Houston
Lighting
& Power
Company

Electric Tower
P.O. Box 1700
Houston, Texas 77001

April 14, 1978
ST-HL-AE-258

Director, Region IV
Office of Inspection and Enforcement
Nuclear Regulatory Commission
Suite 1000
611 Ryan Plaza Drive
Arlington, Texas 76012

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
Written Report on the Reportable Deficiency
Concerning Unconsolidated Concrete in the
Fuel Handling Building for Unit 1 of the South Texas Project

Dear Sir:

The attached report is submitted pursuant to the requirements of 10CFR50.55(e)(3). On March 15, 1978, Houston Lighting & Power Company notified your office of unconsolidated concrete in a slab of the Unit 1 Fuel Handling Building. The report provides a description of the deficiency, an analysis of the safety implications, and corrective actions taken to prevent reoccurrence of the problem. Further detailed discussions or questions should be directed to Mr. R. J. Klapper, 713/481-7217.

Very truly yours,

G. W. Oprea, Jr.
Executive Vice President

JGW/bkl

cc: Boyce H. Grier (Office of Inspection and Enforcement)
C. Thrash (Baker & Botts)
R. Gordon Gooch (Baker & Botts)
J. R. Newman (Lowenstein, Newman, Reis & Axelrad)
H. L. Key

DESCRIPTION OF DEFICIENCY

The 6 ft. thick concrete slab at El. +21'-11" in the STP Unit 1 Fuel Handling Building (See Figure 1) was placed on September 16 and 17, 1977. This slab serves as the structural base for the spent fuel pool and as the ceiling for the ECCS pump cubicle areas. During removal of the forms in November 1977, inspection of the ceiling at El. +15'-11" in the ECCS pump cubicle areas revealed under consolidated areas. Concrete chipping was initiated in November, 1977 and continued intermittently until March, 1978. Access to the areas under investigation was only through erection of scaffolding (approximately 40 feet tall). Initial investigation in November 1977 was in localized areas of the ceiling in the corridor outside the ECCS pump cubicles. During this time period the problem was not considered possibly reportable. However, as investigations continued in this area, the ceiling area in the ECCS pump cubicles became suspect. Therefore, scaffolding was re-erected and investigations initiated in these areas. As a result of the chipping and further inspection, void areas with exposed reinforcing steel bundles were discovered in the ECCS pump cubicle areas (Trains A and B) ceiling ranging in depths up to approximately 6 inches. Figure 2 shows the location of the currently identified areas. Figures 3 and 4 provide representative photographs of the chipped and voided areas showing the exposed reinforcing steel bundles.

With regard to the cause of the deficiency, thermal loads on this Fuel Handling Building slab requires a relatively large reinforcing steel area in the bottom portion of the slab. In addition to the reinforcing steel and necessary support steel, a large number of embedded plates are required to support the ECCS pump monorail, safety injection pump cubicle coolers, mechanical piping, HVAC ducts and electrical cable trays. The initial spacing of the reinforcing steel, 4 layers of No. 11 bars at 4 inch x 6 inch spacing, and the studs on the embedded plates on an 8 inch grid, was identified as an undesirable condition. Revisions were made to the reinforcing steel arrangement which would permit adequate space for the concrete to be vibrated around the layered bars and the studs. The 4 layers 4 inch x 6 inch spacing was replaced by a 3 layer (bundled) at 9 inch x 12 inch spacing.

Although the reinforcing steel arrangement was revised, the bundled bar in both directions of the slab and the studs on the embedded plates restricted the free flow of concrete. Additionally, vibration efforts in certain localized areas were insufficient to adequately consolidate the concrete.

The information concerning this deficiency was identified by Deficiency and Disposition Report and a Field Request for Engineering Action dated March 8 and March 1, respectively, by Brown & Root.

SAFETY IMPLICATIONS

The safety considerations of the voids in the bottom of the 6 ft. thick concrete slab at El. +21'-11" in the Fuel Handling Building include the following:

1. Insufficient bonding of concrete to the rebar at the bottom of the slab decreases the effective strength of the slab. This decrease in strength could cause the slab to fail under loaded conditions.

2. Insufficient bonding of concrete to anchorages of the embedded plates located on the underside of the slab could allow the plates to separate from the concrete if they were loaded.

The Fuel Handling Building is classified as a Seismic Category I Structure in accordance with Regulatory Guide 1.29. The 6 ft. thick concrete slab at El. +21'-11" in the Fuel Handling Building was designed to satisfy the following functional design requirements:

1. Support the following fuel handling facilities and ECCS pump cubicle equipment:

    a. Spent fuel storage (fuel assemblies, racks and pool),
    b. Fuel transfer canal,
    c. Spent fuel bridge crane,
    d. Spent fuel pool heat exchanger,
    e. Spent fuel pool pumps and skimmer,
    f. Monorails for safety injection pumps, and
    g. ECCS pump cubicle coolers.

2. Achieve the objectives for protection of the Fuel Handling System in accordance with Regulatory Guide 1.13.

The slab is designed in accordance with ACI 318-71 code requirements. The concrete strength used is of fc=4000 PSI with reinforcing steel of ASTM A615 grade 60 (Fy=60 ksi).

The spent fuel pool and transfer canal area of the slab is lined with 1/4 inch stainless steel type 304 plate with an integral leak chase system. Embedded plates are required at the bottom of the slab to hang the safety injection pump monorails, the ECCS pump cubicle coolers, mechanical piping, HVAC ducts and electrical cable trays.

The loading on the slab includes all loads due to the weight of the pool, slab and walls; hydrostatic loads; fuel racks and fuel assemblies loads; equipments and crane loads; thermal loads; accident loads; hydrodynamic loads; and earthquake effects. Analysis of the slab is performed by the following two methods:

1. An overall structural frame analysis by STRUDL, and

2. Classical elastic method analysis with rigid connections for the spent fuel pool and transfer canal considering static, dynamic and thermal loads.

The main reinforcement of the slab is designed considering all loads and combinations. The flexural design of rebars is based on the Whitney Stress Diagram, under "balanced conditions", where the concrete reaches its full compressive strength just as the steel reaches its yield-point stress for tension. Without the total bond of concrete to the reinforcing steel at the bottom of the slab, the slab could fail.

CORRECTIVE ACTION

As previously mentioned the corrective actions began in November 1977 when the unconsolidated concrete was initially discovered. Further investigation resulted in the situation being considered reportable after documentation by Brown & Root site QA in early March. The remaining actions involve repairing the slab and instituting measures to prevent recurrence.

Adhesive Engineering Company of California and their licensee, Integral Bonding Systems of Texas, have been contracted to determine the method of repair based on repair qualification tests to be performed on voided areas of the slab. It is anticipated that four potential methods of repair will be investigated; i.e., (1) straight epoxy injection behind embedded plates, (2) epoxy injection of preplaced aggregate, (3) epoxy injection thru a epoxy sealed surface, and (4) epoxy mortar and epoxy bonding agent used in conjunction with shotcrete. The test areas shall be cored and the cores evaluated to determine the most suitable method. Since the repair schedule is dependent upon the repair method investigation, a definitive schedule is not available at this time. It is anticipated that the schedule can be formulated on or about May 1, 1978. However, the repair is expected to be typical construction technique.

Actions being taken to prevent recurrence of this problem include utilizing a pre-pour planning meeting when considered appropriate to insure that all necessary equipment and personnel are assembled at the proper time, and to assure that all personnel involved understand the intricacies of the planned pour. Also, slower pouring times will be used so as to assure more complete consolidation of the initial and intermediate stages of the pour.