REPORT ON REACTOR VESSEL SURVEILLANCE CAPSULE HOLDER TUBE HOLDDOWN MECHANISM

This report has been written pursuant to 10 CFR 50.55(e) on significant deficiencies, and documents the determination as to whether this constitutes a reportable event.

Description of the Problem

The design of the reactor vessel surveillance capsule holder tubes is described in Section 2.5 of B&W Topical Report BAW-10100A[1]. The surveillance capsules are attached to and secured within the holder tube by a spring-loaded push rod assembly holder train as shown in Figure 2-8 of Reference (1). The plenum flange compresses the push rod assembly spring cartridge as the plenum is lowered into the core support shield. The spring-loaded push rod assembly has four 3-piece spacers (see Figure 2-10 of Reference (1)) mounted along its axial length to provide lateral positioning of the push rod. The top two of these spacers are located in that portion of the axial length of the holder tube which is within the shroud tube. The third spacer is axially located in a portion of the holder tube with a thicker wall and within a journal bearing at the lower end of the shroud tube, mounted to the core support shield. The fourth spacer is approximately in the center of the ogee bend in the holder tube.

A female fitting on the lower end of the push rod mates with the top end fitting of the upper surveillance capsule as shown in Figure 2-11 of Reference (1). The bottom end fitting of the lower surveillance capsule mates with a special fitting in the base of the holder tube which restrains the capsules from rotation.

The holder tubes themselves are contained within a shroud tube extending from the plenum flange to a location corresponding to the third push-rod spacer. The lower portion of the holder tube is mounted on two pintles which allow rotation of the tube against the thermal shield for removal or insertion of the reactor internals. Rotation of the holder tube during operation is prevented by the pin locking mechanism on each pintle and bearing, and the holddown force applied by the capsule holder train.

During the week of February 29, 1976, while attempting to remove a surveillance capsule train from its holder tube at the Three Mile Island, Unit 1 Facility, wear to the holder tube was observed. Subsequent removal of the second and third surveillance capsule train indicated similar wear to a second tube. The holder tube was severed at the axial location of the second push rod spacer from the top, thus separating approximately the top six feet of the holder tube. One of these two tubes was also severely worn at the axial location of the first push rod spacer from the top and became separated at that location during capsule removal.

Remote video techniques have been used to inspect for further evidence of internal wear on two tubes at TMI-1 (the intact tube and one severed tube) and all three tubes at Oconee 1. In addition, an external video inspection has been conducted of portions of the surveillance holder tube at TMI-1. Additional holder tube inspections have been recommended by B&W and are either in process or are being planned at the other B&W operating plants of similar design.

The results of the video inspections show evidence of wear on the internal surface of the specimen holder tubes at the axial locations of the spring cartridge, each push-rod spacer, at the surveillance capsule rings, and at locations in the ogee bend where the push rod itself may contact the holder tube. In addition, wear of the holder tube journal bearing has been observed.

Based on the inspections at Oconee 1 and TMI-1, B&W concludes that the cause of the holder tube wear is flow-induced relative motion of the surveillance capsule holder train. This motion is causing mechanical wear at the areas of contact between the holder tube and the capsule holder train.

Evaluation

It is concluded that the surveillance capsule holder tube holddown mechanism (Push Rod Assembly) design represents a deficiency which requires notification of NRC per 10 CFR 50.55(e).

Although the surveillance capsule holder tube and surveillance capsule holddown mechanism do not perform a direct safety function, the surveillance capsules themselves provide monitoring of the fracture toughness properties of the reactor vessel beltline region materials. This monitoring program permits the determination of the reactor vessel operating conditions which assure adequate

fracture toughness throughout the vessel service life. The function of the surveillance capsule holder tube is to support the surveillance specimen assemblies (capsules) in the annulus between the thermal shield and the reactor vessel wall. It can be postulated that extremely severe wear of the surveillance capsule holder tubes at locations below the shroud tube could lead to eventual loss of support to the capsules. Redesign is considered necessary to establish the adequacy of the surveillance capsule holder tubes.

Extensive wear of the lower portion of the holder tube would also have the adverse effect of allowing parts of the holder tube and holddown mechanism to become loose parts in the annulus between the thermal shield and reactor vessel wall. The smaller of these parts could also contact the lower vessel head and lower reactor vessel internals. Damage to the reactor vessel clad, incore instrument guide tubes and lower reactor vessel internals structures could result if no corrective action were taken. This damage would not represent an imminent threat to public health and safety, but could require extensive repair to assure these structures remain serviceable for the life of the plant.

Plants to Which Applicable

Crystal River Unit 3 - CP
Davis-Besse Unit 1 - CP
Midland Units 1 & 2 - CP
Oconee 1, 2, 3 - Operating
Arkansas Nuclear 1, Unit 1 - Operating
Rancho Seco - Operating
Three Mile Island, Unit 1 - Operating

NOTE: This report is not applicable to Three Mile Island, Unit 2, since it utilizes a surveillance capsule holder tube of different design.

Corrective Actions

B&W is presently modifying the design of the surveillance specimen capsule holder tubes. This design modification, when completed, will be described for NRC review in a B&W Topical Report. Until this design can be completed and parts procured, plants in operation are presently either removing all three surveillance capsule holder tubes and their holddown mechanisms, or where the surveillance capsule holder tubes are in serviceable condition, they are removing

the holddown mechanism and replacing it with a modified spring-loaded cartridge. This replacement cartridge is designed to restrain the holder tube with the wear causing portions of the holddown mechanism removed. Operation without the surveillance specimens in the reactor for a period of time has been evaluated, and does not reduce the ability of the present surveillance programs to perform their intended function.

Plants soon to be in operation (Crystal River 3, Davis-Besse 1) will have the present surveillance capsule holder tubes removed prior to reactor operation. The modified design holder tubes will be installed at all applicable plants on a schedule consistent with maintaining an effective reactor vessel material surveillance program.

REFERENCE

(1) B&W Topical Report BAW-10100A, "Reactor Vessel Material Surveillance Program - Conformance to 10 CFR 50, Appendix H, for Oconee Class Plants", February 1975.