FORT CALHOUN STATION

CYCLE IV

IRRADIATED FUEL INSPECTION FOLLOWING CYCLE IV OPERATION

November - December 1978

February 15, 1979

A visual inspection of 52 irradiated fuel assemblies was performed. The visual inspections included eight (8) assemblies which were reloaded for Cycle 5 operation. The remaining 44 visually inspected bundles were not returned to the core for Cycle 5. Eddy current testing was performed on ten (10) fuel assemblies. Seven (7) of the assemblies subjected to eddy current testing were returned to the core for Cycle 5.

The visual inspections were performed in accordance with SP-FE-1. A list of the visually inspected assemblies is found in Table 1. The inspections were performed using the spent fuel inspection stand, an underwater closed circuit television system, the spent fuel handling machine (FH-12), and associated lighting equipment. The television system included a camera equipped with a 5:1 zoom lens, a video tape recording device, and a monitoring unit. When inspecting assembly B009, a fixed lens underwater television camera was used. Inspection of the remaining assemblies was accomplished using the zoom lens equipped camera. Visual inspection was accomplished by inserting the inspected assembly inside the inspection stand, using the spent fuel handling machine. Once the assembly is inside the inspection stand, it can be viewed with the television camera. By moving the assembly in the vertical direction with the refueling machine, the entire length of the assembly can be observed. A minimum full-face scan was observed and recorded on video tape for all faces of each assembly. The full face scan was accomplished at low magnification. Additional inspections at higher magnifications were performed as required following observation of any apparent abnormality during the full-face scan. The camera mount on the inspection stand permitted complete lateral coverage of the entire assembly face at any magnification. All four faces of the inspected assembly were observed by successive withdrawal and rotation of the assembly.

It should be noted that the pool-side television monitor has been modified to eliminate mirror-imaging which results from the use of a right angle mirror on the camera. The video tapes, however, record a mirror image, i.e., images appearing on the right really represent the left side of the object. The auto dubbing comment may refer to the right side of the assembly face but, when the video tape is viewed on a monitor without the mirror-image eliminator, the right side will appear on the left. The notation used to indicate the identity of the face being examined is defined by calling the face which faces the north direction when the assembly is in the southeast orientation as the north face. Figure 1 shows the assembly mapping scheme.

No abnormalities were observed in the eight (8) assemblies returned to the core. Some oxide formations were apparent, but these were normal. Of the 44 discharged assemblies inspected, only two (2) assemblies exhibited abnormal mechanical conditions. Assembly D012 had what appeared to be corrosion on the fifth spacer grid from the bottom of the east face. The damage appeared as a hole in the grid face adjacent to pin M-14 (Figure 1). The damage did not appear to have resulted from fuel handling. Assembly D022 exhibited a failed pin in location N-2 (Figure 1). Two (2) holes were apparent in the cladding: one between the fourth and fifth grid from the bottom and the other between the fifth and sixth grid from the bottom. These holes appeared to be in an advanced stage of hydriding. A possible third hole existed between the above two holes. The holes appeared to be the result of corrosion rather than mechanical damage. However, it is possible that the corrosion could have initiated, by manufacturing defect, by pellet clad interaction, or following mechanical damage. The above pin showed additional evidence of surface corrosion in the vicinity of the holes. Pins on both sides of the failed pin did not exhibit any abnormalities.

Out of the 2704 pins observed during visual examination of 52 assemblies, only one (1) pin was found to exhibit appreciable clad damage. This is less than .04% observable pin failures among the pins inspected. The low radioactivity levels of the reactor coolant during Cycle 4 operations indicated good fuel integrity. Visual examination of the facial pins (which comprise approximately 30% of all the pins in an assembly) confirmed, by discovery of only one (1) failed pin, the excellent fuel integrity maintained during Cycle 4 operations. The above abnormalities are minor in nature and are not expected to impact Cycle 5 operations.

In addition to the visual inspections eddy current testing (ECT) was performed on ten (10) "D" assemblies. These assemblies were selected because they contained CEAs during Cycle 4 and because they occupied core locations near the hot legs. Experience with other Combustion Engineering (CE) assemblies suggests that guide tube wear is most likely to be found in these locations. Assemblies which were tested using the eddy current method are listed in Table 2. The eddy current testing was completed using Special Procedure SP-FE-8 to verify that no appreciable guide tube wear had occurred in the newer reconstitutable type fuel assemblies. Eddy current testing had previously been performed on Fort Calhoun non-reconstitutable fuel, and no significant wear had been observed. However, both CE and NRC interest prompted the further testing of the newer (mechanically different) type fuel to check for guide wear problems. The tests were performed in the spent fuel pool by lowering a one-inch diameter ECT probe (on approximately 40 feet of stainless steel tubing) into each fuel assembly guide

tube using the spent fuel handling machine. As the probe was withdrawn from the guide tube, the voltage and conductivity of the bobbin coil, which was mounted inside the probe, were monitored. The absence of a signal voltage means no wear has occurred in the guide tube. The bobbin coil voltage and conductivity were monitored and recorded for each guide tube of the ten (10) inspected assemblies. The only assembly exhibiting any appreciable voltage signal was D002. The NE guide tube had a voltage reading of 1.0 volt. A voltage reading of 1.0 volts corresponds to no appreciable guide tube wear. No other assemblies had voltage readings above 0.5 volts. Based on the eddy current testing, it can be concluded that no significant guide tube wear problem exists in the CE supplied Fort Calhoun fuel assemblies.

Table 1

List of Irradiated Fuel Assemblies Inspected Visually

1.	A004	18.	C001	35.	D016
2.	A012	19.	C010	36.	D017
3.	A013	20.	C011	37.	D018
4.	A015	21.	C013	38.	D019
5.	A019	22.	D001	39.	D020
6.	A021	23.	D002	40.	D021
7.	A025	24.	D003	41.	D022
8.	A027	25.	D004	42.	D023
9.	A028	26.	D005*	43.	D024
10.	A029	27.	D007	44.	D025
11.	A030	28.	D008	45.	D026
12.	A032	29.	D010	46.	D033*
13.	A033	30.	D011	47.	D034*
14.	A035	31.	D012	48.	D038*
15.	A044	32.	D013	49.	D044*
16.	A045	33.	D014	50.	F004*
17.	B009	34.	D015	51.	E001*
				52.	E101*

*Returned to core for Cycle 5 irradiation.

Table 2

List of Irradiated Fuel Assemblies Inspected by Eddy Current Testing

1. D002
2. D003
3. D004
4 D006*
5. D009*
6. D014
7. D019
8. D020
9. D024
10. D041*

*Returned to core for Cycle 5 irradiation.

FIGURE 1

ASSEMBLY MAPPING SCHEME