



*Reactor Facilities
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May 28, 1976

Mr. James P. O'Reilly, Director
U.S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region 1
631 Park Avenue
King of Prussia, Pennsylvania 19406

Dear Mr. O'Reilly:

STEAM GENERATOR HEAD CLADDING INDICATIONS
NO. 1 UNIT
SALEM NUCLEAR GENERATING STATION
DOCKET NO. 50-272

Supplementary to our verbal report of April 8, 1976 and preliminary written report of May 5, 1976 concerning indications in the stainless steel cladding of No. 1 Unit Steam Generator Heads, the following detailed report is submitted in accordance with provisions of 10CFR50.55(e).

INTRODUCTION

Subsequent to our May 5, 1976 report, nondestructive examinations of the stainless steel cladding in the heads of No. 1 Unit Steam Generators (11-14) were conducted using the water washable dye penetrant method. The results of these examinations along with metallurgical evaluation using replicas, have been reviewed by Westinghouse at Tampa, Florida. These evaluations have not revealed the cause of the cladding indications. A program for ultrasonically monitoring a representative single area of cladding indications in the cold leg of No. 14 Steam Generator is planned, access permitting. If the studies show that these representative cladding indications can be referenced successfully, a surveillance schedule will be incorporated into the nuclear plant inservice inspection program.

EXAMINATIONSA. NDE

Nondestructive examination of the Unit 1 Steam Generators (11-14) using the water washable dye penetrant method revealed extensive transverse and longitudinal cladding indications at bead overlaps and within the weld beads on the No. 14 Steam Generator. These defects were concentrated at one location on the upper bowl of the cold leg side in an area approximately 2' x 4'. The other steam generators No. 11, 12 and 13 and the hot leg side of No. 14 Steam Generator showed minor, randomly scattered indications. In addition, the No. 11 hot leg and No. 14 cold leg have indications at the toe of fillet weld on the cladding joining the partition plate, to the head. Although there were some clad indications in the nozzle of No. 14 Steam Generator cold leg, and minor indications in other steam generator nozzles, there were no clad defects evident in any inner corner radii of the nozzles.

B. FERRITE ANALYSIS

A ferrite composition examination was conducted on the No. 14 Steam Generator within the indication (2' x 4') zone as well as in areas where dye penetrant found no indications. Starting from the top of the channel head bowl, at the junction of the tube sheet cladding to bowl cladding, each weld bead was measured for ferrite with a Severn Gage. A series of locations across the No. 14 steam generator, approximately 18" apart, were checked for ferrite level. Results of the analysis revealed that weld beads measured by the Severn Gage contained 3.5% to 12.5% measured ferrite. There was no significant difference in ferrite content between the areas with dye penetrant indications and areas free from indications.

C. REPLICATION

Four areas with dye penetrant indications were selected for replication of the surface condition. Replicas of acetate film were taken of the No. 14 Steam Generator cladding of the following surface conditions:

- (1) as deposited clad
- (2) polished clad
- (3) polished and etched clad.

These replicas were examined at the Westinghouse Tampa Metallography Laboratory at 50 to 500 magnifications. The results show the indications to be fine, intergranular cracks. The mechanism explaining the formation and the dynamics of its propagation has not been formulated.

EXPLORATORY GRINDING

Four areas where cracks were present in No. 14 cold leg were ground to a depth approximately one-half of the nominal cladding thickness to avoid exposing base metal. The cladding is nominally 0.250", therefore the maximum depth excavated was 0.125". All explored cracks propagated into the cladding normal to the clad surface. The four ground areas were re-examined with dye penetrant. Three areas following grinding showed the cracks still present, while the fourth area 2" x 3", where grinding for chemistry was conducted, was free of any dye penetrant indications.

CHEMICAL ANALYSIS

An area approximately 2" x 3" in the cracking zone of No. 14 Steam Generator was selected for chemical analysis. Results of spectrographic and chemical analysis of the chips revealed the clad metal to be within the specification for all metallic elements. The carbon content was above the specification, however, this could be traced to the particles of grinding cutter abraded into the sample.

CONCLUSIONS

The work jointly conducted by Westinghouse and PSE&G has succeeded in defining the scope of the problem at Salem Nuclear Generating Station (No. 1 Unit). The transverse and longitudinal cracking is concentrated in one area (2' x 4') of the upper bowl of the cold leg of No. 14 Steam Generator. There are minor indications in the No. 11, 12 and 13 Steam Generators as well as the hot leg side of No. 14. The investigation to date has not determined the cause of the cracking but it has determined that the condition at Salem closely parallels the defects revealed in channel head cladding at Consolidated Edison's Indian Point No. 3 Nuclear Generating Station.

The controlled investigation conducted at Salem by Westinghouse and PSE&G has shown that in one isolated area 2" x 3", the defects in the cladding were removed prior to exposure of base metal. Exposure of base metal was averted at Salem to prevent extensive weld repairs which have been previously experienced by others.

A review of the safety implications conclude that the cracks in the cladding at Salem Nuclear Generating Station, No. 1 Unit are acceptable as the integrity of the system is not compromised. The Boiler and Pressure Code allows cladding indications and the subject of surface indications in cladding is defined as part of Section XI Code Case No. 1738 (attached).

5/28/76

CONCLUSIONS (Continued)

The intent of the code case is to verify that the cracks are indeed confined to the cladding and do not progress into the base metal. This condition can be reasonably substantiated by ultrasonic examination of representative cladding defects.

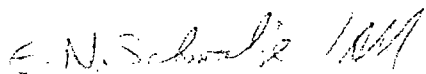
This inspection conducted on the channel head will attempt to:

- (a) identify the cladding indications on the cladding surface from the O.D. of the head.
- (b) measure the thickness of the cladding in the vicinity of the indication from the I.D. of the head
- (c) verify whether the cladding defect has propagated into the base metal.

If successful, the ultrasonic examination will then serve as the baseline preservice inspection of the steam generator cladding. The cladding indications will then be monitored as part of the inservice inspection program for the life-time of the nuclear plant. This examination will be complete by June 30, 1976.

The results of these examinations will be available at the site. If you require additional information our engineers will be available to discuss the details with you.

Very truly yours,


E. N. Schwalje
Manager of Quality Assurance
Engineering and Construction
Department

CC: Dr. Ernst Volgenau
Washington, D.C. 20555

Approved by Council, December 22, 1975

Case 1738

**Examination—Acceptance Standards for Surface Indications in Cladding
Section XI**

Inquiry: Is it permissible to accept surface indications in the patches of clad surfaces examined in accordance with Category B-I-1 and B-I-2, Table IWB-2600, Section XI, provided that the depths of the flaws are within the cladding material?

Reply: It is the opinion of the Committee that surface indications in the patches of clad surfaces, examined in accordance with Category B-I-1 and B-I-2, Table IWB-2600, Section XI, may be permitted and the acceptance standards of IWB-3517.1 may be waived, provided the depths of the flaws are within the cladding material. The provisions of this Case may not be applied for the examination of clad surfaces on the inner corner radii of nozzles.

Meeting of October 31, 1975