

U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-440/89014

Docket No. 50-440

License No. NPF-58

Licensee: The Cleveland Electric Illuminating Company
10 Center Road
Perry, OH 44081

Facility Name: Perry Nuclear Plant

Inspection At: Perry, Ohio 44081

Inspection Conducted: April 25-27 and June 20, 1989

Inspector: *John M. Jacobson*
John M. Jacobson

7/5/89
Date

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

7/5/89
Date

Inspection Summary

Inspection on April 25-27 and June 20, 1989 (Report No. 50-440/89014(DRS))

Areas Inspected: Announced special safety inspection of the licensee's engineering evaluation and corrective actions taken to resolve the loose Drywell Head bolting event (93702).

Results: No violations or deviations were noted. Based on the results of the inspection, the following apparent weakness was observed:

- The licensee should perform a more thorough review of their contractor's engineering efforts.

DETAILS

1. Persons Contacted

Cleveland Electric Illuminating Company (CEI)

- *R. A. Stratman, Director, NED
- *R. A. Newkirk, Manager, Licensing
- *R. J. Tadych, Manager, Mechanical Engineering
- *C. Angstadt, Senior Project Engineer
- +*S. C. Dodej, Lead Structural Engineer
- *G. G. Rhoads, Compliance Engineer

*Denotes those attending the exit meeting on April 27, 1989.

+Denotes participant in telephone exit on June 20, 1989, to discuss revised Licensee Event Report submittal.

2. Loose Drywell Closure Head Bolting

- a. General: Licensee Event Report (LER) No. 89005-01 was issued to document the discovery of detensioned hold down bolting on the Drywell Closure Head. All 144 bolts (2½" diameter) were found in a loosened condition during the Drywell Head removal operation for refueling. The main function of the drywell is to contain the steam released from a LOCA and direct it into the suppression pool. Loose Drywell Head bolts could allow steam to circumvent the suppression pool.

As a result of this event the licensee committed to address the following issues:

- Determine the root cause.
- Perform appropriate corrective actions.
- Assess the safety significance of the event with respect to plant operation with the loose bolting.
- Determine the potential for other components to have similar problems.

The NRC inspector reviewed the original Drywell Head design calculations performed by Newport News Industrial. This calculation determined that the worst case load combination for uplift on the head was approximately 4,084,000 lbs (from NASTRAN analysis). The calculation then assumed that a 1/64" metal to metal gap at the closure joint was acceptable due to the sealing capability of the O-ring seals. The designer then set out to minimize flange stresses at the closure joint while still meeting

the required leak tightness. Using this approach, a bolt prestress of 2237 psi (approximately 500 ft-lbs of torque) was developed. Unfortunately, local deformation was neglected, no basis was documented, and in fact, poor engineering judgment was exercised.

The stiffness of the bolting system (i.e., bolt, washer, nut) is significantly less than the stiffness of the bolt alone. The apparent stiffness of the connection behaves in a non linear manner, especially at low load levels. Short term relaxation due to bolt prestress and local deformation due to service loads, coupled with the low initial prestress, is believed to have caused enough elongation to effectively loosen the bolts.

c. Corrective Actions

The licensee retained the services of Gilbert/Commonwealth to evaluate the bolting issue and to recommend corrective actions. Corrective action was determined to be the application of a revised bolt installation preload. This preload (within Code allowable stress levels) would ensure a tight closure joint under all design loadings and retain a residual preload in the bolts when external loads are removed.

The NRC inspector reviewed the Gilbert/Commonwealth analysis for establishing the revised bolt preload. The calculated flange deflection due to the application of the most severe loading condition (30 psi) was compared to their ANSYS analysis for verification. The deflection generated by ANSYS was within 5.6% and the stress in element 12 (at the flange) was within 6.9% of the calculated values. This verification demonstrated the validity of using the ANSYS program for this design.

The analysis approach was to maximize bolt prestress without inducing flange stresses greater than Code allowables. The revised prestress was determined to be 8870 psi (vs. 2237 previously). This revised bolt prestress is in agreement with EPRI guidelines and should accommodate the service conditions.

The licensee has revised Procedure GMI-0064 to include the new prestress value. Additionally, the required preload will be transformed to an equivalent installation torque via onsite calibration testing using a bolt tension calibrator.

d. Evaluation of Safety Significance

A gap, due to loose bolting, of 1/16" around the complete circumference of the closure flange was conservatively assumed. This gap when added to the accident uplift of 1/64" would result in a total seal gap of 5/64" or a total bypass leakage area of .65 ft.² Additionally, a successful drywell bypass leakage test was performed

on August 9, 1987. Though the tested bypass leakage was much less, the maximum acceptable value of .168 ft.² was conservatively added to the .65 ft.² above. This resulted in a maximum drywell bypass leakage of .82 ft.² which is less than half of the design limit of 1.68 ft.².

The licensee calculated the potential increase in upper fuel pool temperature due to the postulated leakage. This calculation determined the temperature rise to be about 3°F which is considered insignificant. Pool loads due to the discharge of steam through the seal area were also calculated and found to be insignificant. In addition, the licensee calculated the potential increase in containment activity associated with Drywell Head flange leakage into the upper fuel pool and determined the activity increase to be insignificant due to the scrubbing action provided by the water in the pool.

In summary, the Drywell Head flange leakage discussed above would not be expected to increase the consequences of the Design Basis Accident.

e. Evaluation of Generic Applicability

The licensee performed a review of other design work performed by Newport News Industrial to determine if the insufficient preload problem applied to any other bolted connections. The review included the Containment and Drywell Equipment Hatches. The evaluation concluded that adequate prestress levels had been specified for all other bolted connections designed by Newport News Industrial.

3. Exit Interview

The Region III inspector met with the licensee representatives (denoted in Paragraph 1) at the conclusion of the onsite inspection on April 27 and discussed the revised LER submittal via telephone on June 20, 1989. 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.