UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

July 23, 2010

Mr. Michael J. Pacilio
Senior Vice President, Exelon Generation Company, LLC
President and Chief Nuclear Officer (CNO), Exelon Nuclear
4300 Winfield Road
Warrenville IL 60555

SUBJECT: NRC INSPECTION REPORT NOS. 072-00073/09-01(DNMS); 050-00456/09-08; 050-00457/09-08 – BRAIDWOOD STATION

Dear Mr. Pacilio:

On July 7, 2010, the U.S. Nuclear Regulatory Commission (NRC) completed its inspection of the dry cask storage pad construction activities at the Braidwood Station. The purpose of the inspection was to determine whether the dry cask storage pad design and construction activities were conducted safely and in accordance with NRC requirements and design specifications. At the conclusion of the inspection on July 7, 2010, during an exit meeting, the NRC inspectors discussed the preliminary inspection findings with members of your staff. The enclosed report presents the results of this inspection.

The inspection was an examination of the dry fuel storage pad construction activities as they related to safety and compliance with the Commission's rules and regulations and with the conditions of your license. Specifically, the inspectors observed vibro-compaction activities and the placement of the mud mat, structural fill, reinforcement, and concrete for the storage pad. The inspectors also began an in-office review of structural calculations related to the storage pad and the haul path, however not all documents needed to complete this review were available during the inspection period. Areas examined during the inspection are identified in the enclosed report. Within these areas, the inspection consisted of selected examinations of procedures and representative records, observations of activities, and interviews with personnel.

Based on the results of these inspections, the inspectors did not identify any violations of NRC requirements. The storage pad construction activities were conducted in accordance with applicable regulations and license conditions. The licensee's calculations and evaluations relating to the pad and haul path analysis were still ongoing so the inspectors could not complete their review in these areas. The NRC inspection of these activities will be completed prior to storage of fuel on the pad.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

We will gladly discuss any questions you may have regarding this inspection.

Sincerely,

/RA/

Christine A. Lipa, Chief
Materials Control, ISFSI, and
Decommissioning Branch
Division of Nuclear Materials Safety

Docket Nos. 72-073; 50-456; 50-457
License Nos. NPF-72; NPF-77

Enclosure:
Inspection Report Nos. 072-00073/09-01(DNMS);
050-00456/09-08; 050-00457/09-08

cc w/encl: Distribution via ListServ

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

We will gladly discuss any questions you may have regarding this inspection.

Sincerely,

/RA/

Christine A. Lipa, Chief
Materials Control, ISFSI, and
Decommissioning Branch
Division of Nuclear Materials Safety

Docket Nos. 72-073; 50-456; 50-457
License Nos. NPF-72; NPF-77

Enclosure:
Inspection Report Nos. 072-00073/09-01(DNMS);
050-00456/09-08; 050-00457/09-08

cc w/encl: Distribution via ListServ

DISTRIBUTION:

RidsNrrDorlLpl3-2	Steven Orth	Carole Ariano
Resource	Jared Heck	Linda Linn
Susan Bagley	Allan Barker	Jeremy Tapp
RidsNrrPMBraidwood	Steven Reynolds	Matthew Learn
Resource	Patrick Louden	Lionel Rodriguez
RidsNrrDirsIrib Resource	DRPIII	Patricia Buckley
Cynthia Pederson	DRSIII	Tammy Tomczak

DOCUMENT NAME: G:\Work in progress\IR - Braidwood ISFSI Pad Construction rev 1.docx
☒ Publicly Available ☐ Non-Publicly Available ☐ Sensitive ☒ Non-Sensitive
To receive a copy of this document, indicate in the concurrence box "C" = Copy without attach/encl "E" = Copy with attach/encl "N" = No copy

OFFICE	RIII DNMS		RIII DNMS	E	RIII		RIII	
NAME	MCLearn:jm		CALipa					
DATE	07/16/10		07/23/10					

OFFICIAL RECORD COPY

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket Nos:	72-073; 50-456; 50-457
License Nos:	NPF-72; NPF-77
Report Nos:	072-00073/09-01(DNMS); 050-00456/09-08; 050-00457/09-08
Licensee:	Exelon Generation Company
Facility:	Braidwood Station
Location:	35100 S. Route 53 Braceville, IL 60407
Inspection Dates:	On-site: June 29, 2009, July 20, 2009, July 30, 2009, August 18, 2009, October 5, 2009, October 19, 2009, July 7, 2010, in-office review through July 7, 2010
Exit Meeting:	July 7, 2010
Inspectors:	Matthew Learn, Reactor Engineer Sarah Bakhsh, Reactor Inspector Vijay Meghani, Reactor Inspector Mark Mitchell, Health Physicist Jeremy Tapp, Health Physicist
Approved by:	Christine A. Lipa, Chief Materials Control, ISFSI, and Decommissioning Branch Division of Nuclear Materials Safety

Enclosure

EXECUTIVE SUMMARY

Braidwood Station
NRC Inspection Report Nos. 072-00073/09-01(DNMS); 050-00456/09-08; 050-00457/09-08

The purpose of the inspection was to observe and evaluate the licensee's activities associated with construction of a new Independent Spent Fuel Storage Installation (ISFSI) pad. During this inspection period, the inspectors also began review of the design of the new pad to ensure compliance with the regulations and design specifications.

Review of 10 CFR 72.212(b) Evaluations, Appendix A, Review of ISFSI Storage Pad Design

- The licensee's soil and engineering design evaluations were performed in accordance with the Certificate of Compliance, Title 10 Code of Federal Regulations (CFR) Part 72 requirements, and industry standards. A review of the licensee's seismic soil structure analysis, ISFSI pad structural analysis, liquefaction analysis, and heavy haul path analysis was started but the calculations pertaining to the subject were unavailable at the time of the inspection. This review is ongoing and will be documented in the NRC pre-operational testing inspection report. (Section 1.1)

ISFSI Pad Construction

- The licensee's site characterization and soil compaction activities were performed in accordance with specifications, design drawings, and industry standards. (Section 2.1)

- The inspectors concluded that the construction activities for the ISFSI concrete storage pad complied with specifications contained in the licensee's approved engineering change package, design drawings, civil construction specifications, work orders, and applicable industry standards. The licensee provided justifications for any discrepancies which were verified with the designer of the pad. (Section 2.2)

Report Details

1.0 Review of 10 CFR 72.212(b) Evaluations, Appendix A, Review of Independent Spent Fuel Storage Installation Storage Pad Design (60856)

1.1 Site Characterization and Design of the Independent Spent Fuel Storage Installation Pad

a. Inspection Scope

The inspectors evaluated the licensee's soil and engineering design evaluations in preparation for a new dry cask storage pad to verify the licensee's compliance with the Certificate of Compliance, Title 10 Code of Federal Regulations (CFR) Part 72 requirements, and industry standards.

b. Observations and Findings

Soil Analysis and Soil Liquefaction Analysis

The inspectors reviewed the radiological environmental sampling conducted by the licensee prior to initiating the Independent Spent Fuel Storage Installation (ISFSI) construction. The licensee sampled surface soil and soil at approximately 3 feet (ft.) below grade at six locations on the future site of the ISFSI pad. The samples were analyzed by the licensee's contract environmental counting laboratory for the presence of tritium and byproduct gamma emitting isotopes. None of the samples tested positive for the presence of byproduct material as a result of plant operations. The sample counting did identify naturally occurring isotopes at the expected levels and one sample count identified cesium-137 at levels less than the known levels of cesium-137 as a result of atmospheric bomb testing. The licensee is maintaining records of this testing and other environmental radiological testing in support of the ISFSI development. The licensee has no records of spills or releases to the area recorded in accordance with 10 CFR 50.75(g). The licensee conducted this specific review to assure that the area was not contaminated as a result of historic leaks from vacuum breakers along the plant blowdown line. The sampling results confirmed that record.

Initially, six soil borings were drilled within the area of the proposed ISFSI pad to determine the site subsurface conditions. The inspectors reviewed the licensee's report and the soil boring test results. The first 35 ft. of soil consisted of fine loose sand and gravel as demonstrated by the low standard penetration test blow counts. Low blow counts are indicative of low resistance to liquefaction. To minimize susceptibility of the soil to liquefaction during a seismic event, the licensee used a vibro-compaction technique which compacted the soil, increasing its in situ density and shear strength. Vibro-compaction also generally aids to improve the bearing capacity and reduce settlement of the soil of the pad foundation. This denser configuration lowered the initial grade of the proposed ISFSI by approximately 2 ft. Nine additional soil borings were drilled and analyzed following vibro-compaction. A review of the licensee's liquefaction analysis will be completed and documented in the U.S. Nuclear Regulation Commission (NRC) pre-operational testing inspection report.

Seismic Soil Structure Analysis and ISFSI Pad Structural Analysis

A review of the seismic soil structure analysis and ISFSI pad analysis was started but the licensee's calculations pertaining to the subject were unavailable at the time of the inspection. A review of the licensee's soil structure interaction analysis will be completed and documented in the NRC pre-operational testing inspection report.

ISFSI Pad Impact on Flooding Analysis

The ground water table at the ISFSI pad is approximately 6 to 7 ft. below grade. The licensee used a water table value of 5 ft. below grade in their analyses and installed a tile drain system at approximately 5 ft. 6 inches below grade around the ISFSI pad to manage any elevated ground water levels. This drainage system discharged to the existing site drains. The pad is located outside the plant area weirs which control the water elevations in the plant zones. The pad is located at a higher elevation than its surroundings, however water level rise on the operating plant, during a Probable Maximum Precipitation (PMP) event, due to the construction of the ISFSI pad will be negligible. To address any frost heave concerns during cold weather, the licensee placed a frost free granular material under the pad.

c. Conclusion

The licensee's soil and engineering design evaluations were performed in accordance with the Certificate of Compliance, 10 CFR Part 72 requirements, and industry standards. A review of the licensee's seismic soil structure interaction analysis, liquefaction analysis, and ISFSI pad structural analyses was started but the calculations pertaining to the subject were unavailable at the time of the inspection. This review is ongoing and will be completed and documented in the NRC pre-operational testing inspection report.

2.0 Independent Spent Fuel Storage Installation Pad Construction (60853)

2.1 Excavation and Soil Compaction Activities

a. Inspection Scope

The inspectors evaluated the licensee's site characterization, and observed soil compaction activities for the new dry cask storage pad to verify the licensee's compliance with its specifications, design drawings, and industry standards.

b. Observations and Findings

The licensee constructed a reinforced concrete ISFSI storage pad east of the plant protected area. Subsequent to vibro-compaction, the licensee graded the site and removed approximately 2 ft. of soil, ensuring removal of topsoil, organic, and all undesirable material. Rolling of the underlying in-situ material ensured that a suitable sub-grade existed under the pad area. The licensee placed a geotextile fabric on the compacted sub-base which separated the sandy sub-base from the stone in order to achieve the required compaction.

Following receipt of satisfactory compaction results for the sub-grade, the licensee backfilled the area with 3 ft. of non-frost susceptible granular base material (gravel/sand) and compacted the fill to 95 percent of the maximum dry density as indicated in American Society for Testing and Materials (ASTM) D1557. The inspectors observed the licensee place and compact the fill in layers of 6 inches.

The inspectors observed certified personnel perform field tests using a moisture density gauge to verify that each individual lift met the minimum compaction, maximum dry density, and moisture content as specified in technical specifications and established during laboratory tests. The licensee's contractor obtained this data by performing field tests which included wet and dry density, moisture content, and lift thickness, all within the frequencies required by the appropriate ASTM standards.

The licensee performed soil plate load tests for the engineered fill, prior to mud mat placement, to determine the value of the Young's Modulus. This parameter measures the stiffness of the material and was calculated using field tests. There is both a lower and upper limit required to ensure the pad's structural qualifications are met. The lower limit of the Young's Modulus was the minimum required for the strength of the pad while the upper limit was to ensure that the deceleration values of the fuel assemblies would not exceed design requirements during a postulated non-mechanistic tip-over of the cask. The licensee's specifications required the Young's Modulus to be between 7.5 and 20 kilo-pound-force per square inch (ksi).

The licensee committed to follow the ASTM D1194 standards in its civil construction specification and engineering change (EC) package for the plate load tests which required the use of at least three test locations. Instead of using a 2x2 ft. sized plate for the test, the designer of the ISFSI pad (Holtec) recommended using a 1x1 ft. sized plate. Changing the plate size ensured that the data was representative of the engineered fill without significant contribution from the in-situ soil beneath the fill. The licensee's contractor performed one soil plate load test of each of the three sections of the ISFSI pad. The results for the three tests were forwarded to Holtec to determine the Young's modulus. Results from the first test location indicated a Young's Modulus in the range of 3.7 to 6.1 ksi which was below the minimum requirement of 7.5 to 20 ksi. The licensee indicated that due to heavy rain fall, this area was found to be softer than the remainder of the proposed ISFSI pad area. The licensee documented this issue as Action Request (AR) 992085. After giving the fill an opportunity to dry, the licensee's contractor repeated the first test at a fourth, location which was in close proximity to the test area that failed. The average results of the Young's Modulus for the three accepted tests were 9.1 to 16 ksi, which was within the 7.5 to 20 ksi range.

c. Conclusion

The licensee's site characterization and soil compaction activities were performed in accordance with specifications, design drawings, and industry standards.

2.2 Pad Construction Activities

a. Inspection Scope

The inspectors evaluated whether construction activities for the ISFSI concrete storage pad complied with specifications contained in the licensee's approved EC, design

drawings, work orders, and applicable industry standards. The inspectors also reviewed select material, concrete documentation (batch plant tickets), and personnel certification records.

b. Observations and Findings

The storage pad was designed to be a 198 ft. long, 116 ft. wide, and 2 ft. thick reinforced concrete slab. The storage pad was supported by a 6 inch thick concrete mat foundation set on top of 3 ft. of dense graded aggregate.

Placement of Reinforcing Steel

After placement and satisfactory compaction of the engineered fill, the licensee placed a 6-inch mudmat which provided a work surface to facilitate reinforcement bar (rebar) installation and concrete placement. The licensee then installed forms and placed rebar. The reinforced concrete was designed for a nominal compressive strength between 3,000 pounds per square inch (psi) and 4,500 psi at 28 days and the rebar conformed to ASTM A615 Grade 60 steel.

After placing the rebar and securing the forms for each section, the licensee performed inspections of the rebar and the pad general area prior to concrete placement. The NRC inspectors reviewed the design drawings and performed an independent walk down of the proposed south section of the pad. The pad area was free of debris and excessive moisture. The rebar was placed in two upper and lower layers joined by U-shaped bars. The licensee placed the correct size of rebar. The inspectors measured the spacing between the rebar and found it to be per the design specifications.

Placement of Concrete for Storage Pad

The storage pad was designed and constructed in accordance with American Concrete Institute (ACI) 318. The inspectors observed concrete placement for the middle section of the main storage pad. The licensee deposited concrete in this section in one continuous placement. The licensee checked the concrete batch tickets for every truck to confirm that each concrete batch was mixed as specified in the mix design and the mixing time and number of drum revolutions satisfied code requirements to ensure the concrete was suitable for placement. The concrete was tested prior to placement and due to low 28 day concrete strength test results, the concrete mix design for the north section of the ISFSI pad was revised. The revised concrete mix design was acceptable as indicated by the actual 28 day test results of the north section of the pad.

The inspectors observed that the concrete was transported by conveyor belt and deposited in the areas of placement as indicated by the forms. The inspectors noted that the contractor staff maintained careful control of the discharge hose and ensured that concrete had an unrestricted vertical drop to the point of placement to prevent segregation of the aggregate. The contractor used a systematic pattern of vibration to ensure proper consolidation, thereby preventing voids in the concrete slab. The proposed ISFSI pad was constructed in three segments allowing three separate continuous placements of concrete. The licensee applied a broom finish as required by the design to the pad after placement in order to achieve the appropriate surface friction factor.

Concrete Field Tests

The licensee's contractor obtained concrete samples approximately every 50 cubic yards to test air content, temperature, and slump tests. The field tests were satisfactory and within the allowed acceptance criteria. During placement of the middle third of the proposed pad, some of the concrete slump tests were less than the minimum of 3 inches required by specifications. The licensee held the truck in abeyance until field adjustments to the concrete were made and the slump was within specifications before the concrete was placed. Also during placement of the middle section of the pad, a hydraulic line on one of the concrete trucks ruptured and hydraulic fluid spilled onto the ground away from the pad. The truck was immediately stopped and the licensee's pad construction contractor's supervision used a spill kit with spill pads to contain the spill and clean it up. The affected gravel was removed from the area in a bucket and disposed of properly. The concrete truck was repaired onsite. The concrete in the truck was rejected and not used for the ISFSI pad construction. The licensee entered this issue into its corrective action program as AR 981689.

In addition to the field tests, the qualified individuals collected concrete samples in cylinders, one set of 8 cylinders every 100 cubic yards of concrete placed, for the concrete strength tests. The cylinders were adequately stored in accordance with ACI and ASTM standards. The cylinders were cured and tested after 28 days by an independent laboratory to measure the compressive strength of the concrete.

The inspectors reviewed the 28 day concrete compressive strength test results taken from the storage pad to ensure they met the minimum strength of 3,000 psi and maximum of 4,500 psi as specified by the design requirements.

Several 28-day test results exceeded the 4,500 psi maximum strength, these results were provided to the pad designer (Holtec) for review and justification for acceptance. The licensee entered this into its corrective action program as AR 992000. The licensee's revised evaluation will be reviewed and documented in the NRC pre-operational testing inspection report.

In addition to field observations, the inspectors reviewed the rebar certification which could affect the quality of the concrete pad and its design function. The inspectors also reviewed documentation regarding the batch plant certification which was certified in accordance with the Illinois Department of Transportation.

c. Conclusion

The inspectors concluded that the construction activities for the ISFSI concrete storage pad complied with specifications contained in the licensee's approved EC package, design drawings, civil construction specifications, work orders, and applicable industry standards. The licensee provided justifications for any discrepancies which were verified with the designer of the pad.

2.3 Dry Cask Transfer Route

a. Inspection Scope

A review of the licensee's heavy haul road design and underground utilities evaluation for the proposed transfer route for the expected ISFSI load was started but the licensee's calculations pertaining to the subject were unavailable at the time of the inspection. This review is ongoing and will be documented in the NRC pre-operational testing inspection report.

3.0 Exit Meeting Summary

On July 7, 2010, the inspectors conducted an exit meeting to present the results of the inspection. The licensee acknowledged the findings presented and did not identify any information discussed as being proprietary in nature.

Attachment: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee and Contractor Employees

Amir Shahkarami, Site Vice President *
David Dickinson, URS Washington Division
Roger Guse, Task Manager
Tricia Mattson, Braidwood Station Regulatory Assurance *
Wayne Stotts, Implementation Manager
Brian Williams, Valley Construction
Ed Wrigley, Braidwood Senior Project Manager *
Terry Schuster, Chemical and Environmental Manager *

* Persons present during the July 7, 2010 exit meeting.

INSPECTION PROCEDURES USED

IP 60853	Construction of an Independent Spent Fuel Storage Installation
IP 60856	Review of 10 CFR 72.212 (b) Evaluations, Appendix A, Review of Independent Spent Fuel Storage Installation Storage Pad Design

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened	Type	Summary
None		

Closed

None

LIST OF DOCUMENTS REVIEWED

R 981689; Hydraulic Leak on Concrete Truck (ISFSI Pad); October 20, 2009

AR 987035; ISFSI 14 Day Concrete Compressive Strength Exceeds 4500 PSI; October 31, 2009

AR 992000; ISFSI Concrete Cylinders Exceed Compressive Strength Test; November 11, 2009

AR 992085; ISFSI Pad Plate Load Test 1 Failure; November 11, 2009

AR 994674; ISFSI Concrete Cylinders Exceed Compressive Strength Test; November 17, 2009

LIST OF DOCUMENTS REVIEWED (CONTINUED)

Design Analysis 2.4.4-BRW-09-0066-S; Post Vibro-Compaction Acceptance Criterion Analysis for the ISFSI pad; Revision 0

Drawing 2232; ISFSI Pad Plan, Details, and Sections; July 16, 2009

Drawing S-2239; Dry Fuel Storage Project Grading Sections; July 27, 2009

EC 369360; Dry Cask Storage Project Independent Spent Fuel Storage Installation (ISFSI) Pad; Revision 0

Hayward Baker Final Vibro-Compaction Completion Report for ISFSI at Braidwood Generating Station; July 15, 2009

Hayward Baker Vibro-Compaction Addendum #2; Vibration Assessment Plan; June 5, 2009

Holtec International Letter; Engineering Full Requirements for Braidwood; July 24, 2009

Holtec International Letter; Braidwood ISFSI Pad Plate Load Test Results; August 17, 2009

Independent Spent Fuel Storage Installation Civil Construction Specification; Specification No. 129812-BRW-001, Revision 2

Nucor Certified Mill Rebar Chemical and Physical Test Report; May 18, 2009

PSI Addendum #1; Proposed ISFSI Pad – New Location; Braidwood Liquefaction Potential; February 10, 2009

Terracon Concrete Compressive Strength Test Report; 7 Day Breaks for the ISFSI Pad South Section; October 15, 2009

Terracon Letter to Valley Construction; Concrete Compressive Strength Test Results; November 30, 2009

Terracon Plate Load Test, ISFSI Pad, Test Location #2 West

Terracon Plate Load Test, ISFSI Pad, Test Location #3

Terracon Plate Load Test, ISFSI Pad, Test Location #4

URS Washington Division Batching Plant Inspection Trip Report; September 11, 2009

URS Washington Division Batching Plant Inspection Trip Report; Addendum #1; October 7, 2009

URS Washington Group Specification Number 29487-BRW0154-VIBRO-001 for Vibro- Compaction; Revision 0

URS Washington Group Specification Number 29487-BRW0154-VIBRO-001 for Vibro- Compaction; Addendum #2; Revision 0

LIST OF ACRONYMS USED

ACI	American Concrete Institute
ADAMS	Agencywide Documents Access and Management System
ASTM	American Society for Testing and Materials
AR	Action Request
CFR	Code of Federal Regulations
DNMS	Division of Nuclear Materials Safety
EC	Engineering Change
ft.	foot
ISFSI	Independent Spent Fuel Storage Installation
ksi	kilo-pound-force per square inch
NRC	U. S. Nuclear Regulatory Commission
PMP	Probable Maximum Precipitation
psi	Pounds per Square Inch
rebar	Reinforcement Bars