TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE
37401

April 12, 1974

Mr. John F. O'Leary, Director
Directorate of Licensing
Office of Regulation
U.S. Atomic Energy Commission
Washington, DC 20545

Dear Mr. O'Leary:

TENNESSEE VALLEY AUTHORITY - BROWNS FERRY NUCLEAR PLANT UNIT 1 - DOCKET NO. 50-259 - FACILITY OPERATING LICENSE DPR-33 - ABNORMAL OCCURRENCE REPORT BFAO-7422W

The enclosed report is to provide details concerning failure of the HPCI turbine steam supply piping hanger support rods, piping restraints, steam supply valve (FCV 73-16) limit switches, and turbine inboard bearing pedestal. This event occurred on Browns Ferry Nuclear Plant unit 1 on April 4, 1974, and is submitted in accordance with Appendix A to Regulatory Guide 1.16, Revision 1, October 1970.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

for E. F. Thomas
Director of Power Production

Enclosure
CC (Enclosure):
Mr. Norman C. Moseley, Director
Region II Regulatory Operations Office, USAEC
230 Peachtree Street, NW., Suite 818
Atlanta, Georgia 30303

50-259
3874

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ABNORMAL OCCURRENCE REPORT

Report No.: BFAO-7422W
Report Date: April 12, 1974
Occurrence Date: April 4, 1974
Facility: Browns Ferry Nuclear Plant unit 1

Identification of Occurrence

Failure of the HPCI turbine steam supply piping hanger support rods, piping restraints, steam supply valve (FCV 73-16) limit switches, and turbine inboard bearing pedestal.

Conditions Prior to Occurrence

The reactor was in a hot shutdown condition. The reactor pressure was approximately 850 psi with the outboard HPCI steam supply primary containment isolation valve closed.

Description of Occurrence

The HPCI turbine steam supply was isolated on April 2, 1974, for maintenance activities on the gland seal condenser condensate pump motor and a leaking gland seal condenser head gasket while the reactor was in operation. Isolation was accomplished by closure of the outboard primary containment isolation valve (1-73-3). The inboard valve (1-73-2) remained open thus, a portion of the line was exposed to reactor steam.

The unit scrammed at 6:55 p.m. on April 3 due to a generator load rejection trip caused by tornado damage to transmission lines. On April 4 at approximately 2:00 a.m., while the unit was still in the shutdown condition, the steam supply line was charged with steam to the steam supply valve (FCV 73-16) adjacent to the turbine by opening the outboard isolation valve (1-73-3). Approximately 850 psi steam pressure was available for charging the line. When the line was charged, it sustained excessive lateral and vertical movement in the portion between the outboard containment isolation valve and the steam supply valve adjacent to the turbine as the result of a suppositioned slug of water. The damage was discovered at approximately 7:30 p.m. on April 4 by an inspection team who was making a routine check of piping shock arrestors. No attempt has been made to operate the HPCI in the interim.

Designation of Apparent Cause of Occurrence

The single apparent cause of the occurrence was a slug of water created by steam condensed in the steam supply line upstream of the primary containment outboard isolation valve (1-73-3) moving down the pipe when it was charged. A contributing factor to the creation of a water volume in the piping was the arrangement of valves and their positioning. The primary containment outboard isolation valve (1-73-3) was tagged shut on April 2 using the normal hold order clearance procedure to allow repair of the HPCI turbine gland seal condenser leaking head gasket and replacement of the gland condenser condensate pump motor. Tagging the outboard valve for clearance procedure is normal because it is outside the drywell, thus accessible for tagging. The inboard primary containment isolation valve (1-73-2) remained in the open position. This valving alignment allowed steam from the reactor to condense and form a water volume upstream from valve 1-73-3. When valve 1-73-3 was opened to warm the steamline, the valve opening contacts sealed in accordance with designed intent and the valve opened all the way.

Analysis of Occurrence

The damage resulting from the occurrence consisted of the following:

A. Piping adjacent to the turbine -

1. Three vertical pipe hanger rods (7/8" diameter) were broken and one rod was bent.

2. Two rigid wall restraints sustained bending and/or buckling.

3. One hydraulic restraint clevis was sheared off and its associated wall plate was buckled.

4. Two hanger lugs attached to the pipe were slightly deformed.

5. A wall anchor assembly for the turbine discharge pipe was stuck by the steamline and the assembly was buckled slightly.

B. Turbine - The inboard turbine journal bearing cast-iron pedestal fractured in two locations.

C. Steam supply valve adjacent to the turbine (FCV 73-16) - The overhung plastic limit switch on the top of the motor operator was broken. There was no release of radioactive steam or material as a result of this occurrence.

Corrective Action

Following discussions of the occurrence, written instructions (NMI 15.2-A) was prepared which designated the scope of the work to be performed including component inspection and nondestructive testing.

A representative of the turbine manufacturer was called to the site to assist in the investigation and corrective action. A visual inspection of the steam supply piping from the reactor vessel to the turbine was conducted. There were no indications of pipe damage or disturbance inside the drywell. The first sign of damage was on the second pipe hanger outside the drywell and became more extensive in the direction of the turbine. The drywell penetration, large seismic-resistive force restraint outside the drywell, the outboard primary containment isolation valve, and the first hanger assembly on the pipe were in good condition. All piping insulation was removed from the steam supply piping from the drywell penetration to the turbine flange. The insulation was also removed from the upper turbine casing. The uninsulated pipe was thoroughly inspected visually for cracks, distortions, and damage of any type. All pipe welds were liquid penetrant checked and selected welds were ultrasonically checked. Five pipe welds were radiographed and reviewed for unacceptable defects or damage. The lugs attached to the piping were liquid penetrant checked and adjacent pipe areas were liquid penetrant checked. Ultrasonic pipe wall thickness measurements were taken on the circumference adjacent to the turbine flange connection. Ultrasonic wall thickness measurements of the pipe inline with the minimum wall thickness measured circumferentially were taken from the turbine pipe flange upstream to FCV 73-16.

Corrective Action (continued)

Circumferential ultrasonic wall thickness measurements were taken on the pipe upstream of the first elbow from FCV 73-16. All areas where there was any suspicion of damage or possible damage were nondestructive tested. There were no damaged pipe welds discovered and the piping integrity was sound. All pipe wall thicknesses were within acceptable limits. The broken hanger rods, support lugs, and anchor plates were replaced with new material. The broken turbine pedestal was replaced with a new pedestal from the unit 3 turbine. A visual inspection was conducted of the uninsulated turbine casing and valve casing. Casing lugs which mate with inboard pedestal were liquid penetrant tested. A large area of the casing adjacent to the pedestal was liquid penetrant tested. No damage was found by the nondestructive testing. Both sides of the stop valve flange were liquid penetrant tested, and no cracks or damage were found. Other inspections on turbine to pump couplings, journal bearings, shaft seals, shafts, pump thrust bearing, and other pump-turbine components were conducted. The only damage was a wiped thrust bearing on the turbine which did not occur during this incident. A new thrust bearing assembly was installed.

In summary, the nondestructive testing showed the turbine and its piping to be integrent and all damage to pipe supports and restraints was corrected. The turbine pedestal breakage was the only damage sustained by the turbine as a result of the slug of water and it was repaired by new parts replacement. The equipment was properly realigned and assembled in preparation for post maintenance testing. A written post maintenance test program was prepared and performed, which assured that the equipment was operational and should perform its intended function. Operational instruction relating to the steam supply valve alignment for isolating and returning the system to service have been modified to minimize large accumulations of water in the steamline and possible subsequent water hammer. The inherent problem in the piping design which allows such an occurrence has been related to the plant design engineers for corrective action. A permanent modification is expected which will help eliminate this water column collection problem.

Failure Data

No previous similar failure has occurred at Browns Ferry.