AIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

DECLASSIFIED

RL-GEN-1398

Code C-65

~~This document classified~~

by

M. Lewis

BORESCOPE EXAMINATION

OF PROCESS TUBE 2959

January 26, 1967

R. Cooperstein

F. M. Newby

Classification Canceled and Changed To

DECLASSIFIED

By Authority of R.M. Oken

CG-PR-2, 4-21-94

By DK Hanson, 5.9.94

Verified By J.E. Savelly 5-13-94

DISTRIBUTION

1. GO Amy	11. EE Leitz
2. R Cooperstein	12. JS McMahon
3. DH Curtiss	13. NR Miller
4. RL Dickeman	14. WS Nechodom
5. TW Evans	15. RH Nelson
6. WJ Ferguson	16. FM Newby
7. AE Guay	17. JV Olson
8. MC Leverett	18. GE Records
9. DS Lewis	19. GE Files
10. M Lewis	20. -22. Extra

MASTER

This document is classified in the Atomic Energy Act of 1954. Its release or disclosure of contents in any manner to an unauthorized person is prohibited.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED *87B*

DECLASSIFIED

January 26, 1967

TO: M. Lewis

FROM: R. Cooperstein and F. M. Newby

SUBJECT: BORESCOPE EXAMINATION OF PROCESS TUBE 2959

Process tube 2959 experienced a massive fuel failure on January 11, 1967. Approximately 30 seconds after the initial failure indication, a low flow trip on the tube scrambled the reactor. Less than 5 minutes elapsed between the indicated beginning of the rupture and the time tube was diverted.

To initiate the discharge of the fuel from the process tube, a pushing force of 2,788 pounds was required. After the fuel started to move, the pushing force required to continue the discharging dropped rapidly to 538 pounds and continued to decrease slowly to 287 pounds.

A black cloudiness was seen in the discharge chutes during the operation manifesting that particulate oxide fuel, formed in the tube, was eroding from the element as it entered the water. These facts, coupled with the physical condition of the discharged failed element, strongly suggested that an examination of the process tube be made to ascertain whether the tube had incurred any damage.

On examination of the failed element in the storage basin, it was observed that approximately an 8-inch length of its outer cladding and core were missing. The inner cladding of the outer element and the end cap were intact. Closer observation of the element in the fuel examination facility verified the latter observations and also established the fact that it was the upstream end of the element that failed. Figure 1 is a sketch of the element as observed.

Several pieces of the missing fuel were retrieved from the discharge basket. These ranged in size from $1/4 \times 1/2$ to 1×5 inches in length. A section of outer cladding appeared to be adhering to the largest piece seen. The inner cladding exhibited a rough and pocked surface with some wrinkling and several cracks in it near the outer end. Penetration of the cladding at the inner support points was not evidenced.

On borescopic examination of the process tube wall, a black, kidney shaped spot, of undefined material was observed at $17' 9-1/2" \pm 2"$ from the end of the nozzle in the 1:00 o'clock position. The calculated distance, from the end of the nozzle, of the downstream supports on the failed element is $17' 9" \pm 2"$.

The spot had sharply delineated edges. It appeared to be foreign material on the order of 20 mils in height above surrounding tube surface. The spot appeared to be $1/4"$ wide $\times$ $1/2"$ long. No observable marks or color variations

DECLASSIFIED

M. Lewis

January 26, 1967

could be seen on the tube wall surrounding the spot. This is an indication that no excessive heating of the tube had occurred in this area.

Spiral shaped gouge marks were observed at the 7:00 to 8:00 o'clock position on the tube wall about 10" in front of and behind the point where the spot was found. This would place their initial appearance near the central section of the failed fuel element. The marks did not show signs of the presence of upset metal, indicating that only the tube wall film had been pierced. The length of the gouges were of the order of 1" and their width was of the order of 1/4".

Figure 2 is a sketch depicting the relative borescopic observations.

The spot of material observed on the tube wall could be residual uranium oxide which had formed from a piece of fuel lodged near a support after the element failed. Oxidation of such a piece at the fuel-tube interface could result in the formation of an adherent uranium oxide deposit which was tenacious enough to withstand removal by the repeated swabbings. Supporting the contention that the material was uranium oxide, is the fact that after startup, the fission product activity from the tube dropped off with continued coolant flow. Uranium oxide would be washed out under primary coolant operating conditions.

The low flow trip may be attributed to the following sequence of events: as the outer cladding failed and the exposed fuel underwent oxidation, the former was caught by the flowing coolant and pushed outward toward the tube wall as in the case of the opening of an umbrella. The spiral scratchings on the tube wall from the failed end of the element in the downstream direction lends support to this hypothesis.

No visual evidence of heating in the area surrounding the black spot could be found during the examination. This would have suggested the possibility of tube wall hydriding. Had there been discolorations caused by overheating in the environs of the spot, the area of concern was still considered to be too small to cause a weakening of the base metal.

The borescopic examination of the process tube led to the conclusion that the process tube integrity had not been compromised by the fuel element failure. The tube was recharged with Mark I fuel and the reactor restarted.

It is recommended that this tube be reexamined after its next discharge. Reexamination of the tube may provide additional information on the composition of the spot material and any damage that may have occurred from its contact with the tube wall.

RC:FMN:fom

DECLASSIFIED

DECLASSIFIED

Figure I

Fuel Failure #35

Top Section of tube

Figure 2 - Sketch of borescope observations
Top of tube section

DECLASSIFIED

**DATE
FILMED**

10/19/94

END