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ILLINOIS POWER COMPANY

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U-10272
CLINTON POWER STATION, P.O. BOX 678, CLINTON, ILLINOIS 61727

April 30, 1985

Docket No. 50-461

Mr. James G. Keppler
Regional Administrator
Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Subject: Reportable 10CFR50.55(e) Deficiency 55-84-19:
Nelson Studs On Embedment Plates

Dear Mr. Keppler:

On August 28, 1984, Illinois Power Company notified Mr. F. Jablonski, NRC Region III, (Ref: IP Memorandum Y-20790, dated August 28, 1984) of a potentially reportable deficiency concerning Nelson Studs, which have parted from the back of the embedment plates. This initial notification was followed by two (2) interim reports (ref: IP letter U-10204, D. P. Hall to J. G. Keppler, dated October 1, 1984; and IP letter U-10242, D. P. Hall to J. G. Keppler, dated January 21, 1985). Illinois Power's investigation of this matter is complete. Our investigation determined that the problem associated with the parted Nelson Studs was limited to four (4) embedment plates located on the drywell outer wall. These plates have eccentrically located welded attachments utilizing large fillet and penetration welds. In addition, our investigation included a field inspection of other embedment plates for which Nonconformance Reports (NCRs) had been initiated to document occurrences of plate distortion or concrete spalling. No other occurrences of parted Nelson Studs were identified. Our investigation into this matter has determined that this issue represents a reportable deficiency under the provisions of 10CFR50.55(e). This letter is submitted as a final report in accordance with the requirements of 10CFR50.55(e). Attachment A provides the details of our investigation.

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We trust that this final report provides you sufficient background information to perform a general assessment of this reportable deficiency and adequately describes our overall approach to resolve the issue.

Sincerely yours,

D. P. Hall
Vice President

RLC/lr (NRC)

Attachment

cc: NRC Resident Office, V-690
Director - Office of I&E, US NRC, Washington, DC 20555
Illinois Department of Nuclear Safety
INPO Records Center

ATTACHMENT A
Illinois Power Company
Clinton Power Station

Docket No. 50-461

Reportable 10CFR50.55(e) Deficiency 55-84-19
Nelson Studs on Embedment Plates

Final Report

Statement of Reportable Deficiency/Background

Nonconformance Report (NCR) No. 20031 was written to document a condition where an embedment plate on the outside of the drywell wall had pulled away from the concrete (AZ 128° el. 753', S&L dwg. S27-1002-03A). To aid in dispositioning of this condition, the concrete was excavated along the edges of the plate to expose the embedded Nelson studs behind the plate. All seven (7) studs in the outer row were exposed. Six (6) of the seven (7) studs were found detached from the back of the plate. A second plate at AZ 140° was also excavated and found with two (2) of four (4) exposed studs parted from the back of the plate (NCR 21516).

Investigation Results

There are four (4) embedment plates in the drywell outer wall (AZ 128°, 140°, 157°, 174°, el. 755') with eccentrically located beam connections. The end connections had been field modified due to a design change and required large fillet and penetration welds to be applied to the embedment plates. NCR 20031 was written after these modifications to document the fact that the plate at AZ 128° had pulled away from the concrete. The concrete on one side of this plate was excavated to expose the Nelson Studs behind the plate. Six (6) of seven (7) in the outer row were found parted from the embedment plate. Although the embedment plates at AZ 140°, 157°, 174° had not shown any obvious signs of distortion or concrete spalling, they were excavated to determine if any other studs were parted. The fact that beams were also attached to these embedment plates eccentrically (positioned off the centerline of the plate) gave reason to suspect that the modification welding near to the stud row may have caused thermal stresses and/or unobservable plate distortion sufficient to cause the stud failure.

The embedment plate at AZ 140° was excavated on both sides. Two (2) studs in the row of seven (7) closest to the welding area were found parted (NCR 21516). The side away from the welding areas had six (6) of the seven (7) studs exposed. All six (6) were still attached to the back of the embedment plate. The embedment plates at AZ 157° and 174° were excavated on the side near the weld areas. No studs on either plate were found parted. IPQA has written Surveillance Reports to document the results of the excavations.

Since the beams were eccentrically attached to the embedment plate, Sargent & Lundy (S&L) was requested to evaluate the possibility that the modification welding using large (7/8") fillets near the outer stud row was a plausible cause of the studs parting. S&L provided calculation 8.35.0-4A which shows that thermal stress and/or thermal gradient are plausible causes for the studs parting. A copy of calculation 8.35.0-4A was provided to the NRC Region III (J. Jacobson). Mr. Jacobson expressed concern about the possibility that residual stresses remaining in the plate could reduce the capacity of the remaining stud connections. In a meeting February 7, 1985 with Sargent & Lundy, NSED, and Mr. Jacobson, a presentation was made to demonstrate that no residual stresses would remain in the unbroken studs after the plate cooled to ambient temperature. Mr. Jacobson accepted this explanation but requested that stresses due to weld shrinkage be considered also. Sargent & Lundy prepared calculation no. 8.35.0-5A to account for the effects of shrinkage stresses. Based on this calculation, the strength of the remaining unbroken stud connections on each plate will not be diminished by residual or shrinkage stresses. This calculation was submitted to the NRC February 22, 1985, and accepted March 8, 1985.

The review of the existing documentation for the embedment plates supplied by Rockwell Engineering has revealed no obvious discrepancies. The stud welding procedure used by Rockwell (RECO 200-1) had been reviewed and accepted by S&L and Baldwin Associates. The inspection of the stud weld fracture area behind the plate indicated the studs had been welded to the plates properly. Repair travelers S-1331, 1332, 1334, 1335 required replacement of missing studs on four (4) of the five (5) plates in question. Although it is not precisely known which studs were replaced, the travelers S-1334 and 1335 required a visual check of the remaining studs.

Since, 1) the excavations have shown the problem to be limited to the embedment plates at AZ 128° and 140° and only in the area where the fillet welds were applied near the outer row of studs; 2) calculations show welding induced stresses to be sufficient to cause the stud failures and; 3) there is no evidence of improper fabrication; it is concluded that the stud separations were caused by the stresses induced from the large welds applied near the plate edge.

Corrective Action

The loading on the two (2) embedment plates with parted studs is such that repairs were made to restore the full design load capacity, i.e, the total Design Basis Accident (DBA)

loading including Safe Shutdown Earthquake (SSE) and Pool Swell loads. The broken studs cannot be rewelded to the plates. Therefore, a repair design was developed based on welding wing plates to the existing embedments. At AZ 140°, a plate tab was welded to an existing, adjacent embedment plate. At AZ 128° the wing plates, top and bottom, were secured to the drywell wall using Drillco Maxi Bolts. The excavated concrete was replaced with grout.

In addition to the specific embedment plates previously discussed, several other NCRs were written to describe cases of embedment plate distortion. There was one known case where two (2) deformed wire anchors, welded to an embedment plate, had parted (ref: NCR 18764/25462). These were on the bottom row of an embedment plate that has 3 columns of 5 wire anchors each. The welding of the beam seat to the embedment plate with a single bevel, partial penetration weld, had visibly distorted the plate on the bottom (ref: NCR 18764). Illinois Power and S&L evaluated these deficiencies and dispositioned them use-as-is. To preclude any future parting of studs and minimize the distortion of embedment plates, Sargent & Lundy (S&L) has issued Engineering Change Notice (ECN) 4807 with instructions for welding structural steel on embedments. A note (ECN 4807) was added to the general structural steel notes on drawing S21-1001 which gives criteria for when special caution applies for welding to embedments. Baldwin Associates Technical Services (BATS) will include these instructions in each traveler that is issued for structural welding to embedments. These instructions will minimize the buildup of localized thermal stresses by controlling welding sequences and parameters.

All corrective action required to correct the identified deficiencies and preclude their recurrence have been completed.

Safety Implications/Significance

Illinois Power has reviewed the findings of this investigation, and has determined that the matter of the broken studs represents a significant safety issue. S&L has determined that the loading on the beams, (numbered 104 and 103), attached to the embedment plates at AZ 128° and 140° respectively is such that the capacity of those plates with broken studs was insufficient to sustain the total Design Basis Accident loads. Repairs were required and the use of the special Drillco devices was required on beam 104 due to the high reaction loads. Beams 103 and 104 are part of the support for the containment annulus deck at elevation 755'. Safety related equipment is, in turn, supported by this deck area. Even without a rigorous analysis, postulated failure of these embedments and beams is considered unacceptable and represents a significant safety issue. This issue is therefore considered reportable under the provisions of 10CFR50.55(e).