

U. S. NUCLEAR REGULATORY COMMISSION  
REGION III

Report No. 50-316/88026(DRS)

Docket No. 50-316

License No. DPR-74

Licensee: American Electric Power Service  
Corporation  
Indiana Michigan Power Company  
1 Riverside Plaza  
Columbus, OH 43216

Facility Name: D. C. Cook Nuclear Plant, Unit 2

Inspection At: D. C. Cook Site, Bridgman, Michigan

Inspection Conducted: September 7, 8, 15, 21, 22, 27, 28; October 3, 5, 18,  
20, 24; November 1, 3, 8, 9, 17 and 29, 1988

Inspectors: *J. M. Jacobson*  
J. M. Jacobson

12/8/88  
Date

W. C. Liu *W C Liu*

12/08/88  
Date

*J. M. Jacobson*  
R. A. Westberg *ba*

12/8/88  
Date

Accompanying Inspectors: M. Hum (NRR)  
R. Herman (NRR)  
M. Schuster (NRC Consultant)  
E. Martindale (NRC Consultant)

Approved By: *D. H. Danielson*  
D. H. Danielson, Chief  
Materials and Processes  
Section

12/8/88  
Date

Inspection Summary

Inspection on September 7, 8, 15, 21, 22, 27, 28; October 3, 5, 18, 20, 24;  
November 1, 3, 8, 9, 17 and 29, 1988 (Report No. 50-316/88026(DRS))

Areas Inspected: Special announced safety inspection of previous inspection findings concerning welding issues (92701); review of procedures, qualifications, and in-process work activities associated with the Steam Generator Replacement (37702).

Results: No violations or deviations were identified. Based on the results of the inspection, the inspectors reached the following conclusions:

- ° After a considerable amount of rework, the reactor coolant loop welds and steam generator girth welds are acceptable.
- ° The steam generator enclosures have been restored to a serviceable condition.

## DETAILS

### 1. Persons Contacted

#### American Electric Power Service Corporation (AEP) Indiana Michigan Power Company (IM)

W. Smith, Plant Manager  
\*J. White, Site Project Manager  
B. Rarrick, QA Supervisor  
R. Rickman, ISI Supervisor  
B. Radford, Site Structural Engineer  
N. Ruccia, Structural Design Engineer  
J. Reiniger, Structural Design Engineer  
E. Abshagen, RFC Supervisor  
W. Pauls, Design Change Coordinator  
S. Brewer, Manager, Nuclear Safety and Licensing  
S. Heinecke, Project Manager  
J. Sampson, Safety and Assessment Superintendent  
E. Morse, Safety and Assessment Supervisor  
D. Powell, Metallurgist  
P. Barrett, Director, QA

#### U. S. Nuclear Regulatory Commission (U. S. NRC)

\*B. Jorgensen, Senior Resident Inspector

\*Denotes those attending the exit meeting on November 29, 1988.

### 2. Licensee Action on Previous Inspection Findings

- a. (Closed) Violation (316/88024-01): Failure to utilize an effective radiographic technique. The licensee's contractor, performing radiography on the steam generator girth welds, positioned the Cobalt-60 source, 37 inches off the weld centerline. This positioning is contrary to ASME, Section V which requires that the source be positioned as close to the weld centerline as practical.

In an effort to evaluate the effectiveness of the contractor's radiographic technique, the NRC radiographed a section of the girth weld using a more optimized technique. The NRC inspector's technique, which effectively positioned the source on the weld centerline, disclosed a rejectable slag inclusion that ran the entire length of the film. Since the licensee's radiograph of this same area did not detect this slag inclusion, the licensee's technique was shown to be unacceptable.

To correct this problem, the licensee radiographed the four girth welds utilizing a technique which placed the source at the weld centerline. All necessary weld repairs were made and final acceptable radiographs were shot. The NRC inspector reviewed the

radiographs for the No. 4 steam generator taken both before and after post weld heat treatment. The radiographs were taken with both Type T and AA film, utilizing an 88 curie Co-60 source. The final radiographs were found to be acceptable.

It should be noted that extensive rework of the steam generator girth welds was required. This rework was necessitated due to an apparent inappropriate joint design for the welding process utilized (flux-cored arc welding). The lack of adequate joint accessibility for the welding torch created large slag deposits in the weld.

- b. (Closed) Unresolved Item (316/88024-01): Linear indications on the NRC radiograph of Steam Generator No. 1 cold leg, pipe to nozzle weld. During the course of the NRC's evaluation of the project NDE effort, NRC radiographs of this weld disclosed a faint linear indication. Subsequent to this radiograph, some surface grinding was performed. The NRC inspector reviewed the final radiographs of this weld and found the weld to be acceptable. Apparently, the indication appearing on the NRC radiograph was a surface discontinuity.

### 3. Review of Welding Activities

#### a. Reactor Coolant Piping Welds

During the welding of the coolant loop piping to the steam generator nozzle, excessive cracking and lack of fusion defects occurred. Due to the extensive nature of the problem, Region III requested technical assistance from NRR (see attached enclosures).

The NRC inspector participated in the NRR review of this issue and concluded that more aggressive action on the part of the licensee, during the early stages of the problem might have significantly reduced the amount of rework required. In an attempt to maintain production efficiency, the problem became wide spread before it was fully understood.

During the course of radiographing the nozzle to elbow weld on steam generator No. 4 hot leg, a base metal indication on the elbow side of the joint was detected. After the discovery of this indication, the licensee retrieved the original construction radiographs to determine if the indication existed at the time of original installation. The NRC inspector reviewed the radiographs of this weld, dated July 20, 1974, and concluded that the indication existed at the time of original construction. Furthermore, the indications were interpreted as meeting the ASTM E186, Severity Level II criteria for sand inclusions and shrinkage as required by design.

#### b. Steam Generator Girth Welds

As part of the Steam Generator Project, the refurbished upper assemblies were welded to the new lower assemblies. As discussed in

Paragraph 2.a. of this report, a combination of insufficient joint access and less than optimum radiographic technique, contributed to rather extensive weld defects and rework.

The NRC inspector reviewed portions of the final radiography for the girth welds and found them to be acceptable. In addition, the inspector reviewed the chemical and physical test results for both the FCAW (E81T1-NI1) and SMAW (E8018-C3) welding electrodes and concluded that the electrodes were suitable for the application.

c. Reactor Coolant Pumps (RCP)

During a tour of the containment, the NRC inspector observed a cracked weld on the RCP No. 2 bearing lift pump support shelf. The licensee issued Job Order No. 703791 on October 21, 1988 to repair the weld. All other RCP bearing lift pump supports will be inspected by the licensee for a similar condition.

4. Review of Component Cooling Water Piping Repair

Portions of the Component Cooling Water (CCW) system experienced pipe cracking due to an unidentified corrosion related mechanism (NRC Inspection Reports No. 50-315/87023; 50-316/87023, Paragraph 4). In an effort to characterize the cracking mechanism, the licensee removed a two-inch by five-inch portion of the Unit 2 CCW piping containing a crack. This area was weld repaired at that time, with the understanding that the pipe section would be replaced during the upcoming steam generator outage.

The piping replacement was performed per job order No. 018175 and completed on October 22, 1988. The NRC inspector reviewed the material purchase orders, weld records, NDE reports, and hydrostatic test results for the subject replacement effort and found them acceptable.

5. Steam Generator Enclosure (SGE) Structures

a. Review of Rebar and Concrete Placement

The steam generator replacement project (SGRP) required the removal of portions of the steam generator enclosure (SGE) walls and roof slabs. The walls and slabs were then restored to their original configuration to maintain the structural integrity upon completion of the SGRP.

During the process of removing these walls and slabs, the licensee found that many of the rebars had not been installed in accordance with the original placement drawings. The contractor, MK-Ferguson, documented the as-found condition for these rebars on Drawings AF-R-001 through AF-R-028. These drawings were used by the AEP structural design department as bases for determining the potential safety significance in terms of meeting NRC requirements and licensee commitments.

In 1977, the NRC requested that the structural adequacy of the SGE's be evaluated for the transient loads from a postulated steam line break. This request was identified as NRC Question No. 022.3. In addition to reviewing the original calculations, the AEP Structural Design Department performed extensive computerized modeling and analyses of the SGE's using the Franklin Research Laboratories FELAP general purpose structural analysis program. The design loading on the finite element model of the SGE's included the operating loads, the seismic loads, and the transient loads. The analysis for the SGE's was documented in the AEP Calculation No. DC-D-3195-130-SC, Volumes 1 through 4, including the output of the computer runs.

In evaluating the as-found rebar condition, the AEP design engineering group used the aforementioned computer analysis output data to calculate the available capacity of the as-found concrete elements for the worst loading conditions at the most critical locations. The calculations performed by AEP are to ensure that the resulting safety factors prescribed in the updated FSAR for the SGE's are met and the structural integrity is maintained.

The NRC inspector reviewed the design documents pertaining to the evaluation of the SGE's. The relevant portion of the design evaluations for concrete elements 163, 164, and 165 of the SGE was reviewed with respect to the calculated moments and forces versus the allowables. The NRC inspector noted that the results reviewed are all within the allowable values. Furthermore, the NRC inspector held discussions with the responsible AEP design engineers regarding the utilization of the design methods and the design criteria. It was found that the finite element method was used in the computer application and the design criteria were specified in accordance with the updated FSAR requirements. At the time of this inspection, the NRC inspector noted that the aforementioned design evaluations were not checked and approved. The licensee representatives stated that an independent verification will be implemented at a later date to ensure that the design evaluations for the SGE's are adequately performed in terms of meeting the NRC requirements and the licensee commitments.

On the basis of the above design review and the technical discussions with the licensee representatives, the NRC inspector found that the as-constructed SGE structures can serve their intended function during a worst case loading condition.

The NRC inspector also observed portions of the concrete placement for the SGE restoration. Observed slump and density checks for the concrete were well within the ranges specified in the applicable procedures. Concrete working times were closely adhered to due to the addition of slump enhancing treatments. Placement was found to be in accordance with applicable contractor procedures and industry practice. Control of the placement operation was judged to be good.

b. Cadweld Splices

The rebar splices for the SGE's are mechanical joints produced by the Cadweld process. The NRC inspector observed portions of the Cadweld operator training effort, reviewed the MK-Ferguson Cadweld Procedure SQP 10.8, visually inspected approximately 25 completed production joints and observed several in-process splices. All work was found to be acceptable.

During the Cadweld welder/inspector training effort, one of the instructors noted a qualification test weld which apparently did not meet the void criteria. This test assembly which had been previously accepted, contained a void of approximately 1/2 inch in depth while the maximum allowable depth per Specification DCC-CE-154-QCN is 7/16 inch. The licensee issued Problem Report No. 88-640 to document this issue. To preclude any confusion with regard to the void criteria, additional training was conducted. The NRC inspector reviewed the training records and found them acceptable. Since the questionable splice was not a production splice and retraining was accomplished before production commenced, no technical concern exists. MK-Ferguson performs a 100 percent inspection of all Cadwelds. In addition, the licensee has retained the services of an independent inspection agency to perform a second inspection of all production welds.

6. Review of Electrical Modifications

In an effort to evaluate the engineering function with respect to electrical design, the following documents were reviewed:

- PMI-5040, "Design Control Program," Revision 11
- PMI-5040 - Mod. 04, "Request for Change," Revision 0
- AEPSC General Procedure No. GP 301, "Design Changes," Revision 2

In addition, engineering personnel were interviewed and several current design changes were selected for review.

The above reviews and interviews indicated that an assessment of the adequacy of the electrical engineering function could not be completed at this time as the supporting engineering documentation is located at the AEP Headquarters in Columbus, Ohio.

The NRC inspector also reviewed a historic listing of design changes at the plant and selected a sample population for an upcoming Engineering Team Inspection at AEP Headquarters.

7. Exit Interview

The Region III inspector met with the licensee representatives (denoted in Paragraph 1) at the conclusion of the inspection on November 29, 1988. The inspector summarized the purpose and findings of the inspection. The licensee representatives acknowledged this information. The inspector also discussed the likely informational content of the inspection report with regard to documents or processes reviewed during the inspection. The licensee representatives did not identify any such documents/processes as proprietary.