

UPDATED REPORT-PREVIOUS REPORT DATED 5/7/85

Attachment 1
Surry Power Station, Unit No. 1
Docket No.: 50-280
Report No.: 83-014/01-3
Event Date: 03-09-83

Title of the Event: Abnormal Degradation of Fuel Cladding

1. Description of the Event:

Due to the fuel failure indication during Unit 1, Cycle 6 (S1C6) operation, an extensive fuel examination and evaluating program was undertaken and has been completed. The Phase I examinations consisted of visual observations (binocular, TV and fiberscope), sipping examinations using the Nuclear Assurance Corporation system and a single rod leak detection system using the Brown Boveri Reaktor (BBR) system. The Phase II examinations consisted of high magnification TV examination of individual rods in the outer two rows of the fuel assemblies known to be failed based on the BBR ultrasonic system. In addition, a crud scraping program was completed

Phase I visual examination of all fuel unloaded from the core revealed abnormal degradation of 7 fuel rods. Fuel assembly OB3 was observed to have one small hole above grid 2 and one large hole (approximately 1/4 inch diameter) above grid 4 in one of its fuel rods. Fuel assemblies J15, 6A2, 3A2, 1B5, 4A5, and 4A0 were observed to have a missing top end plug in one fuel rod of each assembly. The separation of the plugs from the rods appeared to be at or near the circumferential (girth) weld. These welds are reportable per Technical Specification 6.6.2.a.(3). In addition, a small hole was confirmed in one rod of each of 10 other fuel assemblies. Five rods, located in four assemblies, were noted to have a crack or blister in the girth weld. Two adjacent rods in one assembly appeared to exhibit fretting marks from an adjacent piece of debris. In addition to the visual defects, crud was noted on several assemblies and approximately twenty assemblies contained debris which appeared to be small pieces of metallic shavings.

The results of the sipping and BBR examination data, when combined with visual observations, indicated that 52 of the Cycle 6 assemblies were leaking. When these failed assemblies are broken down by region, approximately 30% of the assemblies of each region in the Cycle 6 core was leaking. The result of the BBR examination indicated that 81 rods in the Cycle 6 core gave defect indications. A high incidence of paired or grouped failed rods was observed (30 of 81 failed rods were associated with a 2, 3, or 4 rod cluster).

During the Phase II visual examination, approximately 60 S1C6 rods in the outer two rows were examined to some extent by high magnification TV. Of these

sixty (60) rods, 48 were known to be defective based on ultrasonic results. Three additional rods, not identified by the BBR examination, appeared to be defective based on the TV examination for a total of 84 defective rods. Two of these three rods were paired with a rod previously known to be defective increasing the number of defective rods in clusters to 33. Direct observations of debris induced fretting were made on 31 rods. Since grouped failures were found to have a correlation with debris induced wear, five additional rods in the outer two rows may be indirectly attributed to debris induced wear. These five rods were either part of a group of failed rods or were adjacent to rods with fret marks. Therefore, a total of 36 of the 51 failed rods which were examined showed evidence of debris induced failure. In addition, other rods were observed to have partial (non-through wall) fretting marks. These events are reportable per Technical Specification 6.6.2.a.(3). In addition to the 36 defective rods in the outer two rows of rods attributed to debris, 14 interior defective rods were paired which may be directly attributed to debris.

In addition to the above observation, the following observations were made during the Phase II examination relative to the end plug defects and the hydride observations:

1. A 12th defective end plug was observed during the Phase II examinations. Of the twelve rods with defective top end plugs, eleven were in the outer two rows of rods and the bottom ends of these rods also exhibited debris induced wear and three were adjacent to rods with fretting defects. In addition to the visual examinations, the end plug weld was retrieved and examined in a hot cell. A second top end plug was also recovered from the bottom nozzle of another assembly and examined. Westinghouse indicated that the exam showed that the end plugs were highly charged with hydrogen which would indicate that the observed end plug damage was due to secondary hydriding.
2. Thirteen of twenty rods with observed hydride blisters also showed evidence of debris induced fretting.

Because of continued fuel failure indication in Unit 1, Cycle 7 (S1C7), the Cycle 7 fuel assemblies were examined for possible leakage during the 1984 Unit 1 refueling outage. Of the 157 assemblies, 8 were determined to be leaking based on sipping examinations. Subsequent high magnification visual examination of the eight assemblies indicated that two (2) fuel assemblies exhibited fretting holes below the first grid; four (4) assemblies exhibited pieces of debris and (2) assemblies exhibited no visual anomalies. Based on preliminary visual evaluation, possible failure mechanisms are debris induced fretting and stress related defects. The evaluation of these defective assemblies is continuing.

2. Probable Consequences and Status of Redundant Equipment:

During steady state power operations, specific activity of the RCS remained below maximum levels specified in the Technical Specifications. During refueling operations, the containment and fuel building ventilation continually exhausts through Category 1 iodine filters. Therefore, the health and safety of the public have not been affected.

3. Cause:

In analyzing the cause(s) of defects after the Phase I examination (March-April 1983), the approach employed was to eliminate specific fuel failure mechanisms based on visual observations and specific analyses, and to focus on the remaining mechanism(s). Based on initial evaluations, baffle jetting, rod bow, fatigue and creep collapse were eliminated as possible failure mechanisms. The other mechanisms which were not eliminated and were evaluated further were high fuel pellet hydrogen, stress induced mechanisms, weld and cladding related defects, corrosion and debris induced fretting. Based on Phase I, the following observations were made concerning the mechanisms which were not eliminated.

1. Some correlation of assembly higher than average hydrogen levels was observed for Region 8 assemblies. This correlation was not supported by evaluation of hydrogen levels and manufacturing traceability data for the individual failed rods. No correlation of pellet hydrogen was found for Region 7.
2. Some correlation was found in Region 8 between failed assemblies and the frequency of occurrence of a group of specific types of weld related reworks. However, Westinghouse has indicated that none of the Region 8 failed rods had any rework operations.
3. Fifteen of the fifty-two failed assemblies contained debris.
4. No correlation between failed assemblies of rods and delta power or final power has been observed.
5. Many of the failed rods in peripheral and interior locations of the assemblies were in locations where debris would be expected to be carried based on the hydraulic characteristics of the bottom nozzle.

Based on the Phase I examinations and the evaluations that took place afterwards, Phase II examinations were conducted to characterize the failure

mechanism(s) to eliminate as many probable mechanisms as possible. Based on all the examinations and evaluations, the following conclusions are drawn with regard to the possible failure mechanisms:

1. Mechanisms such as primary hydriding, weld defects and stress related defects, cannot be excluded based on the available leak test and visual data.
2. Numerous failures in Cycle 6 appear to be debris induced fretting.
3. An evaluation of the fuel failures in Cycle 7 is in progress but has not been completed. However, based on the sipping and video examinations, possible failure mechanisms are debris induced fretting and stress related defects.

4. Immediate Corrective Action:

Cycle 6 fuel assemblies that were determined to be leaking and originally intended for reuse in Cycle 7, were eliminated from the Cycle 7 core design.

Cycle 7 fuel assemblies that were determined to be leaking and intended for reuse in Cycle 8, were eliminated from the Cycle 8 core design. In addition, each assembly which was reused in Cycle 8 core was subjected to a precautionary debris cleaning process. Also, portions of the RCS were cleaned.

5. Subsequent Corrective Action:

It is not planned to use any assemblies known to contain leaking fuel rods in subsequent fuel cycles.

6. Action Taken to Prevent Recurrence:

The company is evaluating the detailed review of the rod design specifications and manufacturing processes being conducted by Westinghouse to reduce the possibility of design and manufacturing related defects in the future.

During the Fall, 1984 refueling outage, the reactor vessel, steam generator channel heads, reactor refueling cavity and the fuel assemblies scheduled for reuse in Cycle 8 core were inspected for debris and cleaned as necessary.

In addition to RCS cleanup, fuel examinations and precautionary fuel cleaning of Cycle 8 fuel, the company, in conjunction with a contractor, has conducted an extensive review of the rod design specifications and manufacturing

process used by Westinghouse to determine if they are conservative enough to reduce the possibility of design and manufacturing related defects in the future. As a result of this review, the company believes that the quality of the Surry 1 Cycle 8 fuel provided by Westinghouse was at least equivalent, and very likely superior, to that offered by other fuel vendors at the time. The changes instituted by Westinghouse since the Cycle 8 fuel manufacture have increased that quality. There were some recommendations made during the review for further improvements in quality and these recommendations have been forwarded to Westinghouse.

7. Generic Implications:

Manufacturing and debris related failures have been observed at other power stations.

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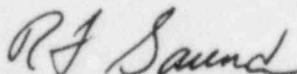
Pursuant to Surry Power Station Technical Specifications, Virginia Electric and Power Company hereby submits the following Licensee Event Report update for Surry Unit 1.

REPORT NUMBER

83-014/01X-3

This report has been reviewed by the Station Nuclear Safety and Operating Committee and will be reviewed by Safety Evaluation and Control.

Very truly yours,



R. F. Saunders
Station Manager

Enclosure

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