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

September 4, 2007

Mr. John S. Keenan
Senior Vice President – Generation and Chief Nuclear Officer
Pacific Gas and Electric Company
P.O. Box 770000
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San Francisco, California 94177-0001

SUBJECT: NRC INSPECTION REPORT 050-133/07-002; 072-027/07-001

Dear Mr. Keenan:

Between June 18, 2007 and August 16, 2007, the U.S. Nuclear Regulatory Commission conducted an inspection at your Humboldt Bay Power Plant Unit 3 facility. The inspection involved site visits by an inspector on two separate occasions. The purpose of these inspections were to review the preparation and construction of the Independent Spent Fuel Storage Installation (ISFSI) vault at Humboldt Bay. On August 16, 2007, an exit briefing was conducted with Mr. Loren Sharp, Director and Plant Manager, and other members of your staff. The enclosed report presents the scope and results of that inspection.

This inspection included a review of ISFSI vault foundation excavation, concrete mix design, inspection of the concrete batch plant, inspection of concrete forms and reinforcing steel, and observation of concrete mixing, delivery, sampling, and placement. The inspection determined that, with the exception of minor deviations noted in the inspection report, you were constructing your ISFSI vault in conformance with the requirements of the standards established by the American Concrete Institute (ACI) and the American Society for Testing and Materials (ASTM), as required by your site specific license. No violations were identified during the inspections.

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 made 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, if any, 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 Ray L. Kelllar at (817) 860-8164.

Sincerely,

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

Docket No.: 050-133
072-027
License No.: DPR-7
SNM-2514

Enclosure:
NRC Inspection Report 050-133/07-002; 072-027/07-001
Attachments:
(1) Supplemental Inspection Information
(2) Humboldt Bay ISFSI Vault - Inspector Notes

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U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket No.:	050-133; 072-027
License No.:	DPR-7; SNM-2514
Report No.:	050-133/07-002; 072-027/07-001
Licensee:	Pacific Gas and Electric Company (PG&E)
Facility:	Humboldt Bay Power Plant (HBPP), Unit 3
Location:	1000 King Salmon Avenue Eureka, California 95503
Dates:	June 18, 2007 - August 16, 2007
Inspector:	Ray L. Kellar, P.E., Health Physicist Fuel Cycle and Decommissioning Branch, Region IV
Approved By:	D. Blair Spitzberg, Ph.D., Chief Fuel Cycle and Decommissioning Branch, Region IV
Attachments:	1. Supplemental Inspection Information 2. Inspector Notes

Enclosure

EXECUTIVE SUMMARY

Humboldt Bay Power Plant, Unit 3
NRC Inspection Report 050-00133/07-003

The Humboldt Bay Independent Spent Fuel Storage Installation (ISFSI) was granted a site-specific license by the U.S. Nuclear Regulatory Commission (NRC) on November 17, 2005. The ISFSI has been designed to hold up to 400 spent fuel assemblies in five storage casks inside a concrete vault. A sixth cask will store greater than class C (GTCC) waste. The underground ISFSI storage vault will be approximately 20 feet wide, 77 feet long and 14 feet thick. The Holtec HI-STAR HB dry storage system, a modified storage/transportation system for the Humboldt Bay fuel, will be used to store the spent fuel.

The ISFSI pad was designated as a structure, system or component Important-To-Safety (ITS) as defined in 10 CFR 72.3. The ISFSI vault concrete structure was designed and required to be constructed in accordance with American Concrete Institute (ACI) 349, "Code Requirements for Nuclear Safety Related Concrete Structures." The inspection included a review of the concrete mix design, concrete material requirements, reinforcing bar specifications, and concrete batch plant along with direct observations of the concrete mixing, placement, sampling, consolidation, curing and testing operations. The concrete was determined to fulfill the safety requirements of ACI 349.

A minor deviation was identified during the inspection that was not considered to be safety significant involving the number of mixing revolutions used to produce the ITS concrete. The licensee entered the deviation into the corrective action system for evaluation. The determination that the deviation was not safety significant was based on the expectation that the concrete will meet or exceed the required minimum 28 day compressive strength of 4,000 psi. NRC Unresolved Item (URI) 72-027/0701-01 was opened to track and confirm that the minimum concrete compressive strength requirements are achieved.

Additionally, several minor deviations from the ISFSI design documents, ACI code and ASTM standard requirements were identified by the licensee and the inspector. These deviations were entered into the licensee corrective action system to ensure that the changes were appropriately tracked. NRC URI 72-027/0701-02 was opened to track and confirm that the deviations do not impact the ability of the ISFSI vault to perform its intended function and that the licensee can approve the changes through the 10 CFR 72.48 process. NRC RIV Policy Guide 4090.10 defines an URI as a matter about which more information is required to ascertain whether it is an acceptable item, a violation, or a deviation. The NRC will review the final concrete compressive strength test results and the 10 CFR 72.48 review(s) to access the potential impact upon the ISFSI.

A summary of the results of the inspection is provided below. Details are provided in the Inspector Notes contained in Attachment 2 to this report.

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

- The ready mix concrete batch plant and the concrete trucks used for mixing the concrete were inspected and found to meet the requirements of ASTM C 94 and the National Ready Mix Concrete Association (Attachment 2, Pages 1-2).

- The mixing revolutions recorded on the concrete batch tickets for the third concrete placement did not meet the ASTM C 94 requirement for mixing between 70 to 100 revolutions. The minor discrepancy was documented in the licensee corrective action system (Attachment 2, Pages 3-4).

- The 28 day concrete compressive strength test results for the first and second concrete placement activities exceeded the minimum strength requirements specified in the FSAR of 4,000 psi. The results of the 7 day concrete compressive strength test results from the third concrete placement activity exceeded 4,000 psi (Attachment 2, Page 11).

- The dry density of the ISFSI vault concrete exceeded the FSAR required minimum density of 146 pcf based on tests conducted in accordance with ASTM C 642. However, the results of similar tests conducted on samples believed to be representative of the concrete placed in the ISFSI vault lids indicated the concrete density was below the specified minimum density of 146 pcf. This potential discrepancy had been entered into the licensee corrective action system (Attachment 3, Page 12-13).

- The tensile tests and chemical analysis of the reinforcing bars for the initial concrete placement activities had been sampled and the test results conformed to the requirements of ACI 349 (Attachment 2, Page 14).

- The concrete sampling activities were performed in accordance with the requirements of ASTM C 172. The field technician responsible for sampling and making the concrete test cylinders was certified as an ACI Grade I Field Testing Technician (Attachment 2, Page 15-16).

- During the excavation process for the ISFSI vault, PG&E geotechnical representatives examined the soil conditions and determined that the site conditions agreed with the geology and geotechnical conditions specified in the ISFSI FSAR. Additionally, the geotechnical calculations were reviewed following the addition of a crushed stone backfill layer beneath the vault to ensure that the modification did not adversely impact the calculation results or conclusions (Attachment 2, Page 17-18).

- Several deviations from the ISFSI design documents, the ACI Code and ASTM standards had been identified during the construction of the ISFSI vault. The discrepancies had been entered into the licensee corrective action system (Attachment 2, Page 18-19).

SUPPLEMENTAL INSPECTION INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel:

L. Pulley, ISFSI Project Manager
L. Sharp, Director and Plant Manager, Nuclear
D. Sokolsky, Licensing Supervisor

Contract Personnel:

M. DeWitt, Quality Verification Engineer
L. Dugay, Humboldt Bay ISFSI Assistant Project Manager
T. Hardwick, Humboldt Bay ISFSI Project Engineer
D. O'Conner, Quality Verification Engineer

INSPECTION PROCEDURES USED

60853	On Site Fabrication of Components and Construction of an ISFSI

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

URI 72-027/0701-01	Review the concrete compressive strength test results to confirm that the concrete compressive strength of the final ISFSI concrete placement meets the specified compressive strength of 4,000 psi at 28 days.
URI 72-027/0701-02	Review the 10 CFR 72.48 safety reviews of the deviations from the design documents, ACI code and ASTM standard requirements to ensure that the deviations do not impact the ISFSI vault and that a license amendment is not required.

Closed

None

Discussed

None

LIST OF ACRONYMS

ACI	American Concrete Institute
AR	Action Request
ASTM	American Society of Testing and Materials
CFR	Code of Federal Regulations
FSAR	Final Safety Analysis Report
GTCC	Greater Than Class C
ISFSI	Independent Spent Fuel Storage Installation
NRC	Nuclear Regulatory Commission
NRMCA	National Ready Mix Concrete Association
PG&E	Pacific Gas & Electric
SAPN	Systems Application and Processes Notification (Problem report)
URI	Unresolved Item

ATTACHMENT 2

Humboldt Bay ISFSI Vault

(Inspector Notes – Table of Contents)

Humboldt Bay ISFSI Vault
(Inspector Notes)

Category: Concrete Curing **Topic:** Other Than High-Early-Strength Concrete

Reference: ACI 349, Sect 5.11.1

Requirement: Concrete (other than high-early-strength) shall be maintained above 50 F and in a moist condition for at least the first 7 days after placement, except when cured in accordance with 5.11.3 (Accelerated Curing).

Finding: This requirement was achieved. The licensee reported curing the concrete for seven days in a moist condition following each of the three concrete placement activities. This requirement was specified in Section 5.8 of Procedure TP 2006-14 where it was required that the concrete be cured for seven days with fresh water, wet burlap or a curing compound.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 0

Category: Concrete Mix & Delivery **Topic:** Conveying

Reference: ACI 349, Sect 5.9.1

Requirement: Concrete shall be conveyed from mixer to place of final deposit by methods that will prevent separation or loss of materials.

Finding: This requirement was achieved. The licensee utilized a concrete pump truck to convey the concrete from the concrete truck to the place of final placement. During the placement of the concrete for the bottom and upper portions of the ISFSI vault, observations indicated that the pump truck discharge hose was placed as close as possible to where the concrete was to be deposited and that the concrete "freefall" distance from the end of the hose was minimized.

Documents Reviewed: None

Category: Concrete Mixing & Delivery **Topic:** Ready Mixed Concrete

Reference: ACI 349, Sect 5.8.2

Requirement: Ready-mixed concrete shall be mixed and delivered in accordance with the requirements of "Specification for Ready-Mixed Concrete" ASTM C 94 or "Specification for Concrete Made by Volumetric Batching and Continuous Mixing" ASTM C 685.

Finding: The intent of this requirement was achieved. The ready mix concrete batch plant was inspected and found to meet the requirements of ASTM C 94 as well as the requirements of the National Ready Mix Concrete Association (NRMCA). A registered engineer had performed the NRMCA inspection and determined that the ready mix batch plant met the NRMCA requirements on June 14, 2007. The concrete trucks used for mixing were supplied from a nearby batch plant and had also been inspected and accepted as meeting NRMCA requirements by a registered engineer on November 7, 2006.

Prior to the initial concrete placement, licensee Quality Verification personnel verified that the mixing trucks (including mixing blades) that were specified to be used during the concrete placement activities still met the NRMCA requirements. On June 19, 2007 a Quality Verification inspector verified that the accuracy of the mixer truck sight gages that were used to measure additional mixing water, were within ASTM C 94 tolerances for truck numbers 70, 71, 72 and 56.

The aggregate, cement and water measurement devices for the batch plant were checked and determined to be within the tolerances of ASTM C 94 prior to batching the concrete. The tolerances for the weights of the various components were specified to be +/- 2% for aggregates, +/- 1% for cement, and +/- 1% for the mixing water. The chemical mix vendor furnished a letter stating that the dispensing equipment met the ASTM C 94 requirements.

During the initial concrete placement activities the concrete batch tickets were reviewed and the inspector noted that the truck number did not appear as required by ASTM C 94. This minor discrepancy was entered into the licensee corrective action system. The discrepancy is not safety significant and constitutes a violation of minor significance that is not subject to enforcement in accordance with Section IV of the Enforcement Policy. During the final concrete placement activities, the inspector noted that the batch tickets included all the required information.

The concrete mixing revolutions were not correctly indicated on the tickets for the third concrete placement. This discrepancy is discussed in additional detail in the datasheet titled "Concrete Mixing & Delivery - Concrete Mixing Revolutions."

Documents Reviewed: Attachment 8.25 of Procedure TP 2006-14, "Batched Scale Calibration Report," Dated June 12, 2007; Attachment 8.24 of Procedure TP 2006-14, "Calibration of Water Meter - ASTM C94," Dated June 12, 2007; HBIP Mixer Truck water dispenser sight gage accuracy check, Dated June 19, 2007; Letter from Grace to Frank Barradas, Dated June 12, 2007

Category: Concrete Mixing & Delivery **Topic:** Addition of Job Site Water

Reference: ASTM C 94, 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 achieved. Section 5.7.4 of Procedure TP 2006-14 required that a minimum of 30 revolutions at mixing speed be performed prior to concrete discharge after water was added. During the initial concrete placement activity, the Qualify Verification Inspector verified the number of mixing revolutions after the addition of water met the procedural requirements. No additional water was reported added to any of the mixing trucks during the second concrete placement. During the final concrete placement activities, the inspector observed on several occasions that the mixing drum

was turned for 30 additional revolutions after the addition of water.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 1

Category: Concrete Mixing & Delivery **Topic:** Concrete Discharge Limits

Reference: ASTM C 94, Section 11.7

Requirement: Discharge of the concrete shall be completed within 1 1/2 hour 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 1 1/2 hour 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 achieved. The travel distance between the concrete batch plant and the concrete placement location was very short and thus delays in placement of the concrete were minimized. The Quality Verification Inspector was responsible to ensure that the trucks did not exceed the time limit or the number of drum revolutions. Attachment 8.2 of Procedure TP 2006-14 required the documentation from the ISFSI Construction Manager and the Quality Verification Inspector that the time limit and revolution limit had not exceeded. During the initial and final concrete placement activities, no trucks were observed exceeding the specified time or revolution limits.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 1

Category: Concrete Mixing & Delivery **Topic:** Concrete Mixing Revolutions

Reference: ASTM C 94, 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 not met by the licensee. The inspector observed the mixing operations during the first and third concrete placement operations. During the initial concrete placement activities the inspector observed the number of mixing revolutions recorded on selected concrete batch tickets to be between 70-100. During the third concrete placement operation the inspector observed that the number of mixing revolutions recorded on the tickets were not within the range of 70-100. In addition to the indeterminate number of mixing revolutions recorded on the concrete batch tickets, interviews with the concrete truck drivers indicated that a least one load may have been mixed for less that the specified minimum number of mixing revolutions required by ASTM C 94. Upon questioning by the inspector, the licensee reviewed the procedure used for the concrete placement and could not locate the ASTM C 94 requirement for the number of mixing revolutions. The inspector informed the licensee that the requirement was located in Section 3.19.12.1.c of Specification HBPP-2006-14 where it was

specified that truck mixed concrete shall be mixed between "70 to 100 revolutions at the manufacturer's mixing speed after all ingredients are added to the drum." The licensee entered the deviation from the ASTM C 94 requirement into the licensee corrective action system as SAPN 1244215.

The NRC reviewed the concrete compressive strength results from the first two concrete placement operations and observed that all the test results exceeded the minimum concrete compressive strength requirements. The NRC will make a final decision on the acceptability of the concrete placed during the final lift that may not have met the ASTM C 94 mixing revolution requirement based on the concrete achieving the final compressive strength requirement of 4,000 psi. The 28 day concrete compressive strength results will be tracked by URI 72-027/0701-01.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 0; Concrete Batch Tickets 71555, 71544, 71537, 71546

Category: Concrete Mixing & Delivery **Topic:** Measurement of Aggregate Materials

Reference: ASTM C 94, Section 8.2

Requirement: Aggregates shall be measured by mass including the mass of dry materials plus the total mass of moisture (both absorbed and surface) contained in the aggregate. The quantity of aggregate used in any batch of concrete as indicated by the scale shall be within +/- 2% of the required mass when the mass is measured in individual weigh batchers. In a cumulative aggregate weigh batcher, the cumulative weight after each successive weighing shall be within +/- 1% of the required cumulative amount up to that point when the scale is used in excess of 30% of its capacity. For cumulative weights less than 30% of the scale capacity, the tolerance shall be +/- 0.3% of scale capacity of +/- 3% of the required cumulative weight, whichever is less.

Finding: This requirement was achieved for the aggregate scale on the batch plant. The batched scale calibration report documented that the aggregate scale had been tested with combined weights of 8,000; 16,000; 24,000; and 32,000 pounds. The tolerance noted for all the weights were less than 1%. The weights used during the calibration were documented to be traceable to National Institute of Standards and Technology.

Documents Reviewed: TP 2006-14, Attachment 8.25, "Batched Scale Calibration Report," Dated June 12, 2007

Category: Concrete Mixing & Delivery **Topic:** Measurement of Mixing Water

Reference: ASTM C 94, Section 8.3

Requirement: The added mixing water shall be measured by weight or volume to an accuracy of 1% of the required total mixing water.

Finding: This requirement was achieved for the water meter used at the batch plant. The calibration for the water meter was accomplished by weighing a metered volume of water on the cement scale. The difference between the calculated volume of water, based on the unit weight of water, was compared to the metered volume of water to determine the percent of error. This process was repeated twice to demonstrate repeatability and both times demonstrated that the meter was accurate to within 1 percent. The weights used during the calibration were documented to be traceable to

National Institute of Standards and Technology.

Documents Reviewed: TP 2006-14, Attachment 8.24, "Calibration of Water Meter," Dated June 12, 2007

Category: Concrete Mixing & Delivery **Topic:** Slump Tolerances

Reference: ASTM C 94, Section 6.1.2

Requirement: Unless other slump tolerances are included in the project specifications, the following tolerances shall apply: 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 is specified as more than 2 inches through 4 inches the slump tolerance is +/- 1 inch. If the slump is specified as more than 4 inches the slump tolerance is +/- 1.5 inches.

Finding: This intent of this requirement was achieved. The licensee initially specified a slump of 4 inches +/- 1 inch in Mix Report Number C-5532. During the initial concrete placement activities the slump for the first load of concrete was recorded at 2.5 inches and the slump for load number 16 was recorded at 7 inches. Both of these concrete loads were outside of the specified slump criteria and thus did not meet the requirements of ASTM C 94. The licensee evaluated the water/cement ratio for the two loads and confirmed that the value was below 0.45. Additionally, the concrete was determined to be placeable in both cases. The concrete was placed by licensee and the discrepancy was entered into the corrective action system as Task Detail 0004 of SAPN 1243756.

The results of the 28 day concrete cylinder breaks from the initial concrete placement activity show that the compressive strength developed were well in excess of the required compressive strength of 4,000 psi at 28 days. The results of the 28 day tests show that the concrete compressive strengths were 6,790; 6,820; 7,300; 7,270; 6,250; 6,970; 6,350; 6,230; 7,550; and 7,660 psi. The discrepancy is not considered to be safety significant based on the placeabliity of the concrete and the acceptable concrete compressive strength test results. Although this condition requires correction, it constitutes a violation of minor significance that is not subject to enforcement in accordance with Section IV of the Enforcement Policy.

To provide concrete that could be more easily placed by pumping, the licensee revised the concrete mix design to specify a maximum slump of 7 inches in Mix Design HB-7000. The additional slump was provided by adding a superplastizer to the concrete mix, which improves the concrete workability without negatively affecting the water/cement ratio. The inspector observed that the concrete slump requirements were achieved during the final concrete placement activities.

Documents Reviewed: Concrete Design Mix Report Number C-5532, Dated June 6, 2007; Engineered Concrete Placement, Inc. Concrete Mix Design ECP HB-7000, Dated June 22, 2007; SAPN 1243756, Task Detail 0004, Dated July 5, 2007

Category: Concrete Placement **Topic:** Concrete Deposition

Reference: ACI 349, Sect 5.10.1

Requirement: Concrete shall be deposited as nearly as practical in its final position to avoid

segregation due to rehandling or flowing.

Finding: This requirement was achieved. The inspector observed the workers using a concrete pump truck to place the concrete during the initial and final concrete placement activities. The discharge point from the pump truck was placed as close as possible (both horizontally and vertically) to the desired concrete placement location.

Documents Reviewed: None

Category: Concrete Placement **Topic:** Concrete Placement Rate

Reference: ACI 349, 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 achieved. The licensee utilized a portable concrete batch plant that was near the location of the ISFSI, to minimize the amount of time required to convey the concrete to the ISFSI vault area. During the course of the initial and final concrete placement activities, the inspector observed that the licensee continually kept the concrete trucks rotating to the concrete pump truck and that the concrete remained in a plastic state until consolidation was completed.

Documents Reviewed: None

Category: Concrete Placement **Topic:** Foreign Material in Concrete

Reference: ACI 349, 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 achieved. The licensee had segregated the components for the concrete at the batch plant. The interior of the concrete trucks were inspected prior to beginning the concrete batching activities on the day of the concrete placement activities. During the course of the initial and final concrete placement activities, the inspector witnessed portions of the concrete placement activities and did not observe any foreign materials in the concrete nor concrete being placed that was partially hardened.

Documents Reviewed: None

Category: Concrete Placement **Topic:** Retempered Concrete

Reference: ACI 349, Sect 5.10.4

Requirement: Retempered concrete or concrete that has been remixed after initial set shall not be used unless approved by the engineer.

Finding: This requirement was achieved. The inspector observed portions of the initial and final concrete placement activities and due to the short haul distance between the batch plant and the concrete placement location, no concrete was identified that experienced an initial set before placement activities.

Documents Reviewed: None

Category: Concrete Placement Prep. **Topic:** Construction Joints

Reference: ACI 349, 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 achieved. Section 5.7.9 of Procedure TP 2006-14 required that the surfaces of the cold joints and construction joints be cleaned and properly prepared to insure adequate bond with the new concrete. Specifically mentioned in this section was to ensure that the joint was free from laitance through the use of sand blasting or high pressure water jetting. During the final concrete placement the inspector witnessed the construction crews wetting the construction joints prior to placement of the concrete. No standing water was observed on the construction joint.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 0

Category: Concrete Placement Prep. **Topic:** Formwork

Reference: ACI 349, Sect 6.1.2

Requirement: Forms shall be substantial and sufficiently tight to prevent leakage of mortar.

Finding: This requirement was achieved. Procedure TP 2006-14, Section 5.6.2 specified requirements for the ISFSI vault formwork. Instructions included were to ensure the forms are mortar-tight, true to dimensions and be coated with a form release agent, if required. Prior to the initial and final concrete placement activities the formwork was inspected and found to be adequate.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 0

Category: Concrete Placement Prep. **Topic:** Laitance Removal

Reference: ACI 349, Sect 5.7.1 (g)

Requirement: Preparation before concrete placement shall include that all laitance and other unsound material shall be removed before additional concrete is placed against hardened concrete.

Finding: This requirement was achieved. Section 5.7.9 of Procedure TP 2006-14 required that the surfaces of the cold joints and construction joints be cleaned and properly prepared to insure adequate bond with the new concrete. Specifically mentioned in this section was to ensure that the joint was free from laitance through the use of sand blasting or high pressure water jetting. Prior to the final concrete placement activity, the inspector observed that the top surface of the concrete had been pressure washed to remove the laitance.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 0

Category: Concrete Placement Prep. **Topic:** Masonry Units

Reference: ACI 349, 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 achieved. Section 5.6.1 of Procedure TP 2006-14 required that subgrade be cleaned and then wetted to prevent absorption of water from the concrete. During the initial and final concrete placement activities, the inspector witnessed the workers wetting the subgrade and masonry units in advance of the concrete placement activities.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 0

Category: Concrete Placement Prep. **Topic:** Reinforcement

Reference: ACI 349, Sect 5.7.1 (e)

Requirement: Preparation before concrete placement shall include that reinforcement shall be thoroughly clean of ice or other deleterious coatings.

Finding: This requirement was achieved. Procedure TP 2006-14, Step 5.6.3 required that the reinforcement be free from loose hardened concrete, dirt, loose scale and other deleterious materials. The inspector observed the condition of the rebar prior to the concrete placement during the initial and final concrete placement activities and noted that no contaminants were present.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 0

Category: Concrete Placement Prep. **Topic:** Reinforcement Conditions

Reference: ACI 349, Sect 7.4.1

Requirement: At time concrete is placed, reinforcement shall be free from mud, oil, or other nonmetallic coatings that decrease bond.

Finding: This requirement was achieved. Procedure TP 2006-13, Section 5.2.1.e required that all reinforcing bars be free from grease, form oil, dirt, loose rust or mill scale, or other contaminants that may reduce the bond between the steel and the concrete at the time the concrete was placed. Prior to the first and final concrete placement activities, the condition of the reinforcing bars were observed and found to be free from contaminants and rust.

Documents Reviewed: Procedure TP 2006-13, "Humboldt Bay ISFSI Project Quality Related Reinforcing Steel Activities," Revision 0

Category: Concrete Placement Prep. **Topic:** Removal of Debris

Reference: ACI 349, 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 achieved. Procedure TP 2006-14 included Attachment 8.2, "Concrete Placement Verification and Inspection Report, " which required the user to verify that the area was clean before the concrete could be placed. The inspector observed the condition of the area where the concrete was to be placed before that initial

and final concrete placement activities and no debris were identified.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 0

Category: Concrete Placement Prep. **Topic:** Water Removal

Reference: ACI 349, 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 achieved. Procedure TP 2006-14, Section 5.6 provided instructions in a pre-placement checklist that were required to be completed before the concrete was placed. The instructions specified that the subgrade and mud mats were to be cleaned and wetted to prevent absorption of the water from the concrete. The next step instructed the worker to remove any standing water that remained after the subgrade wetting operations. During the initial and final concrete placement activities the inspector noted that the workers kept the area in front of the placement activities moist. No standing water was observed inside the concrete formwork area during the placement activities.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 0

Category: Concrete Quality **Topic:** Air-Entraining Admixture

Reference: ACI 349, Sect 3.6.4

Requirement: Air-entraining admixtures shall conform to ASTM C 260, "Specification for Air-entraining Admixtures for Concrete."

Finding: This requirement was achieved. The manufacturer for the air-entraining admixture (DAVAVAIR 1000) certified that the product complied with the requirements of ASTM C 260.

Documents Reviewed: Grace certification for Daravair 1000, Dated June 21, 2007

Category: Concrete Quality **Topic:** Cement Specification

Reference: ACI 349, Sect 3.2.1, 3.2.3

Requirement: Cement shall conform to ASTM C 150, "Specification for Portland Cement." Every shipment of cement shall be accompanied by a certified mill test report stating the results of tests representing the cement in the shipment and the ASTM specification limits for each item of required chemical, physical, and optional characteristics. No cement shall be used in any structural concrete prior to receipt of the 7 day mill test strengths.

Finding: This requirement was achieved. The cement used for the ISFSI vault concrete was supplied and produced by Lehigh Pacific Redding Plant. Samples of the cement were obtained during the concrete placement activities for testing by the Heidelberg Technology Lab, which was on the licensee's approved vendor list. For the initial concrete placement activities, four samples of the cement were obtained and shipped to the lab from two different cement lots. The tests of the initial cement used in the ISFSI

vault indicated that all the cement met the requirements of ASTM C 150, Type II cement. The licensee had established corrective action tracking items (SAPN 1242759 - Task 11 and SAPN 1243862 - Task 4) to ensure that the cement from the second and third concrete placement activities also met the requirement of ASTM C 150.

Documents Reviewed: Heidelberg Technology Center Portland Cement Test Reports Dated August 7, 2007, for Type II cement produced by Lehigh Pacific Redding Plant

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Category: Concrete Quality **Topic:** Clean Water Requirements

Reference: ACI 349, Sect 3.4.1

Requirement: Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete or reinforcement.

Finding: This requirement was achieved. The licensee used the fire water system as the source of the mixing water for the concrete. The fire water system was supplied from the municipal water system. A sample of the water was obtained and analyzed. The amounts of metals, chlorides and sulfates present in the water were all well below the maximum contaminant levels per the California Safe Drinking Water Act of 2004.

Documents Reviewed: Pacific Gas and Electric Company Technical and Land Services Chemical Analysis of Mix Water, Dated February 27, 2007

Category: Concrete Quality **Topic:** Concrete Admixtures

Reference: ACI 349, Sect 3.6.5

Requirement: Water-reducing admixtures, retarding admixtures, accelerating admixtures shall conform to ASTM C 494, "Specification for Chemical Admixtures for Concrete," or ASTM C 1017 "Specification for Chemical Admixtures for Use in Producing Flowing Concrete."

Finding: This requirement was met. The manufacturer for the water-reducing admixture (ADVA 100) provided certification that the product complied with the requirements of ASTM C 1017 using both Type "1" and Type "2" standards.

Documents Reviewed: Grace certification for ADVA 100, Dated June 20, 2007

Category: Concrete Quality **Topic:** Concrete Aggregates

Reference: ACI 349, Sect 3.3.1

Requirement: Concrete aggregates shall confirm to "Specification for Concrete Aggregates" ASTM C 33 or utilized by exception when shown by special test or actual service to produce concrete of adequate strength and durability and approved by the building official.

Finding: This requirement was achieved for the ISFSI concrete aggregates. The licensee tested for organic impurities in the fine aggregates. The Los Angeles abrasion test was conducted for the coarse aggregates. The soundness, amount passing the number 200 sieve, the specific gravity, the absorption, results of clay lumps and friable particles, lightweight particles, potential reactivity, sieve analysis and the petrographic analysis were conducted for both the fine and coarse aggregates. All the test results were satisfactory, except the sieve analysis for the fine and coarse aggregates.

The sieve analysis for the fine and coarse aggregates were slightly outside the allowable tolerances listed for several of the individual sieve sizes that were specified in ASTM C 33. The sieve analysis for the fine aggregate was outside the specified tolerance on the number 8, 16 and 30 sieve sizes. The coarse aggregate was outside the specified tolerance on the 3/8 inch sieve size. ASTM C 33 allows the use of the aggregates where it can be demonstrated that concrete made with the aggregates under consideration will exhibit compressive strength properties at least equal to those of concrete made with the same ingredients. The fine and coarse aggregates had been used in a engineered concrete at a nearby location where the deviations of the aggregate sieve size test results were similar. The results of the testing performed at the nearby location indicated that the use of the aggregates would perform satisfactory in producing adequate concrete strength.

Documents Reviewed: Report 420HB-07.01, "Humboldt Bay Power Plant Tests for ISFSI Safety-Related Concrete Materials - Fine and Coarse Aggregates and Mix Water," Dated May 29, 2007; Email from Mark DeWitt dated July 21, 2007 including test results and graduations using Nor-Cal aggregates.

Category: Concrete Quality **Topic:** Concrete Strength Requirements

Reference: ACI 349, Sect 5.6.2.3

Requirement: Strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met: (a) Every arithmetic average of any three consecutive strength tests equals or exceeds f'c (required 28 day concrete compressive strength) and (b) no individual strength test (average of 2 cylinders) falls below f'c by more than 500 psi.

Finding: This requirement was achieved. The minimum concrete compressive strength specified in the Humboldt Bay ISFSI FSAR was 4,000 psi. The licensee elected to use two separate mix designs during the concrete placement activities for the ISFSI vault. The initial concrete placement activities used mix design HB6500. The results of the 28 day cylinder break test results for the test cylinders were reported as: 6,790; 6,820; 7,300; 7,270; 6,250; 6,970; 6,350; 6,230; 7,550; and 7,660 psi.

The second and third concrete placement activities used the revised mix design HB7000. The results of the 28 day cylinder break tests for the second concrete placement activities were reported as: 7,420; 7,990; 7,760; 8,120; 6,990; 7,020; 7,940 and 7,970 psi. The results of the 7 day concrete cylinder breaks for the third concrete placement were reported as: 5,990; 5,910; 6,700; 6,790; 5,170; 6,830; 5,980; and 6,900 psi.

All the concrete compressive strength results exceeded the minimum compressive strength requirements of 4,000 psi.

Documents Reviewed: SHN Consulting Engineers & Geologists Compression Test Results, Project 007105, Mix Design HB6500, Dated July 19, 2007

Category: Concrete Quality **Topic:** Corrosion Protection

Reference: ACI 349, Sect 4.4.1

Requirement: For corrosion protection of reinforcement in concrete, maximum water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days contributed from the ingredients including water, aggregates, cementitious materials, and admixtures shall not exceed the limits of Table 4.4.1, that specifies the maximum water soluble chloride ion in concrete by weight of cement of reinforced concrete exposed to chloride in service of 0.15 percent. The testing shall conform to ASTM C 1218.

Finding: This requirement was achieved. The licensee obtained two wafers from a single 6 inch by 12 inch cylinder that was cast from Humboldt Bay Mix HB6500. The wafers were pulverized and tested in accordance with ASTM C 1218 requirements. The first and second samples yielded results of 0.0013% and 0.0009% chlorides by weight of concrete, respectively. The upper limit allowed by ACI-349 was specified as 0.15 percent.

Documents Reviewed: TES Log #: TLS-07-CL-1, "Standard Test Method for Water-Soluble Chloride In Mortar and Concrete ASTM C-1218-92," Dated June 21, 2007

Category: Concrete Quality **Topic:** Infrared Spectrum Trace

Reference: ACI 349, Sect 3.6.10.2

Requirement: An infrared spectrum trace of the conformance test sample of air-entraining and water-reducing admixtures shall be furnished with the conformance test results.

Finding: This requirement was achieved. The manufacture of the high-range water reducing admixture (ADVA 100) and the air-entraining admixture (DARAVAIR 1000) submitted infrared spectrum traces for each admixture. As part of the admixture testing, PG&E performed infrared spectroscopy of the dried residues for each of the submitted admixtures. The results of the PG&E infrared spectroscopy tests indicated that the materials matched the infrared spectrum traces provided by the admixture manufacturer, Grace.

Documents Reviewed: TES Log #: 0706014-03A, Dated June 7, 2007; Grace certification for Daravair 1000, Dated June 21, 2007; TES Log #: 0706018-01A, Dated June 14, 2007; Grace certification for ADVA 100, Dated June 20, 2007

Category: Concrete Quality **Topic:** Required Minimum Dry Density

Reference: Humboldt Bay ISFSI SER

Requirement: The minimum dry densities for the reinforced concrete for both storage vault and storage cell lids are 146 pcf.

Finding: The dry density of the ISFSI vault concrete met the minimum specified requirement of 146 pcf. Three samples had been obtained from the ISFSI concrete. The test results varied between 153.1 pcf to 154.6 pcf, when tested in accordance with ASTM C 642.

Testing indicated that the concrete in the storage cell lids did not meet the minimum requirement of 146 pcf. Three specimens were tested and the test results varied from 141.1 to 141.5 pcf. This deficiency is discussed in additional detail in the datasheet

titled "Special Topics - Changes, Tests and Experiments."

Documents Reviewed: SHN Consulting Engineers & Geologists Standard Test Method for Density, Absorption, and Voids in Hardened Concrete ASTM C642-97, Job Number 00715, Dated July 16, 2007 through August 10, 2007

Category: Concrete Quality **Topic:** Water/Cement Ratio

Reference: ACI 349, Sect 4.2.2, Table 4.2.2, 4.1.1

Requirement: Concrete that will be subject to the exposures given in Table 4.2.2 of ACI 349 shall conform to the corresponding maximum water-cementitious materials ratios and minimum strength requirements of that table. The water-cementitious materials ratio shall be calculated using the weight of cement plus the weight of fly ash or other pozzolans.

Finding: This requirement was achieved for the ISFSI vault concrete. During the process of license approval, Humboldt Bay requested to use an upper limit of concrete water-to-cement ratio of 0.45 to limit any possible attack on the cement paste. The initial concrete mix design specified in Report Number C-5532 utilized a maximum water/cement ratio of 0.45. During the initial concrete placement activities the actual water used in the concrete batch was less than the maximum allowed, therefore the specified maximum water/cement ration of 0.45 was met. Based on the results of the initial concrete placement activities, the licensee modified the mix design and changed the maximum water/cement ratio to 0.42 for the remaining concrete placement activities.

Documents Reviewed: Section 5.1.3.3 of the Humboldt Bay Safety Evaluation Report; Lehigh Northwest Cement Co. Report Number C-5532, Dated June 6, 2007; Engineered Concrete Placement, Inc. Concrete Mix Design ECP HB-7000, Dated June 22, 2007

Category: Concrete Reinforcement **Topic:** Minimum Bend Diameters

Reference: ACI 349, Sect 7.2.1

Requirement: The minimum bend diameter, measured on the inside of the bar, other than for stirrups and ties in sizes Number 3 through Number 5, shall not be less than the following: a) No. 3 through No. 8 - 6db; b) No. 9, No. 10, and No. 11 - 8db, c) No. 14 and No. 18 - 10 db.

Finding: This requirement was achieved. Procedure TP 2006-13 specified that the reinforcing bars be cold bent and consist of six bar diameters for bar sizes number 3-8 and eight bar diameters for bar sizes number 9-11. A random inspection of bar bend diameters for those bars that were placed in the bottom portion of the ISFSI vault did not identify any discrepancies.

Documents Reviewed: Procedure TP 2006-13, "Humboldt Bay ISFSI Project Quality Related Reinforcing Steel Activities," Revision 0;

Category: Concrete Reinforcement **Topic:** Reinforcement Cover

Reference: ACI 349, Sect 7.7.1 (a) &(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. 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 achieved. Section 3.17.7.3 of Specification HBPP-2006-01 required that a 2 inch minimum clear cover be provided between the top surface of the ISFSI cask storage vault and that a minimum 3 inch cover be provided for the sides and bottom of the concrete vault. Prior to the initial concrete placement activities the inspector performed several measurements between the rebar and the surface closest to the formwork and between the reinforcing bars and the earth. In all cases the distance between the rebar and the other surface met or exceeded the 3 inch minimum required cover.

Documents Reviewed: Specification HBPP-2006-01, "Independent Spent Fuel Storage Installation (ISFSI) Construction Requirements," Revision 0; Holtec Drawing 4105, "Reinforced Concrete Cross Sections," Revision 2

Category: Concrete Reinforcement **Topic:** Reinforcement Tensile Tests

Reference: ACI 349, Sect 3.5.3.1.1, 3.5.3.2

Requirement: A minimum of one tensile test shall be required for each 50 tons of each bar size produced from each heat of steel.

Finding: This requirement was achieved. Procedure TP 2006-13 required that the reinforcing bars were to be quarantined until the dedication requirements were met. The dedication requirements included performing and bend and tensile test for each heat, for each 50 tons, or part there of from each heat, for each bar size made from that heat number. Additionally, a chemical analysis was required for each heat of material.

The inspector reviewed the testing documentation for the rebar that had been received at the time of the initial concrete placement. Sampling of the each lot size based upon heat numbers had occurred and each lot was below the 50 ton limit. The testing documentation indicated that the tensile test results and the chemical analysis for the reinforcing bars conformed to the specified requirements.

Documents Reviewed: Procedure TP 2006-13, "Humboldt Bay ISFSI Project Quality Related Reinforcing Steel Activities," Revision 0; Quality Source Surveillance Checklist QSSC No. LIV-02, Dated April 24, 2007; TES Log #: 2007-R-1, Date Tested June17, 2007; TLS Log #: 2007-R-2, Date Tested April 23, 2007

Category: Concrete Reinforcement **Topic:** Steel Reinforcement Requirements

Reference: ACI 349, Sect 3.5.1, 3.5.3.1

Requirement: Reinforcement shall be deformed reinforcement, except that plain reinforcement may be used for spirals or tendons. Deformed reinforcing bars shall confirm to ASTM A 615, "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."

Finding: This requirement was achieved for the rebar associated with the initial concrete placement. An inspection of the reinforcing bars used for the Humboldt Bay ISFSI vault initial placement and a review of the reinforcement receipt documents indicated that all the bars that had been received met the requirements of ASTM A 615, Grade 60.

Documents Reviewed: Quality Source Surveillance Checklist QSSC No. LIV-02, Dated April 24, 2007; TES Log #: 2007-R-1, Date Tested June17, 2007; TLS Log #: 2007-R-2, Date Tested April 23, 2007; Harris Salinas Rebar Certificate of Compliance Sheets, Dated April 20 and April 23, 2007

Category: Concrete Sampling **Topic:** Composite Sampling Requirement 1

Reference: ACI 349, Sect 5.6.2.1

Requirement: Samples for strength tests shall be taken in accordance with "Method of Sampling Freshly Mixed Concrete" (ASTM C 172).

Finding: This requirement was achieved. Specification HBPP-2006-01, Section 3.18.2.5 specified that concrete compressive strength samples were to be taken in accordance with the requirements of ASTM C 172. During the initial and final concrete placement activities the inspector observed the laboratory technician obtaining the composite concrete samples from the discharge of the concrete truck. The composite concrete samples from the truck were not taken near the initial or final discharge of concrete from the truck as specified in ASTM C 172.

Documents Reviewed: Specification HBPP-2006-01, "Independent Spent Fuel Storage Installation (ISFSI) Construction Requirements," Revision 0

Category: Concrete Sampling **Topic:** Composite Sampling Requirement 2

Reference: ASTM C 172, Sect 4.1

Requirement: The elapsed time shall not exceed 15 min. between obtaining the first and final portions of the composite sample.

Finding: This requirement was achieved. The inspector witnessed the laboratory technician obtaining the composite samples for the concrete strength specimens during the initial and final concrete placement activities. The elapsed time between obtaining the first and final portions of the composite samples were less than 15 minutes.

Documents Reviewed: None

Category: Concrete Sampling **Topic:** Field Technician Requirements

Reference: ASTM C 31, 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. Equivalent personnel certification programs shall include both written and performance examinations, as outlined in ACI CP-1.

Finding: This requirement was achieved. The licensee had contracted with a concrete testing laboratory to provide qualified ACI technicians to perform the concrete testing activities. The laboratory had furnished ACI certification for two individuals that were qualified as ACI Grade 1 technicians. The inspector observed that the concrete technician present during the initial and third concrete placement activities was qualified as an ACI Concrete Field Testing Technician - Grade 1.

Documents Reviewed: American Concrete Institute Concrete Field Testing Technician - Grade 1, Certification Date November 11, 2003

Category: Concrete Sampling **Topic:** Initial Sample Curing

Reference: ASTM C 31, 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 not achieved during the initial concrete placement activities. Immediately after molding the concrete compressive cylinders, they were transported to the designated storage area by the laboratory technician. The testing laboratory had chosen to use cure boxes for the initial cylinder storage. The cure boxes utilized the heat of hydration to keep the cylinders above the minimum temperature of 60 degrees F. However, the number of cylinders was excessive for the ambient temperatures and the size of the cure box that was chosen for use. Thus, the maximum temperature recorded inside the cure boxes were 90 degrees F for two of the sets of test cylinders and 100 degrees F for the other two sets of test cylinders. This discrepancy was entered into the licensee corrective action system.

The results of the concrete compressive strength tests from the initial concrete placement were reviewed by the inspector and compared to the test results for the concrete cylinders that were cast during the second concrete placement activity that had not experienced a problem with temperatures above the ASTM C 31 specified maximum. All the test results exceeded the minimum compressive strength requirement of 4,000 psi by a substantial margin. This discrepancy is not safety significant due to the fact that the effect of the elevated temperatures for a single day on the concrete cylinders did not contribute significantly to the final compressive strength results obtained at 28 days. Although this condition requires correction, it constitutes a violation of minor significance that is not subject to enforcement in accordance with Section IV of the Enforcement Policy.

Documents Reviewed: SAPN Notification 1243757, Task Detail 0002, Dated July 5, 2007; Compression Test Results, Load No. 1, Dated July 5, 2007; Compression Test Results, Load No. 6, Dated July 5, 2007; Compression Test Results, Load No. 16, Dated July 5, 2007; Compression Test Results, Load No. 21, Dated July 5, 2007;

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

Reference: ACI 349, 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 feet of surface area for slabs or walls.

Finding: This requirement was achieved. Specification HBPP-2006-01, Section 3.18.2.6 specified

that concrete compressive strength cylinders were to be taken for the first batch of concrete produced every day and for every 100 cubic yards produced thereafter or as directed by PG&E personnel. During the concrete placement activities on June 21, 2007 and on August 16, 2007, the inspector witnessed the concrete sampling activities. The concrete was sampled from the initial truck and thereafter from every fifth truck (approximately each 54 cubic yards).

Documents Reviewed: Specification HBPP-2006-01, "Independent Spent Fuel Storage Installation (ISFSI) Construction Requirements," Revision 0

Category: Hot Weather Requirements **Topic:** Protection During Hot Weather

Reference: ACI 349, Sect 5.13.1

Requirement: During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure.

Finding: This requirement was available but not required during the ISFSI concrete placement activities. Procedure TP 2006-14 defined hot weather as conditions described in ACI 305, that typically included wind greater than 10 mph, concrete temperature higher than 85 degrees F and relative humidity less than 50%. These conditions were not observed during the concrete placement activities for the ISFSI vault.

Documents Reviewed: Procedure TP 2006-14, "Humboldt Bay ISFSI Project Quality Related Concrete Activities," Revision 0

Category: Pad Design **Topic:** Soil Properties

Reference: Humboldt Bay ISFSI FSAR

Requirement: Confirm that the geotechnical conditions in the ISFSI vault excavation are bounded by the existing calculation packages.

Finding: The requirement was achieved. During the excavation of the ISFSI vault area, heavy rains had left the bottom of the excavation wet and muddy. The muddy site conditions were attributed to groundwater infiltration that had occurred during recent heavy rains. In order to remove the moist material, the job site had to be over-excavated approximately two feet and backfilled with a crushed stone material. The crushed stone material was placed in six inch lifts and the compaction was measured for each lift. The average density of the first lift was 126 pcf. The average density of the second, third and fourth lifts were 131.5 pcf.

During the excavation process, PG&E geotechnical representatives examined the condition of the soil in the excavation. The site conditions were found to agree with the geology and geotechnical conditions in the FSAR. No earthquake faults were discovered during the examination.

To ensure that the bottom of the ISFSI vault excavation remained bounded by the geotechnical calculations, an evaluation was conducted by the PG&E Geosciences Department. A list of 14 calculations were reviewed including calculations that dealt

with liquefaction, earthquake induced displacements and potential settlement of the vault. The Geosciences Department concluded that the construction modification did not have any adverse impact on any of the calculation results or conclusions and that the conditions of the soil deposits in the ISFSI excavation are in general agreement with the ISFSI FSAR.

Documents Reviewed: Humboldt Bay ISFSI FSAR, Revision 0; Geological and Geotechnical Inspection of the Humboldt Bay ISFSI Vault Excavation, Dated June 1, 2007

Category: Special Topics **Topic:** Changes, Tests and Experiments

Reference: 10 CFR 72.48(c)

Requirement: The licensee may make changes in the facility or spent fuel storage cask design as described in the FSAR without obtaining a license amendment if the change does not meet any of the criteria in paragraph 10 CFR 72.48(c)(2).

Finding: It was indeterminate whether this requirement had been achieved at the conclusion of the ISFSI construction inspection. During the ISFSI construction activities a number of deviations from design documents, code and standard requirements had been identified by the licensee and the inspector. The licensee had originated a SAPN to track all the changes that had been made during vault construction and document them in a 10 CFR 72.48 screen/evaluation.

Examples of the types of changes that were made and documented in a SAPN include:

a) Changing the location of quality related bars to the outside face of the reinforcing curtain (SAPN 1243862, Task0002)
b) Clarification of reinforcing bar spacing (SAPN 1243759, Task 0004)
c) Rebar interference with liner lower ring (SAPN 1243463, Task 0006)
d) Concrete slump outside of tolerance (SAPN 1243756, Task 0004)

Additionally, SAPN 1244216 documented the finding that the concrete dry density of the previously accepted ISFSI vault lids may not meet the minimum specified requirement of 146 pcf. The test of a concrete sample, which is believed to be representative of the concrete placed in the vault lids, was recently discovered to have a dry density of 141 pcf.

The staff recognized that the ISFSI vault had not been officially accepted, however there are a number of issues that could impact the ISFSI design. Depending on the outcome of these issues it is indeterminate whether the licensee would be allowed to make the changes under the 10 CFR 72.48 process. The NRC will review the results of the licensee's 10 CFR 72.48 evaluations for the changes made during construction to the ISFSI vault. The agency review of the licensee's evaluations will be tracked by URI 72-027/0701-02.

Documents Reviewed: SAPN 1244136, "ISFSI Construction 72.48," Dated August 9, 2007; SAPN 1243862, "ISFSI Vault Concrete Lift #3 Issues," Dated July 16, 2007; SAPN 1243759, "ISFSI Vault concrete lift #2 issues," Dated July 6, 2007; SAPN 1243463, "As-installed reinforcement issues," Dated June 5, 2007; SAPN 1243757, "ISFSI concrete test lab

issues," Dated July 5, 2007; SAPN 1243756, "ISFSI Vault first lift concrete issues," Dated July 5, 2007; SAPN 1244216, "Track Trentec concrete density deviation," Dated August 16, 2007

Category:	Special Topics **Topic:** Vault Liners
Reference:	Humboldt Bay ISFSI FSAR
Requirement:	The steel liners are constructed of SA36 or SA516 Grade 70 carbon steel and coated (painted) for protection.
Finding:	This requirement was achieved. The licensee had provided Specification HBPP-2006-02 to the vendor, which specified the type of material and other technical requirements that were to be used in the production of the assemblies. The technical requirements that were specified included that the ASME Boiler and Pressure Vessel Code, Section III, Subsection NF applied to the Important to Safety metal parts of the vault liner; all welds were to be performed to the requirements of ASME Section IX, and that all welds were to be visually examined per ASME Section V, Article 9 with acceptance criteria per ASME Section III, Subsection NF, Article NF-5360. As part of the documentation for the liners, an inspection was performed where the dimensions, welding, painting and NDE processes were verified. A material list was also provided which listed the material type and heat numbers for the material used to produce the liners. The major components consisting of the baseplate, shell, lid ring, anchorblock, gusset, etc. were documented to have been produced from SA36 Carbon Steel.
Documents Reviewed:	Specification HBPP-2006-02, Revision 1; Attachment 7.1, Source Inspection Plan, "Furnish & Deliver Six Dry Cask Vault Assemblies, Dated August 6, 2006