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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

AUG 1 1 1975

Iowa Electric Light and Power Company
ATTN: Mr. Charles W. Sandford
Executive Vice President,
Engineering
Security Building
P.O. Box 351
Cedar Rapids, Iowa 52405

Docket No. 50-331

Gentlemen:

This refers to the inspection conducted by Mr. Cook of this office on July 2, 13-17, 1975, of activities at Duane Arnold Energy Center authorized by NRC Operating License No. DPR-49 and to the discussion of our findings with Mr. Liu and others of your staff at the conclusion of the inspection.

A copy of our report of this inspection is enclosed and identifies the areas examined during the inspection. Within these areas, the inspection consisted of a selective examination of procedures and representative records, interviews with plant personnel, and observations by the inspector.

No items of noncompliance with NRC requirements were identified within the scope of this inspection.

In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and the enclosed inspection report will be placed in the NRC's Public Document Room. If this report contains any information that you or your contractors believe to be proprietary, it is necessary that you make a written application to this office, within twenty days of your receipt of this letter, to withhold such information from public disclosure. Any such application must include a full statement of the reasons for which it is claimed that the information is proprietary, and should be prepared so

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the proprietary information identified in the application is contained in a separate part of the document. Unless we receive an application to withhold information or are otherwise contacted within the specified time period, the written material identified in this paragraph will be placed in the Public Document Room.

Should you have any questions concerning this inspection, we will be glad to discuss them with you.

Sincerely yours,

Gaston Fiorelli, Chief
Reactor Operations Branch

Enclosure:
IE Inspection Report No.
050-331/75-10

bcc w/encl:
PDR
Local PDR
NSIC
TIC
OGC, Beth, P-506A

U. S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

Report of Operations Inspection

IE Inspection Report No. 050-331/75-10

Licensee: Iowa Electric Light and Power Company
Security Building
P.O. Box 351
Cedar Rapids, Iowa 52405

Duane Arnold Energy Center
Palo, Iowa

License No. DPR-49
Category: C

Type of Licensee: BWR (GE) - 538 MWe

Type of Inspection: Special, Announced

Dates of Inspection: July 2, 13-17, 1975

Principal Inspector: R. J. Cook R. J. Cook 8/6/75 (Date)

Accompanying Inspector: None

Other Accompanying Personnel: None

Reviewed By: W. Little, Senior Inspector W. D. Little 8/6/75 (Date)
Nuclear Support Operations Branch

SUMMARY OF FINDINGS

Inspection Summary

Inspection on July 2, 13-17, 1975: Visual examination of damaged relief valve discharge piping supports and subsequent modifications; review of applicable stress analyses and appropriate modification documentation; examination and review of instrumented LPRM instrument tubes.

Enforcement Items

None

Licensee Action on Previously Identified Enforcement Items

Not inspected

Other Significant Items

A. Systems and Components

The licensee found damaged pipe hangers in the torus for relief valve discharge piping. Modifications to strengthen the supports have been completed.

B. Facility Items (Plans and Procedures)

The plant was returned to power about July 20, 1975.

C. Managerial Items

None reviewed

D. Noncompliance Identified and Corrected by Licensee

None reviewed

E. Deviations

None reviewed

F. Status of Previously Reported Unresolved Items

None reviewed

Management Interview

At the completion of the inspection on July 2, 1975 a management interview was conducted with Mr. Liu (Vice President of Engineering) and other members of his staff. The following items were discussed:

A. A proposed fix which consisted of strengthening the discharge piping supports, using high strength bolting and strengthened clamps was discussed. The inspector stated that a confirming strength analysis was expected and the licensee agreed. (Paragraph 6 and 7)

B. The damaged discharge piping in the drywell was discussed. The inspector stated that an analysis would be expected that would show that the pipe strength had not been compromised. The licensee agreed. (Paragraph 8)

C. The inspector stated that to insure that the integrity of the vent piping had not been violated, a NDT examination should be performed where the protective coating had cracked and shown signs of potential straining. The licensee agreed to perform the NDT examinations. (Paragraph 4.c)

D. The inspector stated it would be desirable to perform a visual examination of the torus support to insure that the torus was not shifting. The licensee agreed to inspect torus supports and other support members which might indicate structural shifting. (Paragraph 3)

E. It was understood by the inspector and the licensee that repairs to the discharge pipe hangers would be completed prior to resumption of operation.

At the completion of the inspection of July 13-17, 1975, a second management interview was conducted with Mr. Liu and other members of his staff. The following items were discussed:

F. The inspector stated that his review had revealed that all the commitments made by the licensee during the July 2, 1975 inspection to affect repairs to the relief valve discharge piping supports had been performed. (Paragraph 6-8)

G. The inspector stated that the discrepancies in determining the absolute reaction forces had been discussed with the staff and acknowledged that work was being performed on this analysis. (Paragraph 7)

REPORT DETAILS

1. Persons Contacted

L. Liu, Vice President of Engineering
G. Hunt, Chief Engineer
L. Root, Manager, Mechanical and Nuclear Engineering
E. Hammond, Assistant Chief Engineer
H. Rehrauer, Project Engineer
K. Harrington, Supervisor of Engineering Construction
H. Shearer, Group Leader of Mechanical and Nuclear Engineering
P. Ward, Mechanical and Nuclear Design Engineer
C. Contard, Design Engineer
B. York, Operations Supervisor
J. Vinquist, Electrical Maintenance Supervisor
R. Petrokas, NUTECH Project Engineer

2. General

As a result of damage sustained by relief valve discharge piping located in the drywell,[1/] the licensee opened the torus and inspected piping. The licensee found some damaged hangers for relief valve discharge piping in the torus. The licensee drained the torus for a more thorough examination of the hanger damage. An inspection was performed on July 2, 1975, to review the extent of damage to piping systems within the torus and proposed repair.

On July 13-17, 1975, a follow up inspection was performed to examine structural modifications intended to strengthen relief valve discharge piping hangers and supports in the torus and to review the engineering evaluations associated with these modifications.

3. Piping Description - Torus Side

The relief valve discharge piping vertically penetrates the dry well to torus vent piping. At a location halfway between the torus horizontal midplane and the torus bottom, the discharge piping angles downward at $22\frac{1}{2}^{\circ}$ (below the horizontal) and terminates at a tee (rams head) centrally located near the bottom of the torus. The original support for the vertical section was by a 3/4 inch diameter U-bolt clamped to supporting channel iron welded to pads on the torus wall.

The "rams head" tees were originally intended to be supported by 12WF31 I-beams spread between adjacent torus ring girders. Three 3/4 inch diameter U-bolts attached each "ram head" to the I-beam.

1/ IE:III Inspection Rpt No. 050-733/75-07.

However, it appeared that the I-beams did not support the "rams heads" as vertical clearance of approximately 1 to 2 inches was noted between the I-beam and four of the "rams heads". The 12WF31 I-beams are attached to the ring girders by a weld structure at one end and a bolted attachment at the other end.

The inspector determined that the licensee had inspected the torus support and found no discrepancies.

4. Damage to Relief Valve Discharge Piping Hangers

The first phase of the inspection was performed to review and examine any evidence of damage incurred by the relief valve discharge piping and/or hangers. Each relief valve discharge piping system within the torus was physically examined. The following synopsis describes the "as found" condition within the torus.

a. Two of the discharge piping stations were found with all the hanger U-bolts intact. It was also noted that these stations had minimum vertical clearance, (probably less than ½ inch) between the "rams head" tee and the supporting I-beam.

b. Two of the discharge piping stations were found with the U-bolt support around the vertical pipe section intact; the U-bolt around the "rams head" tee inlet intact; and the U-bolts around the "rams head" discharge in some form of disarray including broken U-bolts, loose U-bolts, and a "rams head" displaced from under a U-bolt.

c. One discharge piping station was found with the U-bolt around the vertical pipe section broken; the U-bolt around the "rams head" inlet intact; both the U-bolts on the "rams head" discharge broken; and the "rams head" supporting I-beam with an approximate 10-20° torsional set. The protective coating at the vent pipe penetration showed some cracking which might be indicative of additional strain being applied at the penetration welds. The penetration was ultrasonic tested and showed no indications of cracking.

d. One discharge piping station was found with the U-bolt around the vertical pipe section broken and the three U-bolts around the "rams head" also broken. This particular relief valve discharge piping had been damaged in the drywell side which probably occurred when the vacuum breaker failed.[2/] This may have aggravated the damage on the torus side but failure of the vacuum breaker does not appear germane to the damage sustained on the torus side.

2/ Ibid.

e. All the supporting I-beams for the "rams head" had loose or missing bolting and the protective coating on some of the welds was cracked. No locking devices or multiple nut fastners were used on any of the bolted fixtures.

5. Relief Valve Operation

The licensee reviewed operating records and found that since June 1, 1974 to the present the relief valves had operated three or four times for each relief. The actual number of lifts at each relief valve operation could not be determined. There appears to be no correlation between the number of relief valve operations (three or four) and the damage sustained in the torus.

6. Repairs and Modifications

Modifications to the vertical pipe section support consisted of attaching the pipe with a 6 inch wide by ½ inch thick U-shaped pipe guide welded to two 12 x 3, 30 lb/ft channel iron welded back to back and centrally stiffened with two 10½ feet long 9 inch wide, 1½ inch thick plates. The support channel is attached to the torus ring girders by welded stand-offs. The ring girder web is stiffened at the stand-offs with ½ inch thick gussets welded on both sides of the ring girder.

The "rams head" support I-beam was centrally stiffened with 1 inch thick by 8 inch wide plate welded to both flanges. Shims were welded under the "rams head" to set the vertical clearance at essentially zero. The "rams head" discharges are attached to the support I-beam by U-shaped clamps 3/8 inch thick by 3 inches wide welded to the support I-beam. The U-shaped clamps are set to permit thermal expansion of the discharge piping. The bolted end of the I-beam was reassembled using high strength alloy 3/4 inch bolts with the nuts tack welded.

When the modifications were essentially completed the entire installation was physically examined by the inspector. No gross discrepancies were noted. Prior to this time welder qualifications were reviewed an no gross discrepancies were noted here or in the fabrication of support structures.

7. Stress Analysis

The licensee contracted an engineering consultant to perform stress analyses of the modifications. The preliminary results of these calculations were critically reviewed by the inspector with members of the licensee's engineering staff.

An 80,000 lb axial reaction discharge force was assumed and the following are the results of the analyses using this force.

Maximum torus ring girder stress is 11,400 psi $\leq$ 19,560 psi allowable.

Maximum vertical section support stress is 20,600 psi $\leq$ 21,600 psi allowable.

Maximum "rams head" support stress is 16,250 psi $\leq$ 24,000 psi allowable.

The allowable stresses were based on the published structural steel minimum yield point stress of 36,000 psi. However, it appears the actual material used have yield point stresses of $>$ 40,000 psi.

Although an 80,000 lbs reaction force was used for the calculations the licensee has received results of preliminary analyses which indicate the actual reaction force may be less than 80,000 lb by a factor of more than 2½. Therefore, there appears to be adequate conservatism built into the modified relief discharge piping supports.

8. Damaged Relief Valve Discharge Piping in the Drywell

As a result of relief valve discharge piping making contact with structural steel in the drywell, the piping was dented. During the UT examination of this piping the wall thickness was reduced to about 0.019 inches below the minimum wall thickness for schedule 40 piping. The licensee contracted a consultant to determine whether the pipe strength had been compromised for the service use of the discharge line. The design pressure for the discharge line is 300 psi. Using ASME Code B31.1 Section 104.12 (a) the required pipe wall thickness for this service is 0.107 inches. The existing pipe wall thickness of 0.300 inch is greater than the minimum required wall thickness for the service use.

9. Instrumented LPRM Instrument Tubes

As a result of an ERDA/NRC request, the licensee has instrumented 8 selected LPRM instrument tubes with highly sensitive accelerometers. The accelerometers are mounted externally to the vessel and are clamped to the LPRM instrument tube extensions under the reactor vessel. The accelerometers are mounted to measure vertical acceleration and are intended to measure any contact of the instrument guide tubes with the channel boxes.

The physical installation of the accelerometers was examined and appropriate documentation was reviewed. No gross discrepancies were noted.