. All breakers on "A" battery bus were closed. The AC supply from MCC-5 to the "A" battery charger was lost when 4KV busses 1 and 2 were lost.

It should be noted that the battery chargers are rated at 300 amps with a current limiting device set at approximately 375 amps. It has been reported that the normal DC load on the "A" bus is approximately 150 amps. Assuming a 350 amp load imposed by the DC emergency oil pump, the load on the DC bus could have been as high as 500 amps. This would have imposed a minimum discharge rate on the "A" battery of at least 125 and possibly as much as 200 amps. A 200 amp discharge rate will lower battery voltage to 105V DC in approximately four hours assuming a fully charged battery initially.

3:00 P.M. The "B" charging pump was lost when E-1 voltage was lost. The "C" charging pump was started immediately to re-establish seals and charging flow. The seal leak-off temperature on reactor coolant pumps "A" and "C" rose sharply as indicated.

#A RCP

Recorder Point No. 1 - Seal leakoff 300°F.
Recorder Point No. 2 - Upper thrust 300°F.
Recorder Point No. 7 - Pump bearing is 280°F.

#B RCP

Recorder Point No. 15 - Pump bearing is 230°F.

#C RCP

Recorder Point No. 17 - Seal leakoff 300°F.
Recorder Point No. 23 - Pump bearing 230°F.

"A" and "C" pumps tripped when 4KV busses 1 and 2 were lost. The seal flow on "A" and "C" pumps decreased to zero. "B" pump continued to run with normal temperature and seal flow. Charging flow was lost for less than one minute.

The volume control tank had no level indicated. Operator switched to refueling water storage tank for supply to re-establish volume control tank for supply to re-establish volume control tank level. Switched back to normal lineup after 30 inches indicated in volume control tank.

A safety injection signal was activated due to instrumentation power supply failure. Pressurizer level remained above 20% and pressure above 2000 psig. All safety injection equipment except that from E-1 bus operated satisfactorily.

Operator observed turning gear oil pump and emergency DC oil pump lights were out.

3:12 P.M. The turbine rolled to a stop approximately 17 minutes after the turbine trip. Condenser vacuum was maintained. The AC turbine gear oil pump was not operable due to loss of MCC-5 power supply; i.e., loss of 4KV bus 1 and inability of diesel breaker 17B to close. The DC emergency oil pump was not operable due to low voltage on "A" battery.

3:20 P.M. The battery bus tie was closed and "A" battery voltage immediately increased to 125 volts. Breaker 15B closed re-establishing voltage on E-1 from "A" diesel. The Control Operator closed breaker 52/12 and picked up 4KV busses 1 and 2 from the start-up transformer. The Control Operator re-established power to 480V bus 1 via station service transformer "A". The turning gear oil pump started when E-1 power was re-established. The generator oil lift pump started and the turning gear engaged attempting to roll the turbine. The turbine would not turn and the turning gear motor began smoking heavily. The turning gear motor was manually tripped. Unsuccessful attempts were made to roll the turbine manually and with an air drive motor. Oil was pouring from the No. 5 turbine bearing. All attempts to roll the turbine were unsuccessful.

Condenser vacuum and steam seals were maintained on the unit and steam dump continued to the condenser.

Restoration of DC power provided for opening of valve 735 to restore reactor coolant pump thermal barrier flow.

3:25 P.M. Restored normal letdown from reactor coolant system.

Approximately five (5) minutes after restoring power to normal, MCC-6 tripped. Operator was unable to close breaker. The control fuses were replaced and the breaker then closed properly.

3:30 P.M. Turning gear oil and lift pump were secured due to oil leakage from No. 5 turbine bearing.

With the reactor in a safe condition, assessment of the turbine damage commenced.

The incident was determined to have been initiated by the decrease in "A" battery voltage to the point where components supplied by the "A" DC bus could not function as designed. Several factors contributed to the loss of voltage on "A" DC bus and the failure to detect this decrease in voltage.

1. The DC emergency oil pump was operating from the "A" DC bus. This resulted in an unanticipated discharge of the "A" battery. Due to personnel error, this pump was left operating and not shutdown after the scheduled two hour test.

   Operating procedures and operator training are being reviewed to insure that unsatisfactory conditions are corrected.

2. No alarm is provided to warn the Control Operator of low DC bus voltage. The installation of suitable alarms is being investigated.

3. The AC oil pump is currently fed off of MCC-5. With the loss of E-1 voltage, MCC-5 is without a power supply. The possibility of changing the AC oil pump power supply to MCC-6 is being investigated in order to provide a completely redundant back-up lubricating oil supply to the turbine.

It is estimated that the unit will be returned to service by May 15, 1971.

Yours very truly,

E. E. Utley
Manager
Generation & System Operations

NBB:dds

cc: Mr. J. A. Jones