NRC FORM 366 (7-77)

UPDATED REPORT - PREVIOUS REPORT DATED 3/23/83

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT

POW 28-06-01

CONTROL BLOCK: (1) (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

Line	Field	Value
01	LICENSEE CODE (2)	V A S P S 1
01	LICENSE NUMBER (3)	0 0 - 0 0 0 0 0 - 0 0
01	LICENSE TYPE (4)	4 1 1 1 1
01	CAT (5)	
CON'T 01	REPORT SOURCE (6)	L
01	DOCKET NUMBER (7)	0 5 0 0 0 2 8 0
01	EVENT DATE (8)	0 3 0 9 8 3
01	REPORT DATE (9)	0 7 1 7 8 4

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)

02 During Unit 1 refueling operations, abnormal degradation of 7 fuel rods was observed.
03 One fuel rod had one small and one large (¼ in.) hole. Six fuel assemblies were
04 observed to have a missing top end plug in one fuel rod of each assembly. This event
05 is reportable per T.S.-6.6.2.a.(3). In addition, a small hole was confirmed in one
06 rod of ten (10) other fuel assemblies. RCS activity remained within T.S. limits,
07 therefore, the health and safety of the public were not affected.
08

Line	SYSTEM CODE (11)	CAUSE CODE (12)	CAUSE SUBCODE (13)	COMPONENT CODE (14)	COMP. SUBCODE (15)	VALVE SUBCODE (16)
09	R C	X	X	F U E L X X	Z	Z

(17) LER/RO REPORT NUMBER	EVENT YEAR		SEQUENTIAL REPORT NO.		OCCURRENCE CODE	REPORT TYPE		REVISION NO.
	8 3	—	0 1 4	/	0 1	X	—	1

ACTION TAKEN (18)	FUTURE ACTION (19)	EFFECT ON PLANT (20)	SHUTDOWN METHOD (21)	HOURS (22)	ATTACHMENT SUBMITTED (23)	NPRD-4 FORM SUB. (24)	PRIME COMP. SUPPLIER (25)	COMPONENT MANUFACTURER
X	X	Z	Z	0 0 0 0	Y	N	N	W 1 2 0

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)

10 A detailed evaluation indicates that several mechanisms contributed to the abnormal
11 degradation. They were: primary hydriding, weld defects, stress related defects and
12 debris induced fretting. A review of the rod design specs. and manufacturing
13 processes is being conducted by Westinghouse. Portions of the RCS will be inspected
14 and cleaned as necessary.

Line	FACILITY STATUS (28)	% POWER (29)	OTHER STATUS (30)	METHOD OF DISCOVERY (31)	DISCOVERY DESCRIPTION (32)
15	H	0 0 0	N/A	C	Fuel Inspection

Line	ACTIVITY RELEASED (33)	CONTENT OF RELEASE (34)	AMOUNT OF ACTIVITY (35)	LOCATION OF RELEASE (36)
16	Z	Z	N/A	N/A

PERSONNEL EXPOSURES

Line	NUMBER (37)	TYPE (38)	DESCRIPTION (39)
17	0 0 0	Z	N/A

8408010076 840719
PDR ADOCK 05000280
S PDR

PERSONNEL INJURIES

Line	NUMBER (40)	DESCRIPTION (41)
18	0 0 0	N/A

LOSS OF OR DAMAGE TO FACILITY (43)

Line	TYPE (42)	DESCRIPTION
19	Z	N/ A

PUBLICITY

Line	ISSUED (44)	DESCRIPTION (45)	NRC USE ONLY
20	N	N/A	

NAME OF PREPARER R. F. Saunders PHONE (804) 357-3184

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ATTACHMENT 1
SURRY POWER STATION, UNIT NO. 1
DOCKET NO.: 50-280
REPORT NO.: 83-014/01-1
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 evaluation program was undertaken and has been completed. The Phase 1 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 4AO 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 events are reportable per Technical Specification 6.6.2.a.(3). In addition, a small hole was confirmed in one rod 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).

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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 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 rods 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 on a rod exhibiting a severely cracked 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.

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 the Category I 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 or 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.

4. Immediate Corrective Actions

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.

5. Subsequent Corrective Action

None.

6. Action Taken to Prevent Recurrence

Vepco 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.

The reactor vessel, steam generator channel heads, reactor refueling cavity and the fuel assemblies scheduled for reuse in Cycle 8 core will be inspected for debris and cleaned as necessary. This will be accomplished during the next refueling outage.

7. Generic Implications

Fuel clad hydriding and debris induced fuel damage has been observed at other power stations.