

1. INTRODUCTION

This report documents the events which occurred at the Babcock & Wilcox Commercial Nuclear Fuel Plant (CNFP) that resulted in a cross-over of a small number of fuel pellets being processed for the Sacramento Municipal Utility District (Rancho Seco, Core 1) and the Arkansas Power and Light Company (Arkansas Nuclear One, Unit 1, Core 1). The detailed evaluation that follows concerns the cross-over of a total of four foreign pellets into Arkansas Nuclear One, Unit 1, Batch 3 fuel. These foreign pellets (SMUD 2.01% enrichment) were found during loading of Arkansas 3.05% enrichment fuel rods.

The mechanism through which the enrichment cross-over occurred has been traced to the design of two roller-micrometer (R/M) installations which were specially installed to process a portion of the Rancho Seco and Arkansas fuel as a result of the recent concern with fuel densification requirements. This design of the R/M allowed fuel pellets to become lodged in locations inaccessible for inspection and cleanout at enrichment changes while permitting them to fall out into subsequently processed material. The equipment at fault has been modified to correct those inadequacies and procedures relating to enrichment control and changeover at the CNFP have been reviewed and are being strengthened to prevent a recurrence.

2. EVALUATION

In late 1972, B&W had begun processing the Rancho Seco and Arkansas fuel. After discovery of the fuel densification phenomenon at the R.E. Ginna plant and after evaluation of subsequent information, it was decided that it would be prudent to increase the nominal density of the Rancho Seco and Arkansas fuel from 92.5% theoretical density (T.D.) to 95-96% T.D. At the time of this decision, rod loading of Batch 1 (2.06%) Arkansas fuel was virtually

complete, Batch 2 (2.72%) Arkansas fuel was in production at Kerr-McGee, and Batch 3 (3.05%) Arkansas fuel deliveries by Kerr-McGee were approximately 50% complete. Deliveries of Batch 1 (2.01%) Rancho Seco fuel by NUMEC were approximately 50% complete, Batch 2 (2.67%) Rancho Seco fuel was in production at NUMEC, and production had not yet begun on Batch 3 (3.00%) Rancho Seco fuel. Approximately 13 metric tons of 3.05% Arkansas fuel and approximately 13 metric tons of 2.01% Rancho Seco fuel were then in storage at the CNFP.

NUMEC and Kerr-McGee were instructed to sinter the balance of the fuel for these contracts to the higher density and to resinter all 92.5% T.D. fuel prior to shipment to the CNFP. B&W installed a sintering furnace at the CNFP to resinter that fuel already on hand. Since the 92.5% T.D. fuel would shrink to varying degrees upon resintering, it was necessary to incorporate a means of sorting the resintered fuel by diameter. The roller-micrometer (R/M) was selected for this sorting. The summary of resintering requirements for Rancho Seco and Arkansas fuel is shown in Table 1. It was not necessary for CNFP to sort the Arkansas fuel resintered at Kerr-McGee because the two lots of 2.72% Arkansas fuel were centerless ground to final diameter subsequent to resintering and the nine lots of 3.05% Arkansas fuel resintered at Kerr-McGee were also sorted at Kerr-McGee. Resintering of the 3.05% Arkansas fuel at the CNFP began December 4, 1972 and continued to February 7, 1973 at which time resintering of the 2.01% Rancho Seco fuel commenced. Resintering of the 2.01% Rancho Seco fuel was completed March 17, 1973. The first R/M station became operational December 7, 1972. A second R/M station was installed on December 11, 1972. Roller-micrometer operations were concluded on March 17, 1973.

SMUD 2.01% pellets were R/M sorted from December 7 through 20, 1972; from December 28, 1972 through January 8, 1973; and again from February 8 through March 17, 1973. SMUD 2.67% pellets were R/M sorted from December 6 through December 20, 1972. Arkansas 3.05% pellets were R/M sorted from December 28, 1972 through February 8, 1973.

On February 21, 1973, during loading of Lot 37, Arkansas 3.05% fuel pellets into cladding, a single 2.01% SMUD pellet was detected visually in each of four different pellet stacks. The detection was visually possible because of a marked difference in color, texture and length of the pellets belonging to the two different enrichments.

Loading was halted and all personnel assigned to the vault and fuel loading room were assembled. They were given a thorough briefing on the situation, stressing the unacceptability of enrichment cross-over. All personnel were instructed to rigorously visually inspect all fuel prior to loading.

No further fuel pellets were detected in loading the balance of the Arkansas 3.05% enrichment.

One hundred forty-six fuel rods had been loaded with Lot 37 fuel prior to the detection of the four foreign pellets from SMUD 2.01% fuel. These rods were set aside for further review. Ten rods were chosen at random and dismantled; all pellets were inspected for the proper enrichment code, i.e., the letter "N". No foreign pellets were found and the decision was made to accept the remaining 136 completed for assembly.

However, on March 16 an Arkansas pellet was visually detected in SMUD 2.01% fuel. This occurrence led to a further review of the situation. All stray fuel had been detected in fuel which had been sorted by the R/M.

An intensive investigation to determine, if possible, the point or points at

which the cross-over could have occurred resulted in the conclusion that it was possible to trap fuel in the R/M in areas in which would escape detection during normal inspection for enrichment changeover. A similar possibility could not be identified in any other piece of equipment. To further evaluate this possibility, the R/M was inspected to simulate preparation for an enrichment changeover. Approximately 100 kgs of scrap pellets were then processed by the standard procedure using a production operator. After processing, the equipment was cleaned out and inspected in the usual manner. The R/M was then operated without fuel. After a short period of time, a fuel pellet dropped to the table. Since the rear of the R/M could not be adequately checked because of the hood restrictions, the hood was removed and the R/M systematically dismantled, disclosing several pellets in hidden locations.

The only evidence of enrichment cross-over in Arkansas 3.05% fuel was the initial detection of four single 2.01% pellets in four separate fuel stacks. Three lots of SMUD 2.01% fuel had been sorted on the R/M immediately prior to the start of Arkansas fuel sorting, hence this was the most probable site of the cross-over.

Subsequently, when a neutron scanning device became available, all Arkansas fuel rods containing resintered/roller-micrometer sorted pellets that had not been released for assembly into bundles were scanned. Two hundred and thirty-three fuel rods were scanned and no foreign pellets were detected, thus providing added assurance that the corrective action taken was effective in preventing further enrichment cross-over.

Presently, approximately 300 fuel rods worth of resintered/roller-micrometer sorted fuel pellets remain to be loaded into rods. These rods will be neutron scanned after loading.

3. CORRECTIVE ACTION

The enrichment cross-over which occurred was due to the design of a type of process equipment. Actions taken by B&W to prevent a recurrence of this situation are as follows:

1. The design of the R/M which allowed pellets to become lodged in locations inaccessible for inspection and cleanout has been corrected by equipment modifications.
2. Procedures relating to fuel pellet enrichment control have been reviewed in depth. These procedures are being strengthened where necessary to provide more comprehensive processing control and documentation prior to further operations.
3. Procedures related to enrichment change-over have been thoroughly reviewed and revised to provide fully independent and redundant inspections of facilities prior to processing a different enrichment.

4. CONCLUSIONS

- A. Based on the marked difference in visual appearance of the Arkansas and SMUD fuel and the rigorous examination during loading of fuel rods, it is concluded that the four tramp pellets detected were an isolated incident. The results of the neutron scanning, thus far, of a cross section of the lots involved and spanning the process period, support this conclusion.
- B. The only fuel pellets sorted on the R/M were SMUD 2.01% and 2.67% and Arkansas 3.05%. Since the only possibility for cross-over was of lower enrichment SMUD fuel into the higher enriched Arkansas fuel, there would be no safety problem, even if some SMUD fuel pellets did escape detection and were loaded into Arkansas fuel assemblies.

- C. The corrective actions described in Section 3, above, will prevent a recurrence of the situation described in this report.

Files

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