



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-4005

August 16, 2005

Mr. George A. Williams
Site Vice President
Grand Gulf Nuclear Station
P.O. Box 756
Port Gibson, MS 39150

SUBJECT: INSPECTION REPORT 050-00416/05-010; 072-00050/05-001

Dear Mr. Williams,

On July 20-21, 2005, the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection at your Grand Gulf Nuclear Station. The purpose of the inspection was to review the construction of the Independent Spent Fuel Storage Installation (ISFSI) pad in accordance with Inspection Procedure 60853, "On-Site Fabrication of Components and Construction of an ISFSI". The enclosed inspection report documents the results of that inspection, which were discussed with Mr. Steven Corley and Mr. James Owens on June 21, 2005.

The inspection included a review of the ISFSI pad and concrete mix design documents, inspection of the concrete forms and reinforcing steel, and observation of the concrete mixing, delivery, sampling, pumping, and placement. The inspection determined that you were constructing your ISFSI pad in conformance with the standards established by the American Concrete Institute and the American Society for Testing and Materials, as required by the Holtec Final Safety Analysis Report. No violations were identified.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction.

Should you have any questions concerning this inspection, please contact the undersigned at (817) 860-8191 or Mr. Scott Atwater at (817) 860-8286.

Sincerely,

D. Blair Spitzberg, Ph.D., Chief
Fuel Cycle and Decommissioning Branch

Docket Nos.: 50-416
72-050
License No.: NPF-29

Entergy Operations, Inc.

- 2 -

Enclosure:
NRC Inspection Report
050-00416/05-010; 072-00050/05-001

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- 3 -

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ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket Nos.: 050-00416; 072-00050

License No.: NPF-29

Report No: 050-00416/05-010; 072-00050/05-001

Licensee: Entergy Operations, Inc.

Facility: Independent Spent Fuel Storage Installation
Grand Gulf Nuclear Station
Entergy Operations, Inc.
P.O. Box 756
Port Gibson, MS 39150

Dates: July 20 - 21, 2005

Inspector: S.P. Atwater, Health Physicist

Approved By: D.B. Spitzberg, Ph.D., Chief
Fuel Cycle and Decommissioning Branch

Attachments: 1. Supplemental Information
2. Inspector Notes

EXECUTIVE SUMMARY

Grand Gulf Nuclear Station
NRC Inspection Report 050-00416/05-010; 072-00050/05-001

The north ISFSI pad measured 61' X 196' and was configured for 4 rows of 12 storage casks each. Although the pad capacity was 48 storage casks, only 44 casks will be stored on it. The last space in each row will be left empty for temporary storage during cask movements. The ISFSI pad and sub-base were designed to meet the compressive strength and hardness requirements of the Holtec #1014 Final Safety Analysis Report (FSAR). In addition, the ISFSI pad was equipped with an integral grounding system for protection against lightning strikes, a lighting system on each storage cask to eliminate shadows, and a temperature monitoring system to provide remote readings of cask outlet air temperatures.

The ISFSI pad was constructed in four sections labeled west end, west central, east central, and east end. During this inspection, the west end section of the ISFSI pad was poured. The concrete volume was calculated at 344 cubic yards. Forty three trucks with 8 cubic yards of concrete each were ordered and delivered. The concrete was provided by the Mississippi Materials Corporation (MMC) of Vicksburg, MS, from their batch plants in Port Gibson and Vicksburg. Concrete pumping was performed by the Hercules Concrete Pumping Company of Pearl, MS.

The concrete was designed, mixed, delivered, sampled, placed and tested in accordance with the American Concrete Institute (ACI) standards and American Society for Testing and Material (ASTM) standards specified in the Holtec FSAR. Details related to the activities observed are provided in Attachment 2 to this report. The following provides a summary of the observations made during this inspection.

On-Site Fabrication of Components and Construction of an ISFSI (60853)

- Documentation of the ISFSI pad design showed that the pad met the design characteristics specified in the Holtec FSAR for thickness, compressive strength, reinforcing steel yield strength and configuration, and soil subgrade modulus of elasticity (Attachment 2, Page 1).
- Appropriately conducted tests confirmed that the pad surface met the minimum coefficient of friction specified in the Holtec FSAR (Attachment 2, Page 2).
- The concrete mix met the design specifications for air entrainment, slump and water/cement ratio (Attachment 2, Pages 2-3).
- The concrete forms were constructed and prepared for concrete placement in accordance with ACI standards with respect to wetting of the interior surfaces prior to concrete placement, removing debris, controlling mortar leaks and deflection, applying release agents to the interior of forms, wetting of masonry units, establishing a minimum concrete cover over reinforcement steel, and removing standing water (Attachment 2, Pages 3-5).

- The applicable ASTM standards for concrete mixing and delivery were met with respect to addition of water at the job site, maximum time and drum revolutions between leaving the batch plant and discharging the concrete and minimum drum revolutions for mixing (Attachment 2, Pages 6-7).
- The applicable ACI standards for concrete placement were met with respect to exclusion of foreign materials, placement rates and minimizing course aggregate segregation (Attachment 2, Pages 7-8).
- Both the ACI and ASTM standards for concrete sampling were met with respect to sampling locations, methods, frequencies, personnel certification requirements, number of samples, and methods for molding and curing strength test cylinders (Attachment 2, Pages 8-10).
- The ACI requirement for maintaining the concrete in the ISFSI pad in a moist condition and above 50 degrees F for a minimum of 7 days after placement was met (Attachment 2, Page 11).

ATTACHMENT 1

Supplemental Information

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel

M. Bonds - Quality Assurance
S. Corley - Engineering Projects (Civil Engineer)
M. Cross - Quality Control
M. Hendrix - Maintenance Support (Field Engineer)
M. Langston - Quality Control
B. Lee - Quality Control Supervisor
M. Locke - Engineering Projects (Project Manager/Civil Engineer)
S. Martin - Engineering Projects Manager
M. Meister - Quality Control
J. Owens - Licensing
E. Rogers - Maintenance Support Supervisor
J. Snyder - Quality Control
G. Williams - Site Vice President.

Vendor Personnel

C. Harrell - Stone and Webster Field Foreman
M. McCormick - Mississippi Materials Corporation Concrete Supplier Representative

INSPECTION PROCEDURES USED

60853 On-Site Fabrication of Components and Construction of an ISFSI

LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

Opened

IFI 72-050/05-001 Results of 28-day Compressive Strength Testing

Closed

None

Discussed

None

LIST OF ACRONYMS USED

ACI	American Concrete Institute
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
ERCN	Engineering Response Change Notice
FSAR	Final Safety Analysis Report
ISFSI	Independent Spent Fuel Storage Facility
M&TE	Measuring and Test Equipment
MMC	Mississippi Materials Corporation
NRC	U.S. Nuclear Regulatory Commission
psi	pounds per square inch

Attachment 2

GRAND GULF ISFSI PAD CONSTRUCTION

Inspector Notes

Category: Characteristics **Topic:** Parameter Set A

Reference: FSAR 1014, Table 2.2.9

Requirement: Characteristics of the ISFSI pad are specified in Table 2.2.9. Table 2.2.9 provides two examples of acceptable ISFSI pad design parameters. Parameter Set A provides the design parameters for ISFSI pads up to 36" thick. Parameter Set B provides the design parameters for ISFSI pads up to 28" thick.

Finding: This requirement was implemented. The ISFSI pad was 36" thick and designed to meet the requirements specified in Holtec FSAR #1014, Table 2.2.9, Parameter Set A.

Parameter Set A required a concrete compressive strength of 4,200 lbs or less at 28 days. Engineering Response ER-GG-2003-0018-001, Step 5.6.3 specified a concrete mix design for a minimum strength of 3000 psi in 28 days with a maximum tolerance up to 4200 psi. The MMC Mix Certification Sheet stated that "the mix will meet a minimum compressive strength of 3000 psi in 28 days when tested, placed, and handled in accordance with ASTM and ACI standards and recommended practices".

Parameter Set A required concrete reinforcing steel to be configured along the top and bottom of the pad in both directions. The steel must be ASTM material with at least a 60,000 psi yield strength. One-inch A706M (#10A706) reinforcing steel was supplied to Grand Gulf by NUCOR Steel Jackson, Inc. under purchase order 26037. The NUCOR Certified Mill Test Reports for the 4 heat numbers included in the purchase order indicated a yield strength of 63,354 to 67,716 psi. The reinforcing steel bars were laced together along the top and bottom of the pad in both directions.

Parameter Set A required a subgrade effective modulus of elasticity of 28,000 psi or less. Engineering Response ER-GG-2003-0018-001, Step 5.12.8.1 required the one foot thick sub-base to have a modulus of elasticity of 16,000 psi or less. Testing performed by GZA GeoEnvironmental, Inc. yielded a modulus of elasticity for the sub-base of 16,500 to 39,000 psi. Change Notice ERCN-03 was generated to clarify the disparities. Holtec Report H12033051 stated that the subgrade effective modulus of elasticity should be calculated using the average soil stiffness down to a depth of 18' below the pad. Engineering Response ER-GG-2003-0018-001 only considered the one foot thick sub-base. When the 17' of soil under the sub-base was included in the calculation and a sub-base elasticity of 39,000 psi was assumed, the effective modulus of elasticity under the ISFSI pad was less than 28,000 psi.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0
Change Notice ERCN-03 to ER-GG-2003-0018-001
Mississippi Materials Corporation (MMC) Mix Certification Sheet

Category: Characteristics **Topic:** Surface Finish

Reference: FSAR 1014, Table 2.2.9, Sect 3.4.7.1

Requirement: Static coefficient of friction between the ISFSI pad and the bottom of the storage cask shall be verified by test. The value of the static coefficient of friction must be greater than or equal to 0.53 when the test is conducted in accordance with the guidelines contained in Section 3.4.7.1 of the FSAR.

Finding: This requirement was implemented. Coefficient of friction testing was performed in accordance with Engineering Response ER-GG-2003-0018-001, Section 8.3. A 48" X 48" X 6" concrete test block was poured and finished with a broom. A 6" X 6" X 2" specimen plate was fabricated and used for pull tests across the surface of the test block. The average coefficient of friction value for 20 pulls was 0.54, as documented in Work Order 58980. The coefficient of friction testing methodology was consistent with section 3.4.7.1 of Holtec FSAR #1014.

Once placed, the concrete was screeded and bull floated to remove surface voids and to settle the course aggregates near the surface. When the concrete was firm enough to walk on, a rotating finisher (whirley bird) was used. Finally the surface was finished to the same texture as used on the test block.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0
Work Order 58980, "ISFSI Concrete Pad - Phase 1", Revision 0

Category: Concrete Mix Design **Topic:** Air Entrainment

Reference: ACI 318, Sect 4.2.1

Requirement: Normal weight concrete exposed to freezing and thawing shall be air-entrained with air content indicated in Table 4.2.1. Tolerance on air content as delivered shall be +/- 1.5 percent. ACI 318, Table 4.2.1 specifies an air content of 5.5% for severe exposure and a maximum course aggregate of 1.5".

Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.6.8 specified an air entrainment of 4-7% for severe exposure and a maximum course aggregate size of 1.5". Change Notice ERCN-01 increased the upper limit on air content to 8%, making the acceptable range 4-8%. The Field Concrete Testing Data indicated that all nine air entrainment tests were between 4 and 6%.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.
Change Notice ERCN-01 to ER-GG-2003-0018-001
Procedure QAI 11.38, Attachment A, "Construction Material Testing Document - Field Concrete Testing Data", Revision 1.

Category: Concrete Mix Design **Topic:** Slump Tolerances

Reference: ASTM C94, Section 6.1.2

Requirement: When the slump specifications are NOT written as a "maximum" or "not to exceed" amount and the specified slump is 2 inches and less, the slump tolerance is +/- 0.5 inches. If the slump specified is 2 to 4 inches, the slump tolerance is +/- 1 inch. If the

slump specified is more than 4 inches, the slump tolerance is +/- 1.5 inches.

Finding: This requirement was implemented. Procedure QAI 11.38, Step 5.4.1 "Concrete Classification Table" specified that for concrete with a specified strength of 3000 psi and a maximum course aggregate size of 1.5 inches, the minimum working limit was a 3" slump and the rejection limit was a 5" slump. The Field Concrete Testing Data indicated that eight of the nine slump tests were between 3.5" and 5". One slump test was 2.5", but still within the tolerance band of +/- 1" provided in ASTM C94.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.
Procedure QAI 11.38, "Field Sampling and Testing of Freshly Mixed Concrete", Revision 1
Procedure QAI 11.38, Attachment A, "Construction Material Testing Document - Field Concrete Testing Data", Revision 1.

Category: Concrete Mix Design **Topic:** Water/Cement Ratio

Reference: ACI 318, Sect 4.2.2, Table 4.2.2

Requirement: Concrete that will be subject to the exposures given in Table 4.2.2 of ACI 318 shall conform to the corresponding maximum water-cementitious materials ratios and minimum strength requirements of that table.

Finding: This requirement was implemented. ACI 318, Table 4.2.2 did not provide a maximum water/cement ratio for concrete with a minimum compressive strength of 3000 psi. Engineering Response ER-GG-2003-0018-001, Step 5.6.6 specified a water/cement ratio of approximately 0.50 based on other ingredients in the mix design and hot weather placement. The Mississippi Materials Corporation (MMC) mix sheet specified a water/cement ratio of 0.52.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.
Mississippi Materials Corporation (MMC) Mix Certification Sheet

Category: Forms Preparation **Topic:** Construction Joints

Reference: ACI 318, Sect 6.4.2

Requirement: Immediately before new concrete is placed, all construction joints shall be wetted and standing water removed.

Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.7.2 required the forms and subgrade to be thoroughly moistened with water prior to placement. Approximately 20 minutes prior to the first placement, the forms and subgrade were thoroughly wetted. Standing water was negligible.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.

Category: Forms Preparation **Topic:** Debris Removal
Reference: ACI 318, Sect 5.7.1 (b)
Requirement: Preparation before concrete placement shall include that all debris and ice shall be removed from spaces to be occupied by concrete.
Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.5.3 required the inside surfaces of the forms to be cleaned of all dirt, mortar, and foreign material. An inspection performed prior to placement indicated that all areas inside the forms were clear of foreign materials.
Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.

Category: Forms Preparation **Topic:** Formwork
Reference: ACI 318, Sect 6.1.2
Requirement: Forms shall be substantial and sufficiently tight to prevent leakage of mortar.
Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.5.1 specified that forms be mortar tight and of sufficient strength to prevent deflections in excess of 1/8" between the joints. The licensee used steel and wood forms. Neither mortar leakage or deflection was observed during the ISFSI pad pour.
Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.

Category: Forms Preparation **Topic:** Formwork Coatings
Reference: ACI 318, Sect 5.7.1 (c)
Requirement: Preparation before concrete placement shall include that forms shall be properly coated.
Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.5.3 specified that all forms be thoroughly coated with form oil prior to use. The form oil shall permit ready release of the forms. Prior to placement, a release agent had been rolled onto the wood segments of the forms. Coatings were not required on the steel segments.
Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.

Category: Forms Preparation **Topic:** Masonry Units
Reference: ACI 318, Sect 5.7.1 (d)
Requirement: Preparation before concrete placement shall include that masonry filler units that will be in contact with concrete shall be well drenched.
Finding: This requirement was implemented. The reinforcement steel was supported by masonry adobes on the bottom and sides. All adobes were thoroughly wetted prior to concrete placement.
Documents Reviewed: None.

Category: Forms Preparation **Topic:** Reinforcement Conditions
Reference: ACI 318, Sect 5.7.1(e); 7.4.1
Requirement: At the time concrete is placed, reinforcement shall be free from ice, mud, oil, or other nonmetallic coatings that decrease bond.
Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.9.5 required the steel reinforcement to be free of materials which are deleterious to the bond. An inspection performed prior to placement indicated the reinforcing steel and all areas inside the forms were clear of foreign materials.
Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.

Category: Forms Preparation **Topic:** Reinforcement Cover - Bottom
Reference: ACI 318, Sect 7.7.1(a)
Requirement: For concrete cast against and permanently exposed to earth, a minimum concrete cover of 3 inches shall be provided for reinforcement.
Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.13.2 required a 3" minimum concrete cover over the steel reinforcement on the bottom. The gap between the reinforcing steel and the forms was measured to be approximately 4 inches.
Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.

Category: Forms Preparation **Topic:** Reinforcement Cover - Top and Sides
Reference: ACI 318, Sect 7.7.1 (b)
Requirement: For concrete permanently exposed to earth or weather, a minimum concrete cover of 2 inches shall be provided for number 6 through 18 reinforcement.
Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.13.2 required a 2 inch minimum concrete cover over the steel reinforcement on the top surface and on the 4 sides. Number 10 reinforcement steel was used. The gap between the reinforcing steel and the forms was measured to be approximately 3 inches. The distance from the top of the reinforcing steel to the top of the forms was measured to be approximately 4 inches.
Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.

Category: Forms Preparation **Topic:** Water Removal
Reference: ACI 318, Sect 5.7.1 (f)
Requirement: Preparation before concrete placement shall include that water shall be removed from place of deposit before concrete is placed.
Finding: This requirement was implemented. An inspection performed prior to placement indicated that all areas inside the forms were clear of standing water.

Documents Reviewed: None.

Category: Mixing and Delivery **Topic:** Addition of Water at Job Site

Reference: ASTM C94, Section 11.7

Requirement: When a truck mixer or agitator is approved for mixing or delivery of concrete, no water from the truck water system or elsewhere shall be added after the initial introduction of mixing water for the batch except when on arrival at the job site the slump of the concrete is less than specified. When adding water, the drum or blades shall be turned an additional 30 revolutions or more if necessary, at mixing speed, until the uniformity of the concrete is within these limits.

Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.8.1 required mixing water to be added in accordance with ACI 318, section 3.4 and ASTM C94. Mixing water was carried on each truck but none was added at the job site during the ISFSI pad pour.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.

Category: Mixing and Delivery **Topic:** Discharge Time and Revolution Limits

Reference: ASTM C94, Section 11.7

Requirement: Discharge of the concrete shall be completed within 90 minutes or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of mixing water to the cement and aggregates or the introduction of the cement to the aggregates. These limitations are permitted to be waived by the purchaser if the concrete is of such slump after the 90 minute time or 300-revolution limit has been reached that it can be placed, without the addition of water, to the batch.

Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.7.1 specified that concrete shall be mixed in accordance with ACI 318. ACI 318, section 5.8.2 specified that ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94.

The Field Concrete Testing Data indicated that the average time from leaving the batch plant to discharge at the site was 78 minutes. Three trucks exceeded the 90 minute limit; one at 93, one at 97, and one at 110 minutes. These 3 trucks were sampled, slump was determined to be within specifications without adding water, and the concrete was placed.

The Field Concrete Testing Data indicated that the average drum counter reading at discharge was 178 revolutions. None of the trucks were discharged with more than 300 revolutions on the drum.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.
Procedure QAI 11.38, Attachment A, "Construction Material Testing Document - Field Concrete Testing Data", Revision 1.

Category: Mixing and Delivery **Topic:** Mixing Revolutions

Reference: ASTM C94, Section 11.5

Requirement: Concrete that is completely mixed in a truck mixer will be mixed at 70 to 100 revolutions at the mixing speed designated by the manufacturer to produce the uniformity of concrete indicated in Annex A1. The mixing revolutions will begin after all ingredients including water, are in the drum. Additional revolutions by the mixer beyond the number found to produce uniformity of concrete shall be at a designated agitating speed.

Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.7.1 specified that concrete shall be mixed in accordance with ACI 318. ACI 318, section 5.8.2 specified that ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94.

The Field Concrete Testing Data indicated that the highest drum counter reading observed was 216 and the lowest was 100. The average counter reading was 178 revolutions, which included the 70-100 revolutions for mixing during transit. The drums were spun at high speed for 2-3 minutes and then slowly in reverse just prior to discharging into the pumper truck hopper.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.
Procedure QAI 11.38, Attachment A, "Construction Material Testing Document - Field Concrete Testing Data", Revision 1.

Category: Placement **Topic:** Foreign Material

Reference: ACI 318, Sect 5.10.3

Requirement: Concrete that has partially hardened or been contaminated by foreign materials shall not be deposited in the structure.

Finding: This requirement was implemented. The concrete was discharged from the truck into the pumper truck hopper and then pumped into the ISFSI pad forms. No partially hardened concrete or foreign materials were found in any of the samples and none was observed entering the forms. All sample remainders were discarded.

Documents Reviewed: None.

Category: Placement **Topic:** Placement Rate

Reference: ACI 318, Sect 5.10.2

Requirement: Concreting shall be carried on at such a rate that concrete is at all times plastic and flows readily into spaces between reinforcement.

Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.7.5 specified that concrete shall be placed while fresh and before it has taken an initial set. The temperature of the concrete shall be less than 90 degrees F and greater than 35 degrees F.

All concrete was immediately pumped into the ISFSI pad forms as it came off the concrete trucks. It was fresh and had not taken an initial set. The Field Concrete Testing

concrete placed. If the temperature approached 90 degrees F, the sampling frequency would be increased.

Three cubic yards of concrete from the first truck were used to clear the protective coating from inside the pump and hose. This concrete was pumped into a front end loader and was discarded. A sample was then taken at the end of the pump hose. Entrained air, slump and temperature were all within specification and the concrete was placed in the forms. Four strength test cylinders were made and labeled.

Thereafter, a sample for entrained air, slump and temperature was taken on every 5th truck, making the sampling frequency every 40 cubic yards rather than 50. Two cubic yards were discharged prior to sampling to ensure the sample was representative of the truck contents. The sample was taken at the discharge of the pump hose just prior to placement in the forms. If the air entrainment and slump were within specifications, 4 test cylinders were made and placement continued. If the air entrainment or slump were out of specification, the truck was rejected. The 17th truck was rejected on an air entrainment value of 2.5%. The 42nd and 43rd trucks were rejected on high slump.

Procedure QAI 11.38, Step 2.10 required that Measuring and Test Equipment (M&TE) used for sampling and testing be within current calibration. The slump cone set and air entrainment meter were manufactured by Forney. The slump cone set was controlled under M&TE #Z-016 and had a calibration due date of September 2, 2005. The air entrainment meter was controlled under M&TE #Z-079 and had a calibration due date of June 6, 2006.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.
Change Notice ERCN-04 to ER-GG-2003-0018-001
Procedure QAI 11.38, "Field Sampling and Testing of Freshly Mixed Concrete", Revision 1

Category: Sampling **Topic:** Field Technician Requirements
Reference: ASTM C31, Section 5.3
Requirement: The field technicians making and curing specimens for acceptance testing shall be certified ACI Field Testing Technicians, Grade I or equivalent.
Finding: This requirement was implemented. Procedure QAI 11.38, Step 2.8 required the personnel performing the sampling and testing to be certified to Level II or Level III in the civil concrete discipline. Procedure EN-QV-111 established the certification requirements for personnel that were qualified to American National Standards Institute (ANSI) N45.2.6. Attachments to Procedure EN-QV-111 contained the certification documentation for each qualified person. The attachments included the individual's level of certification, education, training, experience, and visual acuity information.

The certification attachments were reviewed for the two Level III examiners performing the testing for air entrainment and slump. Their records were complete and indicated they were both certified for Grout/Mortar, Soils and Concrete.

Documents Reviewed: Procedure QAI 11.38, "Field Sampling and Testing of Freshly Mixed Concrete", Revision 1
Procedure EN-QV-111, "Training and Certification of Inspection/Verification and Examination Personnel", Revision 0.

Category: Sampling **Topic:** Required Number of Strength Samples

Reference: ACI 318, Sect 5.6.1.1

Requirement: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day nor less than once for each 150 cubic yd of concrete, nor less than once for each 5000 square ft of surface area for slabs or walls.

Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 8.1.1 required one sample for every 50 cubic yards of concrete placed. The first truck was sampled for entrained air, slump and temperature. The parameters were all within specification and the concrete was placed in the forms. Thereafter, a sample for entrained air, slump and temperature was taken on every 5th truck, making the sampling frequency every 40 cubic yards rather than 50. Two cubic yards were discharged prior to sampling to ensure the sample was representative of the truck contents.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.

Category: Sampling **Topic:** Specimen Curing

Reference: ASTM C31, Section 9.1

Requirement: If the specimens cannot be molded at the place where they will receive initial curing, immediately after finishing move the specimens to an initial curing place for storage. Lift and support the cylinders from the bottom of the molds. Immediately after molding and finishing, the specimens shall be stored for a period up to 48 hours in a temperature range from 60 and 80 degrees F. Record the temperature using a maximum-minimum thermometer.

Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 8.1.7.1 required each strength test set to consist of 4 test cylinders. Nine sets of strength test cylinders were made during this ISFSI pad section pour. Each set contained 4 cylinders. The cylinders were supported from the bottom and immediately taken to the curing lab. After curing for 16-24 hours, the cylinders were stripped and placed in a water bath at 73.4 +/- 3.0 degrees F. The bath contained lime to control pH.

The lab was air conditioned and maintained between 60 and 80 degrees F. The temperature was monitored using a min/max thermometer manufactured by Forney and controlled under M&TE #Z-068. The calibration due date was December 7, 2005.

Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.

Category: Testing **Topic:** Strength Test Results
Reference: ACI 318, Sect 5.6.2.3
Requirement: Strength level of an individual class of concrete shall be considered satisfactory if every arithmetic average of any three consecutive strength tests equals or exceeds 3000 psi AND no individual strength test (average of 2 cylinders) falls below 2500 psi.
Finding: The 28-day compressive strength testing was scheduled to be performed on August 19, 2005. The results will be included in the next Grand Gulf Nuclear Station ISFSI report. Inspection Follow-up Item (IFI) 72-050/05-01 has been generated to track this requirement.
Documents Reviewed: None.

Category: Time To Cure **Topic:** Other Than High-Early-Strength Concrete
Reference: ACI 318, Sect 5.11.1
Requirement: Concrete (other than high-early-strength) shall be maintained above 50 degrees F and in a moist condition for at least the first 7 days after placement.
Finding: This requirement was implemented. Engineering Response ER-GG-2003-0018-001, Step 5.5.4 required the forms to stay on for a minimum of 7 days. Step 5.13.6 required moist curing for a minimum of 7 days in accordance with ACI 301, section 5.3. ACI 301, Section 5.3 provided the following methods for moist curing: 1) continuous fogging or sprinkling; 2) mats or fabric kept continuously wet; 3) application of steam; 4) application of sheet material; or 5) use of curing compounds.

Per telephone conversation on August 10, 2005, the licensee chose to perform moist curing using burlap sheets and soaker hoses. The ambient temperature did not fall below 50 degrees F during the curing. The use of water was discontinued and the forms were removed on July 28, 2005 at approximately noon. This was exactly 7 days after completion of placement and finishing.
Documents Reviewed: Engineering Response ER-GG-2003-0018-001, "Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad", Revision 0.