Stephen E. Quinn
Vice President

Consolidated Edison Company of New York, Inc.
Indian Point Station
Broadway & Bleakley Avenue
Buchanan, NY 10511
Telephone (914) 734-5340

March 7, 1995

Re: Indian Point Unit No. 2
Docket No. 50-247
LER 93-01-02

Document Control Desk
US Nuclear Regulatory Commission
Mail Station P1-137
Washington, DC 20555

The attached supplemental Licensee Event Report LER 93-01-02 is hereby submitted in accordance with the requirements of 10 CFR 50.73.

Very truly yours,

Attachment

cc: Mr. Thomas T. Martin
Regional Administrator - Region I
US Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Mr. Francis J. Williams, Jr., Project Manager
Project Directorate I-1
Division of Reactor Projects I/II
US Nuclear Regulatory Commission
Mail Stop 14B-2
Washington, DC 20555

Senior Resident Inspector
US Nuclear Regulatory Commission
PO Box 38
Buchanan, NY 10511

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NRC FORM 366 (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WTH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Indian Point Unit No. 2	0 5 0 0 0 2 4 7	1 OF 0 6

TITLE (4)

Tears in Refueling Cavity Liner

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 2	0 5	9 5	9 3	0 0 1	0 2	0 3	0 7	9 5		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 1 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Claude Peart, Senior Engineer	AREA CODE 9 1 4 7 3 4 - 5 1 9 0

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On February 7, 1993, at approximately 1630 hours, with the unit in cold shutdown and in its ninth day of a refueling outage, a tear in the west wall of the refueling cavity stainless steel liner was observed by outage support personnel. Upon further inspection, additional smaller tears were noted in the vicinity of the larger observed defect. Subsequent visual inspections of the Refueling cavity liner on February 15 and 20, 1993, identified additional defects in the liner. On February 5, 1995, with the unit in Cold Shutdown and in its second day of a refueling outage, 28 additional small tears were noted by plant personnel during a followup inspection of the liner as previously committed. The conditions detected in 1993 were rectified during the 1993 refueling outage by different methods that included welding of stainless steel plates and application of a high strength polymer over the affected areas. The tears detected during the 1995 refueling outage were immediately rectified with the application of the same high strength polymer over the affected areas as a permanent repair. The root cause of all the defects observed was determined to be transgranular stress corrosion cracking (TGSCC) caused by exposure of the stainless steel liner to an aqueous environment containing chlorides.

No NRC limit was exceeded and there was no impact on public health and safety.

PLANT AND SYSTEM IDENTIFICATION:

Westinghouse 4-loop pressurized water reactor.

IDENTIFICATION OF OCCURRENCE:

Tears in refueling cavity liner.

EVENT DATE:

February 7-20, 1993; February 5, 1995

REPORT DUE DATE:

March 7, 1995

REFERENCES:

Open Item Report (OIR) 93-02-059; 95-02-108

PAST SIMILAR OCCURRENCE:

None.

DESCRIPTION OF OCCURRENCE:

On February 7, 1993, at approximately 1630 hours, with the unit in cold shutdown and in its ninth day of the refueling outage, a tear in the west wall of the refueling cavity liner was observed by outage support personnel. The tear was approximately 15 inches in length with a centerline distance approximately 12 feet from the bottom of the cavity. The observed defect was subsequently documented in an open item report (OIR) and action was taken to repair the observed defect. Reactor disassembly was in progress at the time and the refueling cavity was empty and being prepared for flooding up to facilitate core offload. Upon further inspection of the area, additional smaller defects in the refueling cavity liner were discovered in close proximity to the previously identified tear. The anomalous conditions were subsequently rectified with the welding of two 1/4 inch stainless steel plates over the affected area followed by appropriate non-destructive examination of the welds.

DESCRIPTION OF OCCURRENCE: (continued)

On February 15, 1993, with the core offloaded and the refueling cavity drained, an entry was made into the refueling cavity. A visual inspection of the refueling cavity liner was conducted at this time which revealed ten areas where water appeared to be seeping back into the cavity through the liner. It was observed that these defects were all located at the same 80 foot elevation but on different liner walls.

On February 20, 1993, another entry was made into the refueling cavity and a complete inspection of the refueling cavity wall surfaces was conducted using video and still photography. This visual inspection revealed 16 additional areas with indications on the North, South, East and West Walls. Essentially two type of indications were noted, "L"-shaped and "spider web". Four samples were removed from these indication types and submitted to an outside contractor for metallurgical evaluation and determination of the mechanism and cause of the indications. In order to determine any effects the borated water had, or will have, on the concrete walls of the refueling cavity, a visual examination of the concrete wall through the sample opening in the liner was also performed at this time. This examination revealed that the exposed concrete surfaces had developed a rust colored appearance, which was attributed to the embedded structural steel anchor members. Further, it appeared that the concrete surface had undergone selective leaching. A limited examination of the outside surface of the refueling cavity concrete wall was also conducted which did not reveal any water migration through the wall, as evidenced by the absence of effervescent deposits or scale. Initial efforts by plant personnel to determine the concrete hardness using a rebound number test was inconclusive. Small core bore samples of the concrete behind the steel liner were also taken at this time and submitted to an outside contractor for further analysis. In the areas where core bore samples were taken the concrete removed was replaced with grout in accordance with approved plant repair procedures.

On February 5, 1995, with the unit in cold shutdown and in its second day of the refueling outage, twenty eight new cavity liner defects were observed by plant personnel during the performance of an inspection of the refueling cavity liner. This inspection activity was a required corrective action of the previous assessment of the defects discovered during the 1993 Refueling Outage. The purpose of this inspection was primarily to inspect the areas previously repaired with the epoxy coatings to determine if any visible deterioration had occurred, or propagation of liner tears had developed beyond the repaired area, as well as further inspection of liner weldment areas not previously identified for repair.

The new defects detected in 1995 were located in the same general area of the previously observed defects but were much smaller in size (i.e. approximately 1/16 inch in length) than those detected in 1993. They were identified by the presence of the characteristic rust bleed through from the carbon steel embedments. It is believed that these new defects were present back in 1993 but were not detected because of the inspection approach. In contrast to last outage inspection, which was performed in respirators and from a man-basket, this inspection was performed with face shields and from a ladder which permitted better access and visibility, as well as closer inspection of the liner.

DESCRIPTION OF OCCURRENCE: (continued)

The 1995 inspection of the cavity liner also revealed that the previously epoxy repaired areas were intact with no signs of peeling, cracking or crack propagation beyond the repaired areas. It was also noted that two of the welded plate repaired areas performed in 1993, showed signs of cracking in the liner plate beyond the fillet weld. Based on this inspection findings, the epoxy method of repair was determined to be an acceptable permanent repair method. Consequently, all observed areas were repaired by the epoxy repair method and accepted by Quality Control by February 9, 1995.

ANALYSIS OF OCCURRENCE:

This report is being made consistent with the provision of 10 CFR 50.73 (a) (2) (ii) (B) because the design basis leak prevention function of the refueling cavity liner during anticipated earthquake loadings was compromised. The repair of the observed liner defects were effected during the 1993 and 1995 Refueling Outage, utilizing repair methods that consisted of welding 1/4" thick stainless steel plates, and/or the application of a high strength polymer, over the affected area. The methods of repair employed restored the liner's leak prevention function and should prevent further deterioration in those areas. The inspection conducted during the 1995 refueling outage confirmed the adequacy of the epoxy repair method and was thus approved as permanent repair for all observed defects identified in 1995. The refueling cavity liner will be inspected in the 1997 refueling outage to confirm that no new defects are present. If new defects are discovered they will be permanently repaired and further inspection of the liner conducted as may be required to assure the leak prevention function of the liner is preserved and interfacing structures not compromised.

CAUSE OF OCCURRENCE:

The refueling cavity consists of concrete with a type 304 stainless steel liner. The stainless steel liner is welded to embedded structural steel anchors at the liner seams and anchor plugs. The liner is constructed from a series of integral welded steel plates.

Most cracks in the liner appeared to have originated on the concrete side of the liner, except one crack which appeared to have initiated on the cavity side. Evidence of chlorides was found on the fracture surfaces and also on the concrete side of the specimens. The chlorides most probably leached from the concrete as a result of boric acid interaction. The different crack appearances were due to more severe corrosion of the crack surfaces at one location compared to the others. However, all specimens showed cracking by the same mechanism.

CAUSE OF OCCURRENCE: (continued)

The type of defects observed from the metallographic examinations of the liner samples were determined to be indicative of transgranular stress corrosion cracking (TGSCC). The cracks observed possess the classical branched features of TGSCC. Measured hardness values correspond to those of annealed material, indicating that no significant cold work was present in the material. TGSCC, as with any stress corrosion cracking mechanism, results from a particular combination of material, stress and environment. The most commonly reported cause of TGSCC and pitting in annealed austenitic stainless steel is highly localized destruction of passivity by contact with moisture that contains halide ions, particularly chlorides. It is generally believed that austenitic stainless steels are not susceptible to TGSCC if they are exposed to environments below 140°F. However, it is becoming evident that in the presence of humid environments containing chlorides, stainless steel components will fail from TGSCC even at ambient temperatures.

The initiating event for the determined root cause could not be conclusively assessed. However, it is theorized that one or more of the liner cracks were probably caused by an initial manufacturing defect. Refueling water then seeped through the defect, in small quantities, to the concrete side and found its way around the cavity above one of the horizontal welds (the welds in most part would not let water flow down). TGSCC cracks were subsequently initiated and propagated over several years and resulted in the leaks in the refueling cavity liner from the concrete side to the cavity.

In regards to the samples of the refueling cavity concrete wall, the analysis results revealed that little borated water migration had occurred into the concrete wall thickness. It was determined that if borated water was excluded from the space between the stainless steel liner and concrete surface, this condition could be arrested. Therefore, assuming the refueling cavity liner repairs are effective, further investigation of the concrete is not necessary. Compressive test of the concrete core samples were also conducted but were inconclusive due to the relatively small size of the samples.

Although the inspection conducted during the 1995 refueling outage revealed additional liner defects, these defects were much smaller in size than those observed in 1993 (i.e., 1/16 inches versus up to 15 inches) and are believed to be pre-existing defects. Further, the cavity was reflooded only once since effecting the repairs in 1993. Consequently, the previous conclusions in regards to the concrete wall behind the cavity liner were still deemed valid.

CORRECTIVE ACTION:

1. In response to the OIR documenting the refueling cavity liner defect observed on February 7, 1993, a permanent repair was effected prior to flooding the cavity for core offloading. This consisted of welding two 1/4" thick stainless steel plates over the affected area followed by non destructive examination (NDE) of the welds. The remaining liner defects detected in 1993 and 1995 were repaired during the 1993 and 1995 refueling outage by either welding plates similar to that done previously, or by application of a high strength polymer over the affected areas. As a result of the 1995 inspection, the epoxy coating was determined to be an acceptable permanent repair for all current observed defects. In addition, the epoxy coating method of the repair was shorter and thus significantly reduces personnel exposure. All completed repairs were followed by NDE of the areas.

2. A refueling cavity wall inspection program was developed and implemented during the 1995 refueling outage. As noted previously, this effort resulted in the establishment of the epoxy coating method as a permanent repair for all observed defects and will be implemented again in the 1997 refueling outage to confirm that no new liner defects are present. If new defects are discovered, they will be permanently repaired and an expanded inspection of the liner conducted as necessary, to assure the leak prevention function of the liner is preserved and interfacing structures are not compromised.