U. S. NUCLEAR REGULATORY COMMISSION
REGION I

DOCKET/REPORT NO.: 50-219/95-18

LICENSEE: GPU Nuclear Corporation
Parsippany, New Jersey 07054

FACILITY: Oyster Creek Nuclear Generating Station
Forked River, New Jersey

INSPECTION DATES: October 2-6, 1995

INSPECTOR: _____ 10/18/95
Joseph E. Carrasco, Reactor Engineer Date
Civil Mechanical and
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Division of Reactor Safety

APPROVED BY: _____ 10/23/95
Michael C. Modes, Chief Date
Civil Mechanical and
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EXECUTIVE SUMMARY

The purpose of this inspection was to determine the technical adequacy of the reinforced concrete basemat and its associated structures for the independent spent fuel storage installation at Oyster Creek Nuclear Generating Station. To accomplish this purpose, the inspector reviewed the design considerations of the basemat to ensure its compliance with the American Concrete Institute (ACI) 381.

The ACI 381 requires load contributions due to earthquake and hydro pressure be considered in the design. The licensee's design only accounted for dead load and live load.

As a result of this review, the following observations were made:

- **Seismic Load** - Although static loads were the only loads considered in the design of the basemat, the licensee will perform a dynamic analysis of the soil structure interaction to determine the effects of a postulated seismic event on the already-installed basemat. These proposed analyses will also address NRC Information Notice 95-28, "Emplacement of Support Pads for Spent Fuel Storage Installation."

- **Hydrostatic Load** - The NRC reviewed the geotechnical report, which indicates that groundwater was encountered in all test boring ranging in depth from 10.5 to 13.0 feet below existing ground level. The NRC inspector verified the depth of the ground water table by examining other hydrological data provided by the licensee's environmental staff. This data matches the values of the geotechnical report. Hydrostatic loads are not applicable to the design of this basemat, because the groundwater table is way below the ground level.

- **Soil-Bearing Capacity** - The licensee's geotechnical report recommended that the basemat should be designed for an allowable soil bearing pressure of 2300 pounds per square foot (PSF). The maximum stress in the soil exceeded this 2300 PSF figure according to the basemat design calculation. The licensee computed the maximum allowable soil bearing pressure of the soil underlying the basemat at approximately 44 feet; and, based on the results of the density testing completed during the construction of the basemat, the maximum allowable soil bearing is 4500 PSF.

Quality Verification Group's Involvement in the Project

The Quality Verification Group (QV) is actively involved in the project as evidenced below:

- **Soil Compaction** - The compaction requirement for the soil beneath the basemat and approach basemat is 95%. QV found in five locations, the compaction was found below the specified 95%. These five locations were reviewed by the licensee's consultant and dispositioned as acceptable.

- **Placing of the Rebar** - The basemat was designed to have #11 rebars spaced at 12-inch centers for the top and #11 rebar spaced at 9-inch centers for the bottom. QV found the bottom rebar of the basemat was spaced at 12-inch centers instead of being spaced at 9-inch centers. This was corrected by adding an additional layer of #8 rebars between the #11 rebars.

- **Placing of the Concrete** - During the concrete pour, air entrainment in concrete was limited to a range from 4.5 to 8.0 % per unit volume (20 yards batch). The QV group identified the entrainment air in three batches was 3.7% per unit volume. This finding was assessed and dispositioned by the licensee's engineering as "used as is."

- **Flatness of the Basemat** - Final flatness testing of the basemat was specified to be 1/8 inch per 10 feet radius. QV found it to be greater than 1/8 inch. The flatness specification was relaxed to a more achievable 3/8 inch per 10 feet radius.

- **Roadway Upgrades** - The results of the roadway analysis performed by the licensee demonstrated that, in its present configuration, the roadway is capable of withstanding the weight of the fully-loaded transporter. Therefore, no modifications of the road are needed.

Considering the fact that the licensee's basemat design and installation were completed prior to the issuance of the NRC Information Notice 95-28, it appears the licensee is taking the proper steps to accommodate the stipulations of the NRC IN 95-28 into the existing basemat. The NRC would like to be advised of the results of your proposed dynamic analysis or the soil/structure interaction for the basemat. The licensee's engineering staff is proceeding in a cautious and systematic manner. The technical challenges of the project are being aggressively pursued. The licensee's QV group appears to be effective in detecting construction errors during the basemat installation activities. Attention to detail and more engineering involvement or presence during these construction activities could minimize these errors.

DETAIL

1.0 BACKGROUND

Horizontal storage modules (HSM) are designed to provide a self-contained modular structure for storage of spent fuel canisterized in a dry-shielded canister (DSC). The HSM is constructed from reinforced concrete and structural steel. The thick concrete roof and walls of the HSM are designed to provide substantial neutron and gamma shielding. The licensee is procuring the HSMs from Vectra Technologies in accordance with their QA plan. The HSMs were classified as nuclear safety-related. The HSM was designed to sit on a basemat of a 36-inch thick and 41'-0" X 108'-2" reinforced concrete slab supporting a total of 20 back-to-back NUHOMS precast HSMs.

2.0 PURPOSE OF THE INSPECTION

The purpose of this inspection was to determine the technical adequacy of the installation of a reinforcement concrete basemat and approach slabs for the Oyster Creek Nuclear Generating Station (OCNGS) Independent Spent Nuclear Fuel Storage Facility (ISFSI).

3.0 SCOPE OF THE INSPECTION

This inspection included a review of the design basis for the basemat to ensure its compliance with the building code requirements of the American Concrete Institute (ACI) 381. This inspection also reviewed the basemat's installation records.

4.0 ASSESSMENT OF BASEMAT DESIGN

4.1 Acceptance Criteria

The industry standard for the design and installation of this basemat is the ACI 381. In Section 9.2, this building code requirement specifies the load combinations to be considered in the design of the basemat. Sections 9.2.2. through 9.2.7 also require load contributions due to wind, earthquake, earth pressure, fluid pressure, impact, and temperature be included in the design when these loads produce significant stresses in the structure.

4.2 Review of the Basemat Design Loads and Load Combinations

The design calculation of the basemat considered dead load and live load. Dead loads are due to weight of the modules, side shield walls, canisters, and basemat. Live loads are due to operational loads and snow.

The ACI 381 required that load contributions due to earthquake and hydro pressure be included in the design, but this was not the case.

4.2.1 Seismic Load

In addition to the design requirements established in the ACI 381, the NRC issued an Information Notice (IN) 95-28 in June 1995, which states that the design of dry storage foundation mats should consider the same design basis events that were considered in the design of the power plant. The existing

analysis of the Oyster Creek dry fuel storage foundation mat considered wind in excess of the design wind speed at Oyster Creek. However, seismic loads were not considered.

To ensure that seismic loads do not affect the structural adequacy of the basemat, the licensee will perform a dynamic analysis or a soil structure interaction to determine the effects of a postulated seismic event on the basemat. These proposed analyses shall also address the NRC Information Notice 95-28, "Emplacement of Support Pads for Spent Fuel Storage Installation."

4.2.2 Hydrostatic Load

The geotechnical report states that groundwater was encountered in all test boring ranging in depth from 10.5 to 13.0 feet below existing ground surface, but the report added that these observations were made at the time of the field investigation--meaning that the groundwater levels may vary with daily, seasonal, tidal, and climatic fluctuations. If the groundwater raises higher than established in the soil report, hydrostatic loads should be considered for the design of the basemat. The NRC inspector verified the depth of the ground water table is at 13 feet below the ground level by examining other hydrological data provided by licensee environmental staff. This data matches the values of the geotechnical report. Therefore, hydrostatic loads are not applicable to this design case.

4.2.3 Soil-Bearing Capacity

The geotechnical report recommends that basemat should be designed for an allowable soil-bearing capacity of 2300 pounds per square foot (PSF). The basemat's design calculation allows the maximum stress in the soil to exceed this 2300 PSF figure. The licensee computed the maximum allowable soil bearing pressure of the soil underlying the basemat at approximately 44 feet; and, based on the results of the density testing completed during the construction of the basemat, the maximum allowable soil bearing is 4500 PSF.

5.0 QUALITY VERIFICATION GROUP'S INVOLVEMENT IN THE PROJECT

Quality verification (QV) is actively involved in the dry fuel storage. This involvement includes the verification of the construction of the dry storage pad. The licensee's QV utilized the expertise of a contractor to perform site specific studies, compaction testing, and final storage slab flatness testing.

Through the records reviewed, it is evident that GPU's QV verified the installation of the concrete basemat with checks of the critical parameters such as slab thickness, rebar size and placement, cleanliness of the formwork, and the concrete placement with testing for air entrainment, slump and compression testing. There appears to be a lack of engineering involvement in the witnessing the ISFSI site activities. The QV inspector made several observations that could be prevented if the cognizant engineer or the responsible designer was present on-site during the execution of key activities.

5.1 Soil Compaction

The compaction requirement for the soil beneath the basemat and approach basemat is 95%. But in five locations, QV found the compaction was below the specified 95%. These five locations were reviewed by the licensee's consultant and dispositioned as acceptable.

5.2 Placing of the Rebar

The basemat was designed to have #11 rebars spaced at 12-inch centers for the top and #11 rebar spaced at 9-inch centers for the bottom. The licensee's QV found the bottom rebar of the basemat was spaced at 12-inch centers instead of being spaced at 9-inch centers. This was corrected by adding an additional layer of #8 rebars between the #11 rebars. Attention to detail and more engineering involvement during these activities could minimize these problems.

5.3 Placing of the Concrete

During the concrete pour, air entrainment in concrete was limited to a range from 4.5 to 8.0 % per unit volume (20 yards batch). The licensee's QV group identified the entrainment air in three batches was 3.7% per unit volume. This finding was assessed and dispositioned by the licensee's engineering as "used as is." This is an example of an effective QV.

5.4 Flatness of the Basemat

Final flatness testing of the basemat was specified to be 1/8 inch per 10 feet radius, but it was found to be greater than 1/8 inch. The flatness specification was relaxed to a more achievable 3/8 inch per 10 feet radius.

6.0 ROADWAY UPGRADES

The licensee evaluated the roadway from the reactor building railroad airlock to the dry storage facility. The results of the roadway analysis performed by the licensee demonstrated that, in its present configuration, the roadway is capable of withstanding the weight of the fully- loaded transporter (e.g., GPU Calculation C-1302-915-5320-001). The site design drawings do not show any safety/important-to-safety underground commodity along the load path.

7.0 MANAGEMENT OVERSIGHT

There appears to be a lack of engineering involvement during important activities of the installation of the basemat for the ISFSI. The licensee's quality verification was effective in detecting the deficiencies on time.

8.0 CONCLUSION

Considering the fact that the licensee's basemat design and installation were completed prior to the issuance of the NRC Information Notice 95-28, it appears that the licensee is taking the proper steps to accommodate the stipulations of the NRC IN 95-28 into the existing basemat. The licensee's engineering staff is proceeding in a cautious and systematic manner. The

technical challenges of the project are being aggressively pursued. Further, the QV group appears to be effective.

9.0 EXIT MEETING

The inspector met with the licensee personnel, denoted in Attachment 1, at the conclusion of the inspection, on October 6, 1995, and summarized the scope of the inspection and the inspection results. At the end of this meeting, the licensee senior officer stated that the results and the final report of the dynamic analysis of the basemat will be made available to the NRC for its review. The licensee had no specific concerns with inspector findings. Further, no proprietary documents were reviewed during the conduct of this inspection.

Attachment: Persons Contacted

ATTACHMENT 1

Persons Contacted

General Public Utilities Company

G. W. Busch	Manager Licensing
* S. Levin	Director, Operations & Maintenance
* T. Sensue	Licensing Engineer
* J. C. Solakiewicz	QV Manager
* D. L. Robillard	NSA Lead Assessor
* P. Czaya	Licensing Engineer
* A. R. Baig	Project Engineer
E. P. O'Donnell	Director of Engineering Projects
L. Gorozdi	Civil/Structural Engineer
K. Whitmore	Civil/Structural Manager
S. Parsons	Nuclear Safety Assessment

U. S. Nuclear Regulatory Commission

* S. Pindale	Resident Inspector

* Indicates those present at the exit meeting on October 6, 1995.