CP&L

Carolina Power & Light Company

January 14, 1976

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Mr. Norman C. Moseley, Director
U. S. Nuclear Regulatory Commission
Region II - Suite 818
230 Peachtree Street N. W.
Atlanta, Georgia 30303

Dear Mr. Moseley:

H. B. ROBINSON UNIT NO. 2
LICENSE NO. DPR-23
BULGED AREAS IN THE CONTAINMENT LINER

The attached report is submitted as a follow-up to an unusual event report dated June 24, 1974. This report is titled "H. B. Robinson Unit 2 Bulged Areas in the Containment Liner" and is organized as follows: Background, Strain Gage Monitoring Program, and Conclusions.

It is our conclusion that the containment liner is safe under normal operating and original design accident conditions and we plan to terminate the strain monitoring program. All data and results referred to in the attached report are available in the plant files.

Yours very truly,

E. E. Utley
Vice President
Bulk Power Supply

DLF:blh
Attachment

cc: Mr. R. W. Reid

336 Fayetteville Street • P. O. Box 1551 • Raleigh N. C. 27602

H. B. ROBINSON UNIT 2
BULGED AREAS IN THE CONTAINMENT LINER

Background

In 1974 the NRC requested that Carolina Power & Light's H. B. Robinson nuclear plant containment liner be monitored for unusual bulging which may have been caused by excessive thermal expansion; excessive pressure differential across the liner; or cyclic pipe loading at penetrations of the liner. A containment liner surveillance program was established to accomplish the following:

1. Determine appropriate locations for monitoring.

2. Measure liner contours at the selected locations to determine if bulges existed.

This surveillance program examined three areas as follows:

a. The areas surrounding and adjacent to feedwater penetrations.

b. An area in the mid-plane of the containment liner.

c. An area at the springline of the containment.

The results of this surveillance program showed no liner bulging greater than allowable acceptance criteria in the areas selected. This program is documented in GAI Report #1850 titled, "H. B. Robinson Steam Electric Plant Unit No. 2, Reactor Containment Building Liner Bulges Surveillance Results, Carolina Power & Light" by Gilbert Associates, Inc. Although no bulges were found in the areas selected for surveillance, an area of bulged appearance was noticed at an elevation of approximately 330 ft. This bulged area was noticeable from the scaffolding which had been erected to allow access to the containment springline. This area was investigated and resulted in an unusual event report. Subsequently, the following actions have been taken related to the bulged area.

1. The bulged area contours have been mapped relative to the theoretical radius.

2. The bulged area has been tap tested to determine the exact location of void areas.

3. A complete ultrasonic examination of the bulged area was conducted to locate Nelson studs and determine the integrity of the studs.

4. Hammer pendulum tests were conducted to verify the integrity of the studs.

5. Plant QA files were searched to determine if the bulged area had been previously documented.

6. The bulged area of the liner was subjected to a full pressure structural integrity test and integrated leak rate test in accordance with Regulatory Guide 1.18 and Appendix J of 10 CFR 50. The post test inspection of the bulged area revealed no adverse effects.

7. The bulged area was inspected by your Mr. L. Baratan, W. Swan, and H. Whitener.

8. Field testing of material similar to the liner was conducted to determine stud loading and approximate sheer stress necessary for liner rupture.

9. A finite element mathematical model stress analysis was performed by Ebasco Services, Inc., the original designer of the containment liner. This analysis concluded that the bulged liner was safe for normal operation and loss-of-coolant accident conditions.

Strain Gage Monitoring

Based on the above, CP&L concluded that continued operation was safe under all conditions but as an additional precautionary measure, the bulged area was instrumented with 29 rectangular rosette strain gages to determine if the bulged area was increasing in size with time. The strain monitoring program has been in progress from prior to initial criticality following the 1974 refueling to the present time. The strains have been plotted and reviewed and preliminary Report No. 1519 has been issued by Brewer Engineering Lab, Inc.

The purpose of the strain gage monitoring program was to either support our belief that the bulge was a passive anomaly which has existed since initial construction or to alert us in the event that the bulged area was growing. The monitoring program was planned for one cycle; to commence with heatup following refueling and run to the next refueling shutdown.

The strain gage placement was selected to monitor logical groups of gages as follows:

1. Gages located across the boundary line between the void area behind the bulge and the solid area behind the bulge in a vertical line.

2. Gages located across the boundary line between the void area behind the bulge and the solid area behind the bulge on a horizontal line.

3. Gages located on the intersection of diagonals of the studs.

4. Gages located directly on top of studs.

5. Gages located in the center of two adjacent studs on a horizontaal line.

6. Gages located in a vertical line crossing three

solid/void interface areas.

7. Gages crossing a liner-plate weld and associated vertical weld channel.

8. Gages crossing a liner-plate weld and associated horizontal weld channel.

9. Gages placed in a line parallel and adjacent to a horizontal liner-plate weld and associated weld channel.

10. Gages were placed in groups on small areas to give indication of any local movement.

11. Gages were placed in line across the bulged area to give an indication of the movement of the bulged area as a whole.

12. Gages were located in unbulged and less bulged solid areas to serve as control data points.

Since a piece of the original liner plate was not available, a similar material was used as a dummy plate and placed adjacent to the liner in a manner such that it will remain unstrained.

Three gages did not set up properly and did not yield useful data. Four gages appeared to be going into compression in recent months but it was determined that all of these gages have grounds of 12 megohms or less. The sixty-six remaining channels of strain gage information were more than adequate to monitor the activity of the bulge.

Results

A typical strain gage plot is attached for illustration. The graph shows strains from each of three strain elements of a rectangular rosette gage plotted with time. In general, the gages all showed movement from the period July through September, 1974 following the return to full power operation after the refueling. This movement appeared to be caused by the temperature change or temperature gradient across the liner due to the reactor heat inside containment. No subsequent similar movements were observed in response to temperature effects, so the initial movement may have been due to a curing of the gage epoxy bond or some other initial instability. During this initial three-month period all but five of the gages went into tension and reached a peak strain of several hundred micro inches/inch, although some were higher. The five gages that went into compression peaked in the range of 250 to 750 micro inches/inch. The gage which reached the maximum strain was located in a solid unbulged area. By the end of September, 1974, the gages had stabilized out and most had come back to or below the point of zero strain indicating that the strains were within the elastic region of the liner material. The few strain channels that did not return to zero remained in the zero to 200 micro inches/inch range.

For the 14-month period from October, 1974 to the present time, there has been virtually no movement in the majority of the gages. In some of the gages a slight movement of 50 to 200 micro inches/inch into compression can be seen as a gradual downward drift over the 14-month period.

None of the sharp, lasting strains occurring in opposite directions on adjacent gages as predicted in the case of bulge movement were seen.

An exact determination of what is happening in the bulged area or what caused the initial hump in the data cannot be made. The data does not indicate movement of the bulge as a whole or of any high local strains in the area of studs, weld channels, the center of the bulge, the solid/void area interface line or the solid unbulged regions.

Conclusion

1. The bulged area examined is one of many similar areas which exist throughout the containment building. Approximately 11 areas of this nature exist at elevation 330 ft. These bulged areas are referred to in plant construction QA files and their presence and attempted corrective action was acknowledged and reviewed during plant construction.

2. The bulged area is within, or only slightly above, original specification acceptance criteria for liner plumbness and out-of-roundness.

3. The strain monitoring program indicates no gross movement or growth of the liner.

4. These bulges have existed in their present state since initial construction and are not growing.

5. The containment liner has been analyzed in the bulged condition and has been found safe for continued operation under normal and accident conditions.

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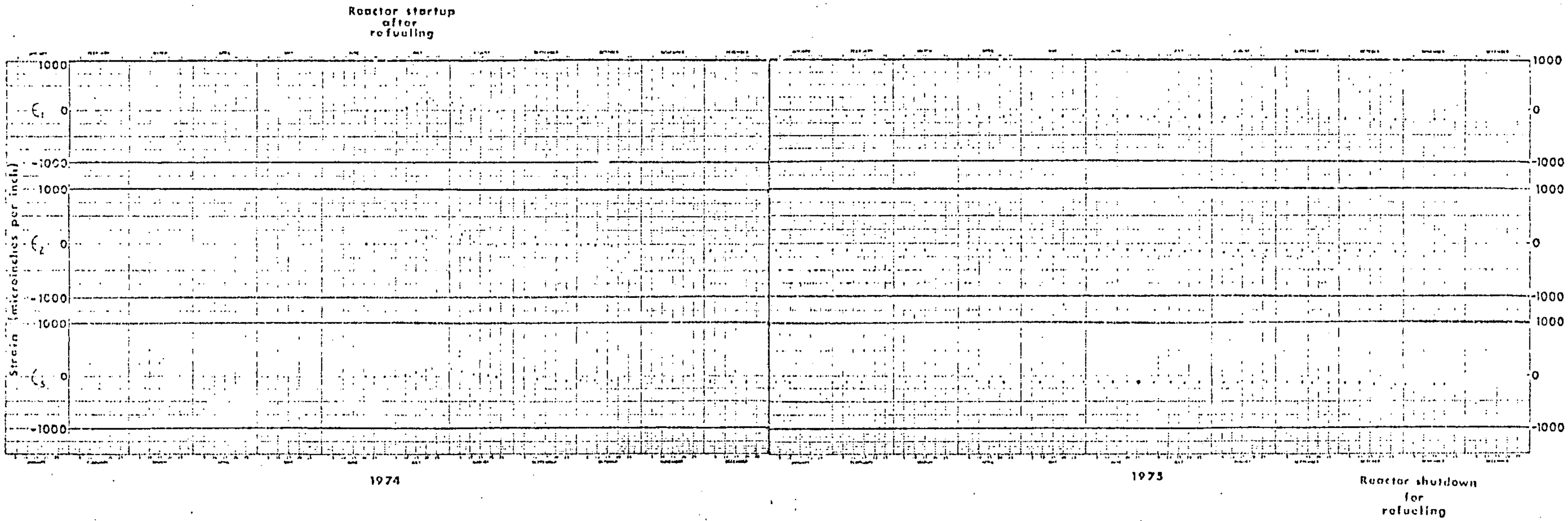
Reactor startup
after
refueling
Strain (microinches per inch)
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Reactor shutdown
for
refueling