

LICENSEE EVENT REPORT (LER)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED FORM NO. NRC-516
REVISED 8/21/86

FACILITY NAME (1)						LICENSURE NUMBER (2)				PLANT (3)	
Indian Point Unit No. 2						0 6 0 0 0 2 4 7				1 OF 0 7	
TITLE (4)											
Environmental Qualification of Electrical Splices											

EVENT DATE (5)			LEA NUMBER (6)				REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)														
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME			LICENSURE NUMBER												
1	2	0	1	8	7	8	7	0	1	7	0	0	1	2	3	1	8	7				0 6 0 0 0		
OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 50. (Check one or more of the following) (10)										LICENSURE NUMBER												
N												0 6 0 0 0												

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 50. (Check one or more of the following) (10)										LICENSURE NUMBER		
N												0 6 0 0 0		
POWER LEVEL (11)												0 0 0		

NAME (12)						TELEPHONE NUMBER (13)					
Jude G. Del Percio, Manager, Regulatory Affairs						9 1 4 5 2 6 - 1 5 1 2 7					

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (14)														
CAUSE	SYSTEM	COMPONENT	MANUFAC. TYPEN	REPORTABLE TO NRC (15)	CAUSE	SYSTEM	COMPONENT	MANUFAC. TYPEN	REPORTABLE TO NRC (15)	CAUSE	SYSTEM	COMPONENT	MANUFAC. TYPEN	REPORTABLE TO NRC (15)

SUPPLEMENTAL REPORT EXPECTED (16)										EXPECTED SUBMISSION DATE (16)		MONTH	DAY	YEAR
YES (17) OR COMPLETE EXPECTED SUBMISSION DATE (18)										X NO				

In response to IE Notice 86-53, an inspection program was initiated during the current refueling outage to evaluate the safety related electrical splices located in those areas of Indian Point Unit 2 (IP2) which would be subject to a harsh environment during accident conditions. The purpose of the inspection was to verify that the field installation matched the tested (qualified) configuration. The results of this program indicated that certain splices did not meet the acceptance criteria, and hence the affected electrical devices were potentially unavailable in a high energy line break environment. The affected electrical splices were replaced with qualified splices during the 1987 refueling outage. Procedural measures, including QA/QC coverage of replacement splice installations, were instituted.

A meeting was held with the NRC at the Region I, King of Prussia, office on December 1, 1987. A comprehensive presentation was made to them regarding the results of our inspection program and additional qualification testing, our corrective actions, and reportability of the event.

The public health and safety were not affected.

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U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO 3150-0104
EXPIRES 8/31/85

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NOTE: If more space is required use additional NRC Form 366A (1/17)

Plant and System Identification:

Westinghouse 4-loop Pressurized Water Reactor

Identification of Occurrence:

An inspection program for safety related electrical splices at IP2 which included additional environmental qualification testing of splices was undertaken during the 1987 refueling outage. The program identified splices that did not meet the acceptance criteria which led to a determination that the affected electrical safety devices could potentially have been inoperable for service in a high energy line break environment.

The results of this inspection program, our corrective actions and reportability of the event were discussed with the NRC during the December 1, 1987 meeting at King of Prussia.

Event Date: December 1, 1987

Reference: Significant Occurrence Report (SOR) 87-603 and NRC Notification under 10 CFR 50.72 (b) (2) (i) on December 1, 1987.

Past Similar Occurrence: None

Description of Occurrence:

In response to IE Notice 86-53, an inspection program for safety related electrical splices located in areas of the facility which would be subject to a harsh environment during accident conditions was undertaken during the 1987 refueling outage. This inspection could not be performed while the unit was on line as it involved time consuming measurement of individual splices requiring an outage of sufficient duration. The electrical installation procedure and practices utilized at IP2 required extensive use of terminal blocks inside the containment, which was confirmed during a previous terminal block inspection. Therefore, the majority of the safety related electrical splices inside the containment were expected to be located at the containment penetrations.

In May 1987 after identification at Carolina Power & Light's H.B. Robinson Station of a factory installed second splice on each pigtail from the

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LET IF MORE SPACE IS REQUIRED USE CONTINUOUS NAC FORM 2042 (1/77)

Crouse-Hinds penetrations, we commenced an investigation into the possible existence of the same condition at IP2. This investigation identified a similar second splice on the 4" lead wires from the penetration in addition to the field installed splices on the 5' pigtailed from the same penetrations. The 5' pigtailed are connected to the lead wire splices and 4" lead wires at one end and the field installed splices and field run cables at the other end. Upon investigation the second splices could not be verified to be the same as the field installed splices. It was believed that these second splices were Crouse-Hinds factory installed splices. A Company review of documentation on the Crouse-Hinds penetrations, supported by the recollection of a retired Westinghouse employee, who supervised the post installation testing of the splices, indicated that United Engineers and Constructors (UE&C), the facility's Architect Engineer, had consulted with the Westinghouse Engineering Project Manager to effect repairs and replacement of the splices in 1970-71 during original construction. Based upon this review and our engineering evaluation, made prior to the recently completed inspection, it was believed that the generic splice concerns raised by IE Notice 86-53 were not present and that IP-2 was equipped with operable splices. However, since adequate documentation to establish qualification of these splices could not be found in Westinghouse files or within the Company, we decided to perform qualification testing.

Safety related electrical splices located in harsh areas at IP2 consist of the following types:

- o Field installed splices inside the containment at the penetration- These splices were installed mostly during the original plant construction following an UE&C splice installation procedure.
- o Splices at 4" lead wires from the Crouse-Hinds penetrations inside the containment - These splices were supposed to be factory installed by Crouse-Hinds. Our investigation also revealed that instrumentation related Crouse-Hinds splices were remade during original plant construction due to unacceptable post-installation test results.
- o Splices with Raychem heat shrink tubing.
- o Taped splices at motor leads.

The following summarizes the results of the splice inspection and/or test program and the qualification status of each of these four kinds of splices:

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LER 18 must be used in conjunction with existing NRC Form 266 (11/77)

Field installed splices inside the containment at the penetrations

These splices were mostly installed during original plant construction following an approved UE&C procedure, and are located at the 5' pigtailed from the penetration assemblies. The inspection results indicated that approximately 69 out of 103 splices either did not meet the seal length criteria or seal length could not be determined. The inspection only included the instrumentation and control related splices and did not include those in the 480V power circuits. As explained in the following paragraphs, the associated Crouse-Hinds splices on 480V heavy power related leadwires could not be included in the qualification testing. Hence a decision was made to replace both splices, the field installed UE&C and the factory installed Crouse-Hinds, on each power related pigtail from the Crouse-Hinds penetrations.

Crouse-Hinds factory installed splices

A test program was undertaken for the Crouse-Hinds splices to establish their environmental qualification. These splices are installed at the 4" leadwires from the penetrations. Acceptance criteria for inspection of these splices were then developed from configurations of the test specimens which successfully passed the test program.

A total of 14 specimens, including the instrumentation and control related Crouse-Hinds splices, were included in the qualification testing program for incontainment application. The test specimens were removed from the installed penetration pigtails at IP2 where they had been naturally aged for over 10 years. Test specimens included splices from instrumentation and control applications. Due to the unavailability of spares on 480V power related penetration pigtails, none could be tested. Some specimens were tested in an as-is condition with only an additional 2 years of artificial aging for in-containment applications. Other specimens were modified by installing additional protective measures e.g., Raychem Nuclear Jacket Repair Sleeves (NJRS), covered with RTV 21 or sigmaform "Shrink around" sleeving. The modified specimens were aged an additional 15 or 30 years of in-containment conditions.

The as-is instrumentation test specimens did not meet the test acceptance criteria on insulation resistance (IR) during the initial phase of the LOCA testing. The as-is control specimens and the instrumentation splices with NJRS modifications had acceptable performance during and after testing. The testing was completed on November 13, 1987.

The installed Crouse-Hinds control splices were inspected against the successful as-is control test specimen configuration. Approximately 30 out of 472 control splices did not meet inspection criteria and were repaired.

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IF MORE SPACE IS REQUIRED USE SEPARATE NRC Form 204 (1/77)

The instrumentation splices which did not meet test criteria and the 480V power splices which could not be tested, were remade or repaired.

Splices with Raychem heat shrink tubing

These splices were installed after the original plant construction, and are located both inside and outside the containment. The inspection results indicated that approximately 25 out of 41 such splices inside the containment and most of the splices outside the containment did not meet installation acceptance criteria on seal length of heat shrink tubing over the spliced cable outer insulation. These acceptance criteria were developed from Raychem and industry environmental qualification test results. The splices inside containment that did not meet the seal length criteria were considered unqualified since they did not match the tested configuration. A majority of the installed splices outside the containment however were considered qualified or qualifiable based upon various industry testing and analysis for their application.

Taped Splices at motor leads

Inspection of the motor leads identified taped splices at the safety related pump motors inside containment. The original plant termination utilized white scotch tape which was a qualified tape. Certain motor leads were identified to have black tape. Qualification status of the black tape is currently being investigated, although the tape splices have already been replaced.

Certain pump motors in harsh areas outside the containment were also identified to have taped splices at the motor leads. This tape is found to be equivalent to Scotch 33+ which is considered acceptable for Auxiliary Feed Pump room environment. Other applications of this tape are being investigated.

Analysis of Occurrence:

As the IR values recovered after the initial transients, the reliability of the control room instrumentation reading could be expected to improve with time. The Emergency Operating Procedures adequately address instrument setpoint errors except for the initial phase of the accident.

A number of safety related devices may not have been operable under a high energy line break environment inside the containment as some of the associated splices (Crouse-Hinds controls, field installed UE&C splices at the penetrations, some Raychem heat shrink tubing, and taped splice

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applications) did not meet the inspection criteria which were developed from qualification testing. The splices at the containment penetrations on power circuits which were not tested or inspected would conservatively be considered inoperable. Due to the number of safety related devices involved, operability of which under conservative worst case accident conditions could not be established, it has been concluded that the IP2 could have been in an unanalyzed condition that significantly compromised plant safety. This conclusion has been made notwithstanding the conservatism involved in the analyses namely:

- o The conservatisms in the calculated worst case containment envelope used for qualification
- o The splices where overlap could not be measured were conservatively considered unqualified

The public health and safety were not affected.

Cause of Occurrence:

The significant majority of the splices that did not meet the inspection criteria or test acceptance criteria were installed during original plant construction by UE&C and/or Westinghouse. Inadequate attention to qualification requirements of the Crouse-Hinds factory supplied penetration configuration led to a failure to qualify the factory installed splices at the 4" pigtails at the time of construction of the plant. Poor workmanship and inadequate attention to the details of the electrical splice installation procedure have been identified as a primary reason for the splice deviations.

Corrective Action:

The new Raychem splices that did not meet the inspection criteria have been either replaced with WCSF-N heat shrink tubing or a Raychem Nuclear Jacket Repair Sleeve (NJRS) has been installed on them.

The Crouse-Hinds instrumentation splices at 4" lead wires, and the field installed UE&C instrumentation splices at 5' pigtails which did not meet the inspection criteria have been repaired with Raychem NJRS coverings.

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The field installed UE&C control splices at the penetrations which did not meet the inspection criteria have been repaired with a Raychem NJRS covering and RTV. The Crouse-Hinds control splices which did not meet the inspection criteria have been replaced using WCSF-N heat shrink tubing.

The Crouse-Hinds and UE&C splices at the penetration associated with 480V power circuits have been remade with Raychem WCSF-N heat shrink tubing. The motor lead tape splices are also being remade with Raychem WCSF-N heat shrink tubing. The splice repair work was completed during the 1987 refueling outage.

The repaired splices with Raychem WCSF-N heat shrink tubing are qualified via various Raychem and industry testing of Raychem heat shrink tubing application.

The Crouse-Hinds instrumentation splices repaired with Raychem NJRS covering are qualified via the recent Con Edison testing. The existing Crouse-Hinds control splices are also qualified via this recent testing for an additional two years. Additional testing to extend their qualified life or replacement with qualified splice configuration will be performed before the end of this two year period.

The repaired UE&C splices are qualified via a combination of the WCAP 7410L for the original field installed splices, recent Con Edison testing, and engineering analysis for applicability of the test results to the repaired configuration and material compatibility.

The Emergency Operating Procedures will be updated prior to criticality from the 1987 refueling outage with instrument loop error values representative of the insulation resistance of the existing and repaired splices established by qualification testing.

Although the significant majority of the splices that did not meet the inspection and/or test criteria were installed by UE&C and/or Westinghouse, our training program has been updated to ensure emphasis on correct splice installation. Our current splice installation procedure and improved QA/QC coverage of splice installation are expected to prevent future recurrence of splice installation deficiencies.



Consolidated Edison Company of New York, Inc.
Indian Point Station
Broadway & Bleakley Avenue
Buchanan, New York 10511-1099

December 30, 1987

Re: Indian Point Unit No. 2
Docket No. 50-247
LER 87-017-00

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

The attached Licensee Event Report LER-87-017-00 is hereby submitted in accordance with the requirements of 10 CFR 50.73.

Very truly yours,

Stephen Bram
Vice President
Nuclear Power

Attachment

cc: Mr. William Russell
Regional Administrator - Region I
U.S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, PA 19406

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
P.O. Box 38
Buchanan, NY 10511

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