

SSER

Task: Allegation A-139, A-140

Reference No.: 4-84-A-06-34, 4-84-A-06-35

Characterization: It is alleged that a review of the placement records for the concrete basemat indicates instances of poor concrete placement practices during construction of the basemat that were in violation of the specification and the American Concrete Institute (ACI) standards, and that these poor placement practices led to the cracks found in 1983.

Assessment of Allegation: The nuclear plant island structure (NPIS) housing all the seismic Category I structures is supported on a continuous reinforced concrete foundation basemat 270 feet wide, 380 feet long and 12 feet thick. The basemat was constructed in 28 concrete placements. Section 3.8.3.2 of the Waterford Final Safety Analysis Report (FSAR) references ACI Standard 301, Specification for Structural Concrete for Buildings, as a main construction standard. The Project Specification LOU-1564-472, Concrete Masonry, embodies the project concrete construction procedures.

To assess the allegation, the NRC staff reviewed 20 of the placement documentation record packages, Stop Work Order (SWO) No. 1, Deficiency Reports (DRs), Deficiency Notices (DNs), Non-Conformance Reports (NCRs), surveillance reports, Project Specification LOU-1564-472, applicable J. A. Jones and EBASCO work procedures, and construction photographs and drawings. The NRC staff also conducted several walkdowns to observe cracks in the basemat.

The NRC staff review of the placement record packages revealed that approximately 106 NCRs, 46 DNs and 42 DRs were related to the basemat. The following recurring problems were found:

- o Excessive movement of concrete
- o Inadequate vibration
- o Excessive lift height
- o Concrete dropped greater than five feet
- o Inadequate testing frequency
- o Inadequate curing logs, and
- o Out-of-tolerance concrete test results (air content, slump, mixing time, mixer revolutions, volume of water added).

Daily inspection records indicate that corrective actions were taken as soon as some of these conditions were noted. The NRC staff review of the NCRs generated to address the last item indicated that the concrete batches which did not meet the air content and slump requirements were rejected as soon as the test results were known. However, a few yards of concrete were placed prior to the discovery of deficiencies. These small quantities of concrete did not have any impact on concrete strength because the average strength of all the concrete placements was recorded to be about 5,300 psi, approximately 32% over the required design strength of 4,000 psi.

Curing deficiencies were primarily record-keeping in nature. For example, the curing inspection logs did not contain information on curing conditions during weekends. This deficiency was addressed by examining the weather data for the days when the curing conditions were not recorded, and by the Windsor-probe tests for some placements (other than for the basemat) to assure that the in-place strengths were not affected. From the NRC staff review of these data, it is apparent that this record-keeping problem had no impact on the structural integrity of the basemat.

Considering the construction technique and the large volume of the concrete free of the reinforcement congestion and open reinforcing spacing, the instances of poor vibration and excessive lift heights would not be likely to

produce inadequate consolidation or any significant voids. Construction drawings and construction photos examined by the NRC staff indicate very clearly the lack of reinforcing congestion and the ease of accessibility for the crews and equipment. The lack of significant voids is also evident from an examination of the drilled cores from the placement of Block 10B. The cores taken from the center portion of Block 10B do not indicate any voids as a result of inadequate consolidation. (The average strength of the cores was 6,150 psi at 32 days.) The poor consolidation discovered was found near water stops and the key-ways, which were located next to the formed vertical faces of the blocks. The records for placements indicate that these voids were discovered and were repaired right after the placement.

The NRC staff review of SWO No. 1 (issued after the first three blocks were placed) and surveillance reports also indicate that LP&L made attempts to assure that deficiencies were corrected and concrete was placed in accordance with the project purchase specification. The NRC staff believes LP&L was successful in achieving a quality product in the basemat construction.

EBASCO NCR W3-6212, which addressed basemat cracks identified in the summer of 1983, did not characterize the cause of the cracking. The cracks were described as "widespread hairline cracking." The disposition included consideration of two issues: stability of the containment vessel and long-term corrosion, both of which were discussed in memoranda from 1977, when the first cracking was noted (NCR W3-535). Another EBASCO letter, dated July 27, 1977, which was not part of either NCR, gives as a possible cause of the cracking "the results of the concave shape (high at the containment) which the mat has assumed due to differential settlement."

Based on the above review, the NRC staff concludes that in spite of the occasional violations of ACI standards, the construction of the concrete basemat has met the intent of the project specifications and the FSAR criteria. The cracks are not the result of observed and recorded deficiencies during concrete placement operations although the thermal effect during the normal temperature-buildup from the heat of hydration is believed to probably have created tensile cracking. The staff further concludes that the quality of the basemat has not been impaired, as shown by the average strength of the field cured test cylinders.

During the NRC staff walkdown of the basemat, it was noted that there was water standing inside a vertical electrical conduit some 4 feet above the floor elevation at the -35 feet level. This conduit is located in a corridor along the south wall of the emergency feedwater pump room for the A-train in the auxiliary building. The conduit runs vertically up from the basemat and provides the pathway for the leads to a terminal box for instrumentation connections to the piezometers and other foundation monitoring equipment used during construction. LP&L was unable to provide drawings to show the installation details, but the NRC staff believes that the source of the standing water is the same as that which has appeared in the area of the basemat seepage zones, namely groundwater.

Potential Violations: None.

Actions Required: See Item 19 of the Enclosure to D. Eisenhower's letter to J. M. Cain (LP&L), June 13, 1984.

References

1. WSES FSAR Unit 3, Sections 3.8.3.2 and 3.8.3.6
2. Project Specification LOU-1564-472.
3. Stop Work Order No. 1, dated December 16, 1975.

4. DRs, DN's, and NCRs.

	<u>NCRs</u>		<u>DNs</u>	<u>DRs</u>
22	124	7149	C-7	56
52	174	7150	C-12	54
64	535	7151	C-13	13
78	723	7154	C-27	14
93	6212	7353		
97	6245	7481		
106				

5. Placement Packages for blocks 1, 11A, 15, 14A, 5A, 9A, 10A, 4, 5B, 8B, 7B, 10B, 17, 16, 6, 2, 11B, 9B, 8A and 7A.
6. SCD Report 1.
7. Mat 10B Placement Report, May 1976.
8. "Evaluation of Concrete in the basemat Waterford Unit No. 3,"
R. E. Philleo, May 1984.
9. Ebasco procedures QCIP6 and 7.
10. J. A. Jones Procedures W-WP-7, W-WP-8, and W-SITP-4.
11. Construction Photographs 468, 492, 502, 4513, 515, 518, 520, 554, 568, 575, 578, 607, 670, 692, P060035, P060036, P060012, and P060028.
12. Ebasco Dwgs LOU-1564: G-499S01, G-499S02, G-499S03, G-500S01, G-500S02.
15. Surveillance Reports.

Statement Prepared By:

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Document Name:

SSER X A-139

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Document Comments:

A-140

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*Sounding up
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[Potential Violations: None.]

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