TENNESSEE VALLEY AUTHORITY
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37401

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July 16, 1974

Mr. D. F. Knuth, Director
Directorate of Regulatory Operations
U.S. Atomic Energy Commission
Washington, DC 20545

Dear Mr. Knuth:

BROWNS FERRY NUCLEAR PLANT UNIT 2 - POTENTIAL DESIGN DEFICIENCY ON OPERATION WITH UNRECOVERED STEAMLINE PARTS

Initial report of the subject potential deficiency was made on June 13, 1974. A report similar to this was sent to the Directorate of Licensing on July 10 as requested in a letter to J. E. Watson from A. Giambusso dated June 21.

In conformance with paragraph 50.55(e) of 10 CFR Part 50, this is submitted as a final report involving the unrecovered steamline parts.

Very truly yours,

J. E. Gilleland
Assistant to the Manager of Power

Enclosure
CC (Enclosure):
Mr. Norman C. Moseley, Director
Directorate of Regulatory Operations
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TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT UNIT 2

OPERATION WITH UNRECOVERED STEAMLINE PARTS

Description of the Event

During surveillance testing of the RCIC system, auxiliary boiler steam (150 psig) was inadvertently introduced into the main steam line. The MSIV's were closed and the GE-supplied steam line plugs (GE Drawing No. 731E860) were installed in the RPV steam lines. The inflatable seal on the plug was pressurized to 40 psig with instrument air. The "C" steam line plug blew out and struck the vessel wall a glancing blow, at the same time hitting the vent line on steam line plug "A" 3 in. above the plug. The plug then fell back into the vessel and sank, coming to rest near the center of the reactor on top of the blade guide handles. The water in the vessel was at normal operating level, which is 15 ft. above the top guide. None of the handles on the blade guides on the top guide were damaged.

The guard flange (GE Part No. 158B775A-P6) was stripped off the steam line plug as it left nozzle "C." The 3/4-in. diameter nylon rope (which was secured around the refueling bellows lifting clip and the handle in the plug vent line) was sheared 18 in. from the vent line handle. The steam line plug rotated 180° before striking steam line plug "A." The guard flange struck the vessel wall at 350° azimuth below nozzle "A." Steam line plug "C" vent line was turned down as it hit steam line plug "A" knocking off four 1/4-in. SS bolts, five 1/4-in. SS washers, and two pieces of safety wire. From steam line plug "C" eleven 1/4-in. SS bolts, one 1/4-in. bolt head, twelve 1/4-in. washers, six pieces of SS safety wire, one 3/16-in. Allen-head SS screw, and one 3/16-in. SS flat washer were knocked off and scattered over a wide area in the vessel and outside the vessel flange.

A careful search of the reactor and surrounding area resulted in the recovery of all parts except one 1/4-in. SS bolt 1 in. long, three 1/4-in. SS washers, one 3/16-in. SS Allen-head screw, and one piece of SS safety wire.

Following the discussion with the AEC on June 13, 1974, all of the control rod guide tubes of the Unit 2 reactor pressure vessel were reinspected to try to locate the missing pieces. One 1/4-in. diameter stainless steel washer was found and removed.

Safety Evaluation

A. The reactor pressure vessel cladding was visually examined (10X) where the steam line plug and the guard plate made contact. There was no evidence of indentations or upset metal. Based on this information, the structural integrity of the reactor pressure vessel is not considered to be affected by this incident.

B. If a part found its way into a guide tube, the part could migrate into the control rod drive and be captured by the drive filter. This would not affect the drive's scram capabilities. Although it is extremely unlikely, it could lodge between the control rod guide tube base and the index tube of the drive. This could result in preventing blade withdrawal but not insertion.

Although the above mentioned situation could create an operational problem, it poses no safety problem.

C. The obvious concern associated with the lost parts is that associated with the potential for fuel bundle flow blockage and subsequent fuel damage. A detailed study of flow blockage in a BWR has been made in a GE Topical Report (Reference 1). That report contains the following conclusions based on analyses of high power density fuel operating at 18.5 kW ft.:

a) It would take more than a 90 percent inlet area blockage to cause a MCHFR less than 1.0; therefore, no fuel rod damage would occur unless more than a 90 percent blockage occurs.

b) If the blockage were more than 90 percent, clad melt and fuel crumbling would occur. This would lead to high radiation sensed by

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(1) Consequences of a Postulated Flow Blockage Incident in a Boiling Water Reactor - NEDO-10174.

the main steam line radiation monitors which would scram and isolate the reactor. Offsite doses would remain less than 10CFR20 limits.

Based on the information concerning the size of the lost parts the following conclusions are drawn:

1) If the parts found their way into the lower plenum, the fluid velocities would be high enough to sweep them up toward the fuel bundles only if the parts maintained a horizontal position. In the vertical position the velocities are not high enough to lift the parts. Also, if the parts were lying on the bottom head where the fluid velocities are low, it is considered unlikely that they could get swept up off the vessel surface. Therefore, even though it is possible for the washers to get lifted up toward the fuel, its occurrence is considered unlikely.

2) Because the fuel bundle orifice diameters are considerably larger than the lost parts (center bundles 2.211 in., peripheral bundles 1.469 and 1.244 inches, low enriched bundles 1.800 inches) it is not possible for the inlet orifices to become blocked.

3) If the parts were swept up toward the orifice region they would most likely pass through the orifice and become trapped against the lower tie plate. The cross sectional area of the individual parts is so small that the flow area reduction would be minimal.

4) If the parts become fragmented into small pieces these pieces could become lodged in the fuel bundle spacers, which would probably cause local boiling transition and overheating with subsequent cladding damage due to fretting. However, this should only be limited to a small number of rods in the core because of the limited amount of material.

5) The small size of the parts precludes damage to or seizure of the recirculation pumps.

Therefore, it can be concluded that the lost parts will not pose a safety problem.