UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
1600 EAST LAMAR BLVD
ARLINGTON, TEXAS 76011-4511

February 25, 2013

Christopher J. Schwarz, Site Vice President
Arkansas Nuclear One
Entergy Operations, Inc.
1448 SR 333
Russellville, AR 72802-0967

SUBJECT: ARKANSAS NUCLEAR ONE – INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI) INSPECTION REPORT 05000313/2012008, 05000368/2012008, AND 07200013/2012001

Dear Mr. Schwarz:

A routine site inspection was completed of your dry cask storage activities associated with your Independent Spent Fuel Storage Installation (ISFSI) on October 29 through November 1, 2012. A preliminary exit was conducted with your staff to discuss the findings of the inspection on November 1, 2012. The inspection was continued on December 18, 2012, to review information regarding the thermal validation test conducted in accordance with Condition 9 of the Holtec International Certificate of Compliance No. 1014. This portion of the team inspection included individuals from NRC's Spent Fuel Storage and Transportation (SFST) Division. After reviewing information provided on the thermal validation test and participating in telephonic discussions involving your staff, a final telephonic exit was conducted on February 18, 2013.

The focus of the inspection was to evaluate the status of your dry cask storage activities to verify ongoing compliance with the Holtec International HI-STORM 100 Certificate of Compliance No. 1014 and associated Technical Specifications, Holtec International HI-STORM 100 Final Safety Analysis Report (FSAR), Energy Solutions VSC-24 Certificate of Compliance and associated Technical Specifications, Energy Solutions VSC-24 FSAR, regulations in 10 CFR Part 20 and Part 72, and any changes that had been made to your ISFSI program since the last NRC inspection. This inspection included the areas of radiation safety, cask temperature monitoring, quality assurance, corrective action program, safety evaluations, records, periodic surveillance requirements for the VSC-24 casks, and how you addressed industry issues that affected you.

The inspection also reviewed the special requirements of Condition 9 of the Holtec International Certificate of Compliance No. 1014. Condition 9 required two special tests to validate that the design and modeling of the Holtec HI-STORM 100 system provided adequate cooling of the spent fuel in the canister during storage and that the supplemental cooling system was adequately sized to provide cooling during certain phases of cask loading to maintain the spent fuel below key design thermal limits that could degrade the fuel cladding. The NRC concluded that ANO had successfully completed the supplemental cooling system test required by Condition 9 for the first time use of a supplemental cooling system that had not been previously tested. Holtec reviewed your test results and concluded that the test validated the thermal

methods described in the FSAR which were used to determine the type and amount of supplemental cooling necessary. However, the NRC found that the thermal validation test performed to comply with Condition 9 for the first cask placed in service exceeding 20 kW had not fully implemented ANOs quality assurance requirements. This test was required by Condition 9 of the Certificate of Compliance No. 1014 to validate the analytic methods and thermal performance predicted by the licensing basis thermal models in Chapter 4 of the FSAR. As such, the thermal validation test was required by 10 CFR Part 72, Subpart G to be performed under your quality assurance program. Specifically, the test used measuring instrumentation that had not been controlled or calibrated in accordance with the requirements in 10 CFR 72.164. Failure to use measuring instruments not calibrated under the ANO quality assurance program is identified as a Non-Cited Violation. Validation of the data collected by the instrumentation used during the thermal validation test is currently considered indeterminate. Resolution of this issue will be tracked as an Unresolved Item.

The thermal validation test data was forwarded to Holtec International for evaluation of compliance with Condition 9, which would allow the results of the thermal validation test to be referenced by other HI-STORM 100 users, including those with other overpack configurations. Holtec International performed the evaluation under their quality assurance program and concluded that the test data had confirmed the adequacy of the thermal models in Chapter 4 of the FSAR. As such, Holtec International informed their users that the ANO thermal validation test satisfied the requirement of Condition 9 for the Holtec HI-STORM 100 cask system users. The NRC has determined that there are sufficient differences between the various HI-STORM overpack designs that an independent evaluation of the conclusion reached by Holtec International will be performed. Confirmation of the adequacy of the ANO thermal model test results for all other HI-STORM overpack designs will be tracked as an Unresolved Item.

In addition, two other Non-Cited Violations of NRC regulations were identified during this inspection. One related to the helium backfill of your HI-STORM Casks 31, 35, 36, and 37 which had been identified as an industry generic issue by Holtec International. The other related to an inadequate trainbay floor loading seismic analysis which was identified by your staff to the NRC. If you contest these Non-Cited Violations, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington DC 20555-0001; with copies to the Regional Administrator, Region IV DMNS Director, Office of Enforcement, and the NRC Resident Inspectors at Arkansas Nuclear One.

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 you choose to provide one, 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 should not include any personal, privacy or proprietary 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 817-200-1191, Mr. Vincent Everett at 817-200-1198, or Mr. Lee Brookhart at 817-200-1549.

Sincerely,

/RA/

D. Blair Spitzberg, Ph.D., Chief
Repository & Spent Fuel Safety Branch
Division of Nuclear Materials Safety

Dockets: 50-313, 50-368, 72-13
Licenses: DPR-51, NPF-6

Enclosure:
NRC Inspection Report 05000313/2012008;
05000368/2012008; 07200013/2012001

w/ attachments:
1. Supplemental Information
2. Condition Reports Reviewed During the Inspection
3. Loaded VSC-24 Casks at Arkansas Nuclear One Station
4. Loaded Holtec Casks at Arkansas Nuclear One Station

cc w/attachments: ListServ®

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SUNSI Rev Compl.	**X Yes** ☐ No	ADAMS	**X Yes** ☐ No	Reviewer Initials	JVE
Publicly Avail	**X Yes** ☐ No	Sensitive	☐ Yes **X No**	Sens. Type Initials	JVE

RIV:DNMS/RSFS	DNMS/RSFS	DNMS/RSFS	HQ:SFST	HQ:SFST	R-IV/C:DRP-E	R-IV/C:RSFS
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ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket:	05000313, 05000368, 07200013
Licenses:	DPR-51, NPF-6
Report Nos.:	05000313/2012008, 05000368/2012008, and 07200013/2012001
Licensee:	Entergy Operations, Inc.
Facility:	Arkansas Nuclear One, Units 1 and 2 Independent Spent Fuel Storage Installation (ISFSI)
Location:	1448 SR 333 Russellville, AR 72802-0967
Dates:	October 29 – November 1, 2012 December 18, 2012
Inspectors	Vincent Everett, RIV RSFS, Team Leader Lee Brookhart, RIV RSFS, Inspector Jimmy Chang, HQ SFST, Thermal Engineer Rob Temps, HQ SFST, Senior Inspector
Accompanying Personnel:	Eric Simpson, RIV RSFS, Inspector-in-Training
Approved By:	D. Blair Spitzberg, Ph.D., Chief Repository and Spent Fuel Safety Branch Division of Nuclear Materials Safety

EXECUTIVE SUMMARY

Arkansas Nuclear One
NRC Inspection Report 50-313/2012-08, 50-368/2012-08, and 72-13/2012-01

A routine team inspection, consisting of two site visits, was conducted of the Arkansas Nuclear One (ANO) Independent Spent Fuel Storage Installation (ISFSI) on October 29 through November 1, 2012 and on December 18, 2012. The first site visit reviewed a number of topics to evaluate compliance with the applicable NRC regulations and the provisions of a general license in accordance with the Holtec HI-STORM 100 cask system and Energy Solutions VSC-24 cask system. The second site visit reviewed the thermal validation test performed by ANO to comply with Condition 9 of the Holtec Certificate of Compliance (CoC) No. 1014. Technical experts from NRC Headquarters Spent Fuel Storage and Transportation Division assisted in the review of the thermal validation test. Thirty seven HI-STORM 100 casks and twenty four VSC-24 casks were currently loaded and stored on the ISFSI pad, which was located within the Part 50 reactor facility protected area. The inspection found that the spent fuel was safely stored at your ISFSI in accordance with NRC regulations, the Holtec HI-STORM 100 general license, and the Energy Solutions VSC-24 general license. The storage casks were in good physical condition. The dry fuel storage staff were knowledgeable in the licensing requirements related to storage activities for both licenses and had been diligent in reviewing issues that were occurring in the industry to determine if programmatic changes were necessary at ANO. Two issues that were documented by your staff in 2011 are discussed in this inspection report which resulted in Non-Cited Violations. The first related to the amount of helium that was placed in the HI-STORM casks 31, 35, 36, and 37. This issue had been originally identified by Holtec as a potential generic issue and reported to the industry. The other related to the trainbay floor loading seismic analysis while the HI-STORM system was in a free standing stack-up configuration. This issue was identified by the NRC at another reactor site and was found by your staff to also be applicable to ANO.

Arkansas Nuclear One had loaded twenty four VSC-24 casks from December 1996 through June 2003. The VSC-24 casks are currently monitored under CoC No. 1007, Amendment 4 and FSAR, Revision 5. Starting in 2003, ANO switched cask designs to the Holtec HI-STORM 100 cask system. Thirty seven Holtec HI-STORM 100 casks were loaded from December 2003 through November 2010. Future loading operations are currently on hold pending resolution to the trainbay floor loading issue. The HI-STORM 100 casks are currently monitored under the CoC amendments and FSAR revisions that were in use by ANO at the time of cask loading (see Attachment 4).

Operation of an ISFSI at Operating Plants (60855.1)

- Quality assurance audits and surveillances were being implemented that included ISFSI related activities. A recent 2012 quality assurance audit had reviewed a wide range of topical areas associated with dry cask storage and found that the ISFSI programs were being effectively implemented (Section 1.2.a).

- The Unit 1 and the Unit 2 spent fuel were different designs which affected the radiation levels during cask loading. The Unit 2 spent fuel was approximately 18 inches longer than the Unit 1 spent fuel and resulted in the top of the spent fuel being closer to the multipurpose canister (MPC) lid. The licensee used a tungsten shield for neutron shielding and lead blankets to reduce the radiation levels during cask loading (Section 1.2.b).

- Personnel doses during cask loading ranged from 0.079 to 0.499 person-rem for the Holtec MPC-24 canisters and 0.331 to 0.665 person-rem for the MPC-32 canisters for the last seventeen casks loaded by the licensee (Section 1.2.b).

- Radiological dose rates around the ISFSI pad were less than 1 mrem/hr gamma and neutron. No unexpected radiological conditions were observed during the ISFSI tour. The ISFSI pad area was properly posted (Section 1.2.c).

- Vent surveillances of the loaded casks were being implemented in accordance with Technical Specifications (Section 1.2.d).

- Selected condition reports were reviewed for the period 2009 thru 2012. A wide range of issues had been identified and resolved. Resolution of the issues was appropriate for the safety significance of the issue. No adverse trends were identified during the review (Section 1.2.e).

- The supplemental cooling system (SCS) validation test required by Condition 9 of Holtec's CoC No. 1014 was completed on a loaded cask with a 20 kW heat load. The test involved taking temperature and flow measurements of the SCS inlet and outlet to verify the system was adequately sized to maintain adequate cooling to the annulus gap between the canister and the HI-TRAC transfer cask during onsite transport operations to keep the temperature of the spent fuel cladding below design basis limits. The data was provided to Holtec for analysis. Holtec determined that the data collected by ANO validated that the SCS was adequately sized to maintain acceptable temperatures of the fuel cladding (Section 1.2.f).

- While using the supplemental cooling system on a 27.64 kW cask, steaming was observed in the annulus area between the HI-TRAC transfer cask and the canister. Though the SCS was sized for canisters with heat loads up to 36.9 kW, it had not been sized to account for ANO's use of neutron shielding, lead blankets, and fire blankets placed on the canister lid to provide personnel protection for high heat load (kW) canisters. This configuration reduced the effectiveness of the SCS to cool the canister. ANO established a 26 kW limit on their casks to reduce the lid temperature to below 350 degree F due to personnel and operational safety concerns (Section 1.2.g).

- The thermal validation test required by Condition 9 of Holtec's CoC No. 1014 was performed on a 23 kW cask. The test involved monitoring inlet and outlet vent temperatures and taking air flow measurements from locations within the annulus between the HI-STORM cask and the loaded canister to verify predictions made by the licensing-basis thermal model. ANO performed the test using instrumentation that had been certified and/or calibrated by the vendors, but had not applied the requirements of the ANO quality assurance program to the control and calibration of the test instruments. The NRC has identified this failure to follow the ANO quality assurance program for the thermal validation test instrumentation as a Non-Cited Violation of 10 CFR 72.164 (NCV 72-13/1201-01). The validity of the data collected during the test has been identified as an Unresolved Item (URI 72-13/1201-02) (Section 1.2.h).

- The ANO thermal validation data was provided to Holtec for analysis. Holtec determined that the data collected by ANO validated the analytic methods and thermal performance of the HI-STORM 100 cask system. Holtec concluded that the ANO test results could be

applied to the other HI-STORM 100 overpack designs specified in the Certificate of Compliance No. 1014. The NRC is performing an independent evaluation of Holtec's position and will track this issue as an Unresolved Item (URI 72-13/1201-03) (Section 1.2.h).

- In 2009, a concern related to Holtec's decision to stop the helium leak testing of the Holtec canisters during fabrication was identified by the NRC. As a result, Holtec agreed to reinstate the helium leak test. However, during the interval in which testing had been suspended, a number of canisters had been distributed by Holtec that had not been leak tested. ANO had received seven of the affected canisters and had loaded the canisters with spent fuel and placed them on the ISFSI pad. The NRC determined after review of information provided by Entergy and Holtec, that the seven loaded canisters were acceptable for continued use (Section 1.2.i).

- Arkansas Nuclear One had reviewed a number of industry issues that could have an impact on the ANO dry fuel storage program. These included issues related to NRC Information Notice 2011-10, vacuum drying issues related to Holtec Information Bulletin (HIB) - 45/48, heat load calculations related to HIB-51, and isolation of the canister while filled with water related to HIB-53. A Non-Cited Violation (NCV 72-13/1201-04) was identified for ANO's failure to place the required amount of helium into Casks 31, 35, 36, and 37 due to miscalculating the total heat loads of those casks (Sections 1.2 j, k, l).

- The licensee identified errors and unjustified assumptions in a previous analysis that was performed to validate the structural adequacy of the auxiliary building floor during stack-up operations. A Non-Cited Violation (NCV 72-13/1201-05) was identified for failure to adequately demonstrate that the trainbay floor could withstand the stack-up floor loading that could occur during a design basis seismic event (Section 1.2.m).

- The licensee had completed the VSC-24 five year interior inspection as required by Technical Specifications. The surveillance did not reveal any significant problems (Section 1.2.n).

- The work orders for the VSC-24 annual exterior inspections were reviewed for the years 2009, 2010, 2011, and 2012. All issues requiring attention were addressed. The types of defects identified were minor and had minimal impact on the structural and shielding ability of the casks. Efflorescence deposits were observed by the NRC inspectors on cracks on several of the VSC-24 casks and around the vent areas of several Holtec casks (Section 1.2.o).

- Records were maintained that described the specific fuel parameters for the spent fuel stored in each of the licensee's loaded casks (Section 1.2.p).

<u>Review of 10 CFR 72.212(b) Evaluations (60856.1)</u>

- Two revisions to the 10 CFR 72.212 Evaluation Report for the VSC-24 casks and one revision to the 10 CFR 72.212 Evaluation Report for the HI-STORM 100 casks had been issued since the last NRC inspection. The changes were administrative in nature and did not have any programmatic or safety impacts (Section 2.2).

Review of 10 CFR 72.48 Evaluations (60857)

- The 10 CFR 72.48 screenings reviewed during this inspection met requirements. No 10 CFR 72.48 evaluations had been performed in the past three and a half years (Section 3.2).

Report Details

Summary of Facility Status

The ANO ISFSI consisted of three pad areas adjacent to each other east of the turbine building inside the protected area. The first pad contained the twenty-four Energy Solutions VSC-24 casks that had been loaded from 1996 to 2003. The second and third pad areas were on the north side of the VSC-24 pad and were used to store the Holtec casks. There were thirty-seven Holtec casks currently in storage with room for eleven more. For the Holtec casks, two canister designs were used at ANO. The MPC-24 canister stored a maximum of twenty-four assemblies. The MPC-32 canister stored a maximum of thirty-two assemblies. All Unit 1 spent fuel was stored in the MPC-24 canister. Unit-2 spent fuel was stored in both the MPC-24 and MPC-32 canisters. The Unit 1 spent fuel bridge mast consisted of a design that did not allow the grapple to move spent fuel close to the edge of the spent fuel pool, which restricted movement such that certain outer MPC-32 canister slots could not be accessed. The MPC-24 canister did not present this same problem and all twenty-four slots could be accessed with the Unit 1 spent fuel bridge mast. The Unit 2 spent fuel bridge mast did not have this limitation and could be used to load either the MPC-24 or MPC-32 canister.

The licensee used two versions of the Holtec HI-STORM concrete storage cask overpack designs at the ISFSI. The first twelve Holtec casks placed on the ISFSI pad were HI-STORM 100S overpacks (with nine MPC-24 canisters and three MPC-32 canisters). Since then, the HI-STORM 100S Version C overpacks have been used (containing eleven MPC-24 canisters and fourteen MPC-32 canisters).

The licensee had encountered a high temperature concern while loading Cask 26 with a heat load of 27.64 kW. The supplemental cooling system had problems maintaining cooling for the cask resulting in concerns for worker safety while around the cask. As such, future casks were being limited to 26 kW, which may result in the use of only the MPC-24 canister until the problem is resolved. More discussion of the supplemental cooling system issue related to adequate annulus cooling is provided in this inspection report under Section 1.2.g.

Both Unit 1 and Unit 2 conducted outages every 18 months. Both reactor cores contain 177 fuel assemblies. Unit 1 was a Babcock & Wilcox (B&W) reactor. Approximately 60-62 spent fuel assemblies (1/3 of the core) were replaced during each outage. The Unit 1 fuel was kept in the reactor for 3 cycles. The Unit 1 spent fuel pool currently has full core offload capability, but will lose this capacity after the next outage in the spring 2013. Unit 2 was a Combustion Engineering (CE) reactor. Each outage replaced approximately 84-88 spent fuel assemblies (½ of the core). The Unit 2 fuel was kept in the reactor for two cycles. Unit 2 received a power up-rate from the NRC which resulted in the Unit 2 fuel reaching higher burn-up levels. The Unit 2 spent fuel pool currently does not have full core offload. The next outage is planned for the spring 2014.

1 Operations of an Independent Spent Fuel Storage Installation (ISFSI) at Operating Plants (60855.1)

1.1 Inspection Scope

An inspection of the status of the loaded casks at the ANO ISFSI was completed to verify compliance with requirements of the Holtec HI-STORM 100 Certificate of Compliance (CoC) and Final Safety Analysis Report (FSAR) and the Energy Solutions

VSC-24 CoC and FSAR. The inspection reviewed a broad range of topics from quality assurance oversight of activities to the current radiological conditions at the ISFSI pad. Condition reports issued since the last NRC inspection in April of 2009 were reviewed to verify that issues related to the ISFSI and the spent fuel cask handling crane (L-3 crane) were being captured, adequately evaluated, and properly resolved. Industry issues that could affect the ANO dry cask storage program were reviewed to verify that the licensee was aware of the issues and had performed an evaluation to determine if the issues affected ANO's dry cask storage program.

1.2 Observations and Findings

a. Quality Assurance Audits and Surveillances

The quality assurance organization had included ISFSI related activities in their audits and surveillances. A quality assurance audit was performed during August and September of 2012 of the ISFSI program. Audit Report QA-20-2012-ANO-1 was issued on September 18, 2012. The audit found that the ISFSI program and procedures were effective in implementing activities that affected quality. There were no adverse quality assurance findings and no programmatic weaknesses that would impact the overall effectiveness of the ISFSI related programs. Eight condition reports were issued as a result of the audit that documented several issues including the designation of previous revisions of the 72.212 Evaluation Report still being active, completeness and accuracy of forms, damage to the fence around the ISFSI pad, inconsistency of information on the nameplates on the stored casks, clarity of procedure guidance, and completion of corrective actions for two condition reports related to the ISFSI. The audit reviewed a wide range of topics including procedural controls related to the physical inventory of the spent fuel, maintenance of ANO licensing basis documents including when changes are made by Holtec to the cask's FSAR, timely completion of the 30-day notification to the NRC that a cask had been placed in service, control of changes to the cask design and equipment using the 10 CFR 72.48 process, controls to ensure that spent fuel loaded in the casks comply with the technical specifications for acceptable fuel, verification that critical activities associated with completing the cask sealing operations were performed in compliance with procedures, verification that procedural restrictions associated with moving the loaded cask to the pad were complied with, completion of required training for workers, completion of required surveillance requirements, and verification that previously identified audit issues had been adequately addressed and resolved.

In addition to the quality assurance audit in 2012, two quality assurance surveillances were conducted. Surveillance Report QS-2012-ANO-006, dated March 6, 2012 and Surveillance Report QS-2012-ANO-009 dated April 2, 2012 provided follow-up reports on previously identified quality assurance findings. Surveillance Report QS-2012-ANO-006 reviewed an issue associated with missed surveillance activities and inadequate documentation of quality verifications performed on the VSC casks. The issue had been documented as Quality Assurance Finding QAF-CR-ANO-C-2011-02235. The surveillance found that the responsible organization assigned to address the issue had performed an apparent cause evaluation and identified acceptable corrective actions to prevent recurrence. At the time of the surveillance, 13 of the 20 corrective actions had been completed. The remaining corrective actions had been assigned to responsible organizations with due dates. Quality assurance management considered some of the assigned due dates excessive. These were reassigned to a more timely date. Surveillance Report QS-2012-ANO-009 reviewed an issue associated with inadequate

implementation of the process for performing work activities in the refueling/dry fuels organization. The issue involved procedurally required actions during work activities. Quality Assurance Finding QAF-CR-ANO-C-2012-0101 had been issued to document the problem. The quality assurance surveillance found that six of the nine corrective actions had been adequately closed. The remaining actions were assigned and schedule for completion within a reasonable time frame.

b. Radiological Information Related to Cask Loading

The Unit 1 and Unit 2 spent fuel were different designs which affected the radiation levels during cask loading. The Unit 2 spent fuel was approximately 18 inches longer than the Unit 1 spent fuel and resulted in the top of the spent fuel being closer to the canister lid. The licensee was using a tungsten shield for neutron shielding and lead blankets on the canister lid to reduce the radiation levels during cask loading work activities. In addition, for the higher heat load (kW) casks, fire blankets were used to protect the workers from the high temperatures on the lid and upper portions of the cask. Attachment 4 “Loaded HI-STORM Casks at the ANO ISFSI” of this inspection report provides person-rem doses for loading the thirty-seven Holtec casks. The Unit 1 spent fuel is all loaded in the MPC-24 canisters. The seventeen Unit 1 canisters averaged 0.425 person-rem per canister to load. Of the 20 Unit 2 canisters loaded, three were MPC-24 canisters and seventeen were MPC-32 canisters. The three MPC-24 canisters with Unit 2 spent fuel averaged 0.578 person-rem per canister to load. The seventeen MPC-32 canisters with Unit 2 spent fuel averaged 0.505 person-rem.

The doses for the last several casks were reviewed to determine the distribution of the dose among the workers. The doses shown in the following table were from the electronic dosimeters worn while around the casks and include both gamma and neutron exposures. The majority of the dose was typically received by radiation protection, mechanical, and welding personnel with the doses varying from cask to cask as to which was the predominant exposure group. Reviewing the ALARA records for several of the casks found that the higher doses were being experienced during welding related activities and the process of lowering the canister from the transfer cask into the storage cask.

Table 1: Doses (mrem) by Group During Cask Loading

Cask #	30	31	32	33	34	35	36	37
Decay Heat-kW	23.21	26.59	26.01	10.86	10.99	26.36	26.15	26.46
Rad Protection	118	**151**	160	27	35	**171**	**129**	96
Mechanical	123	130	**173**	**30**	**54**	140	124	**123**
Welders	**141**	118	147	**30**	30	140	98	90
Operations	46	37	75	0	5	148	75	64
QC	36	41	43	8	15	31	36	38
Others	35	16	18	0	2	15	11	9
Total dose	499	493	616	95	141	645	473	420

Neutron doses for the Holtec casks were being monitored during loading. The neutron component since Cask 20 was reviewed to determine the neutron contribution for each cask loading. The doses in Table 2 below were from the electronic alarming dosimeters.

A gamma sensitive electronic alarming dosimeter and a separate neutron sensitive electronic alarming dosimeter were used. The electronic alarming dosimeters were required each time the individual was in the radiologically controlled area near the cask. The neutron component ranged from 25% to 50% for the MPC-24 canisters and 25% to 45% for the MPC-32 canisters. The neutron percent contributions varied significantly and could not be correlated to the cask's total decay heat load.

Table 2a: Neutron Verses Gamma Dose for MPC-24 Cask Loading

Cask #	Gamma (mrem)	% Gamma	Neutron (mrem)	% Neutron	Total Dose (mrem)	Decay Heat (kW)
23	136	50%	138	50%	274	11.51
24	-	-	-	-	189	12.54
25	54	68%	25	32%	79	9.74
28	259	63%	150	37%	409	18.16
29	90	49%	92	51%	182	14.31
30	373	75%	126	25%	499	23.21
33	58	61%	37	39%	95	10.86
34	81	57%	60	43%	141	10.99

Table 2b: Neutron Verses Gamma Dose for MPC-32 Cask Loading

Cask #	Gamma (mrem)	% Gamma	Neutron (mrem)	% Neutron	Total Dose (mrem)	Decay Heat(kW)
20	183	55%	148	45%	331	23.50
21	217	58%	159	42%	376	25.91
22	244	68%	114	32%	358	25.57
26	497	75%	168	25%	665	27.64
27	268	55%	217	45%	485	26.67
31	383	78%	110	22%	493	26.59
32	413	67%	203	33%	616	26.01
35	423	66%	222	34%	645	26.36
36	346	73%	127	27%	473	26.15
37	293	70%	127	30%	420	26.46

The neutron component was contributing one-fourth to one-half of the overall personnel dose based on the electronic alarming dosimeters. However, the personnel dosimeter used as the dose of legal record (DLR) provided by Landauer and being worn by the workers was not recording a neutron dose, even though the DLR had a CR-39 neutron chip. The Radiation Protection Supervisor for ALARA could only remember one individual that had received a neutron dose on his DLR. The dose was 25 mrem. Previous inspections by Region IV at other ISFSI sites have found that the accuracy of the electronic neutron dosimeter has been sometimes questioned in that workers performing the same task and around the cask for approximately the same time period were not always receiving the same electronically recorded neutron dose. In addition, each individual worker was typically receiving only a few mrem neutron dose per cask loading which was not showing up on the individual's DLR. This indicated that the

CR-39 chip has a threshold, possibly in the range of 20-30 mrem, before a neutron dose is recorded. The licensee was made aware of the issue, including the need to determine if the electronic alarming dosimeters were providing a sufficiently accurate neutron dose that should be manually added to each individual's permanent record to account for the CR-39 chips' inability to measure low neutron doses on the personnel dosimeters used for the dose of legal record.

c. Radiological Conditions Related to Stored Casks

A tour of the ISFSI pad was conducted to observe the condition of the loaded casks and to take radiological measurements. The radiological survey was performed by a licensee radiation protection technician with a neutron sensitive remball and an Eberline ASP-1 gamma detector. General area background readings before reaching the ISFSI concrete pad were zero neutron and 0.24 mR/hr gamma. Radiation levels along the edge of the ISFSI pad taken during the walking tour were less than 1 mR/hr gamma with no detectable neutron. The readings were consistent with previous radiological surveys performed by the licensee. Previous surveys had documented that no contamination had been found on the pad. The area around the casks was roped and posted as a radiation area and radioactive materials area and required a radiation work permit for entry. Radiation levels adjacent to several casks were measured. The highest readings were found at the inlet vents on the bottom of the casks. For the VSC-24 casks, measurements made on several cask vents were less than 1 mR/hr gamma and 0.2 mrem/hr neutron on contact. The Holtec casks were typically in the same range of exposure levels with the highest Holtec cask surveyed at 4 mR/hr gamma and 3 mrem/hr neutron on contact at one of the inlet vents. Previous surveys by the licensee had noted slightly higher readings on some of the vent screens.

Located on the fence on the east side of the ISFSI pad were four thermoluminescent dosimeters (TLDs). The fence was approximately 40 feet from the casks. Two of the TLDs were on the VSC-24 end of the ISFSI pads. These were TLD #1 (#34) and TLD #2 (#35). The other two TLDs were located on the Holtec end of the ISFSI pad. These were TLD #3 (#62) and TLD #4 (#63). The TLDs were evenly spaced along the fence such that they viewed the full length of the ISFSI pad on the east side. The TLDs on the fence contained a CR-39 neutron chip and had occasionally recorded neutron doses above 20 mrem for the six month period, but this had not been consistent. The TLDs were processed semi-annually.

Table 3 below provides the results of the TLDs located on the fence near the ISFSI. For the two TLDs closest to the VSC-24 casks, a general decrease in radiation levels over time was observed. Both TLDs were influenced slightly by the Holtec HI-STORM casks that had been loaded on the north end of the ISFSI pad, with TLD #35 showing more of an effect. By the second half of 2002, twenty-three VSC-24 casks had been loaded with no Holtec casks on the ISFSI pad. The two TLDs placed on the fence approximately 40 feet from the casks read 547 mrem and 558 mrem respectively for the semi-annual period for the second half of 2002. This was documented in Inspection Report 72-13/2003-01, dated February 7, 2003 (ADAMS Accession ML030380281). As can be seen from Table 3 below, even with an effect from the HI-STORM casks, the two TLDs near the VSC-24 casks showed a drop of approximately 40% in the dose rate over the 10-year period from 2002 to 2012. The TLDs nearest the HI-STORM end of the ISFSI pad were affected by the ongoing loading of casks onto the ISFSI pad. TLD #62 showed a decrease over time and was less influenced by the new casks, but TLD #63 reflected

the additional casks being placed on the north end of the ISFSI pad and showed several periods with increased readings with a net change over the 3 ½ year period of zero. Prior to 2009, there were 29 HI-STORM casks on the ISFSI pad. During the 1st semi-annual period of 2009, two casks were added to the ISFSI pad. In the 2nd semi-annual period of 2009, two more casks were added to the ISFSI pad. During the 2nd semi-annual period of 2010, the latest four casks were added to the ISFSI pad.

Table 3: Radiological Readings Near the ISFSI Pad (mrem per Six Month Period)

	TLDs Nearest the VSC-24 Casks		TLDs nearest the HI-STORM Casks	
Time Period	TLD #34	TLD #35	TLD #62	TLD #63
1st Semi-Annual 2009	349	441	682	681
2nd Semi-Annual 2009	370	421	697	872
1st Semi-Annual 2010	302	409	613	729
2nd Semi-Annual 2010	336	422	644	819
1st Semi-Annual 2011	320	353	570	758
2nd Semi-Annual 2011	328	397	621	827
1st Semi-Annual 2012	296	382	584	680

The environmental reports for the period of 2009 through 2011 were reviewed to determine if the environmental TLDs were being influenced by casks on the ISFSI pad. The environmental TLD program included sixteen inner ring dosimeters located 0.4 to 0.9 miles from the plant with one dosimeter in each of the sixteen sectors around the plant. In addition, eight dosimeters were placed at special interest points ranging from 1.8 to 19 miles from the plant to provide data further from the plant and to provide representative background levels. The background value for 2011 was determined to be 6.9 mrem/quarter based on Dosimeter #7 located 19 miles from the plant in direction 210 degree at the Entergy Supply Yard on Highway 10 in Danville. The mean reading averaged over the four quarters of 2011 for the sixteen inner ring dosimeters was 8.5 mrem/quarter with a range for the sixteen dosimeters of 6.1 to 10.3 mrem/quarter. This was consistent with historical averages from 2000 to 2010 of 6.7 to 8.8 mrem/quarter. Dosimeter #1 was located at 88 degree (east) and 0.5 miles from the plant in the direction of the ISFSI and was closest to the ISFSI pad. This dosimeter averaged 9.0 mrem/quarter for 2011 and was within the statistical variance of the overall average of all the environmental dosimeters indicating that radiation levels in the east direction were not statistically different than those in the other directions from the plant. The environmental TLD values for 2009 and 2010 were consistent with the 2011 values. The background levels were 6.5 mrem/quarter in 2009 and 6.9 mrem/quarter in 2010. Dosimeter #1 was 8.8 mrem/quarter in 2009 and 8.6 mrem/quarter in 2010. The mean for the sixteen inner circle dosimeters for 2009 was 8.3 mrem/quarter and 8.2 mrem/quarter for 2010. As such, there was no indication that the radiation levels from the ISFSI were affecting offsite dose levels. The nearest resident to the east of the plant was 0.8 miles away.

During the tour of the ISFSI pad, the inspectors observed that the welding shop was the nearest occupied facility located to the west of the pad near the end with the HI-STORM casks and was used by the welders as a work area and office area. Based on the TLD results for the TLDs on the ISFSI fence (TLDs #62 and #63), the annual dose had

averaged over 1,000 mrem/year (1 rem/yr) at the 40 foot distance from the ISFSI pad. The welding shop was further away, estimated to be 200-300 feet from the ISFSI pad. The licensee maintained a TLD in the welding shop to measure radiation levels. The workers in the welding shop were radiation workers and were assigned DLRs. The inspectors toured the east end of the welding shop and discussed the potential dose impact of the nearby ISFSI with a welding supervisor, whose office window looked out onto the ISFSI pad. The welding supervisor was wearing his DLR and stated that he wore it at all times while onsite. A discussion with the ALARA Supervisor was held to discuss the exposures that the welders may be receiving due to the ISFSI nearby. A dosimeter located in the welding shop to record ambient radiation levels as part of the environmental dosimeter program had recorded 111 mrem gamma dose for the first six months of 2012. The dosimeter recorded no neutron exposure on the CR-39 neutron chip. The values recorded on the dosimeter in the welding shop represented 24 hrs/7 days a week. Over a six month period, this would be approximately 4380 hours. Natural background radiation levels were not subtracted from the recorded values. When considering the typical work week, the total exposure time would be 1,000 hrs per six month period (2,000 hrs/year) or about ¼ that measured on the TLD. This would equate to 111 mrem per semiannual period divided by ¼ equals approximately 28 mrem exposure per six month period during work hours. This would be 4 - 5 mrem per month. However, the welders were typically not in the welding shop all day and performed other tasks onsite away from the welding shop. The welding supervisor could be considered an individual that would be in the welding shop more often due to paperwork and management tasks, plus his office was on the side of the building facing the ISFSI pad. As such, he was selected as the person of interest in reviewing the affect of the ISFSI pad on the dose to individuals in the welding shop. The DLR results for the welding supervisor were reviewed for 2010 and 2011 and compared to the electronic dosimeter readings which represented his dose while in the radiologically controlled area inside the plant. An electronic dosimeter was worn while in the plant's radiologically controlled area and taken off when leaving the area. The welding supervisor did not wear an electronic alarming dosimeter while in the welding shop. As such, the contribution from the ISFSI pad could be determined by subtracting his electronic dosimeter reading from his DLR reading. For 2011, the DLR read 104 mrem annual dose. The electronic dosimeter read 106 mrem. For 2010, the DLR read 27 mrem annual dose and the electronic dosimeter read 21 mrem. If there was any dose from the ISFSI pad, it appeared to be minimal. The inspectors concluded that the overall affect of the ISFSI pad on the welding shop personnel was not significant, especially considering the variations from year to year that the workers were already experiencing as radiation workers.

d. <u>Cask Temperature Monitoring (TS 3.1.2 for HI-STORMs and TS 1.3.1 for VSC-24s)</u>

For the Holtec casks, Technical Specification (TS) 3.1.2 of CoC No. 1014 required either a daily inspection of the inlet and outlet vents for blockage or daily verification that the temperature difference between the HI-STORM outlet temperature and the ISFSI ambient temperature was less than a specified temperature. This temperature value varied between various amendments utilized at ANO. None of the thirty-seven HI-STORM casks stored at ANO's ISFSI were equipped with temperature monitoring equipment. As such, the licensee performed daily vent inspection to comply with TS 3.1.2. For the Energy Solutions casks, Technical Specification 1.3.1 of CoC No. 1007 required a daily inspection of the VSC-24 inlet and outlet vents for blockage to ensure adequate cooling.

The vent inspection surveillances for both the HI-STORM and VSC-24 casks were performed using Procedure 1015.003B “Unit Two Operations Logs,” Revision 73. Documentation was reviewed for the months of June 2009, April 2010, October 2011, February 2012, and June 2012 for compliance with the technical specifications. Of the six months selected for review, the surveillance requirement was met and no cask vents were reported as being blocked. During the review of condition reports, CR-ANO-C-2011-1070 documented that an operator found two rubber non-slip mats that had been blown against two VSC-24 storage casks during the night. The mats were observed to be blocking one inlet vent on the two different VSCs. The operator generated the condition report and removed all mats from inside the ISFSI fenced area. The mats were originally placed on the concrete pad as an industrial safety precaution to help prevent slip injuries.

e. Corrective Action Program

Selected condition reports since the last NRC inspection in April of 2009 were reviewed. The licensee provided a list of condition reports related to the ISFSI and the spent fuel pool overhead crane (L-3 crane) from which the NRC inspectors selected a number for further review. The condition reports and a brief description of each are provided as Attachment 2 to this inspection report.

A wide variety of issues were identified in the condition reports. Resolution of the issues was appropriate for the safety significance of the issue. No significant trends were found during the review of the condition reports, which covered a three and a half year period. The licensee’s condition reports had been categorized based on significance. Procedure EN-LI-102 “Corrective Action Process,” Revision 19, defined Severity Level A as significant conditions adverse to quality, Severity Level B as conditions adverse to quality, Severity Level C as an event or condition of minor consequences, and Severity Level D as a condition requiring no action assignment.

f. Condition 9: Supplemental Cooling System

On September 29, 2009, ANO notified the NRC (ADAMS Accession ML092810250) of the completion of the supplemental cooling system (SCS) validation test and analysis required by Condition 9 of the Holtec CoC No. 1014. The requirement in Condition 9 applied to each first time user of a SCS that had not been previously tested. Technical Specification 3.1.4 required the SCS to be placed in service within four hours of completion of canister drying operations when the canister contained one or more fuel assemblies with an average burnup of ≥ 45,000 MWD/MTU or the canister’s total heat load $Q_{(CoC)}$ was > 28.74 kW. The purpose of the test required by Condition 9 was to verify that the design and operating features of the SCS being used by the licensee was adequate to ensure adequate cooling of the canister shell to keep the spent fuel stored in the canister below the thermal limits specified in the license.

The SCS consisted of a large circular pipe positioned on top of the HI-TRAC transfer cask. The pipe sprayed coolant down the sides of the canister in the annulus gap between the canister shell and the HI-TRAC transfer cask to provide cooling to the canister. The coolant was then collected in the bottom of the HI-TRAC annulus and pumped to an air heat exchanger were it was cooled and then returned to the sprayer on the top to repeat the process. The system used contamination-free (demineralized)

water as the coolant and was required to be sized to limit the coolant temperature to below 180 degrees F under steady-state conditions for the design basis heat load at an ambient air temperature of 100 degrees F. The pump and air heat exchanger were required to be electrically powered with a backup power supply (a battery) for uninterrupted operation.

Condition 9 required first time users of a SCS (not previously tested) to measure and record the coolant flow rate and the coolant temperatures for the inlet and outlet of cooling provided to the annulus between the HI-TRAC transfer cask and the canister. The user was also required to record the canister operating pressure and decay heat. From this data, an analysis was performed to validate the thermal methods described in the FSAR which were used to determine the type and amount of supplemental cooling necessary.

The first use of the SCS was tested at ANO on August 5, 2005 during the loading of Cask 15 (MPC 24-45) with a total decay heat load of 19.992 kW. Cask 15 was an MPC-24 design. The SCS was listed in FSAR Table 8.1.6 "HI-STORM 100 System Ancillary Equipment Operational Description" as Important-to-Safety, Category B and was described in FSAR, Appendix 2.C "Supplementary Cooling System." The test was performed under the ANO quality assurance program. Calibration records were reviewed for the thermometers and flow meters. Wika thermometer, Serial # SCS-T101 was calibrated on June 27, 2005. Wika thermometer, Serial #SCS- T102 was calibrated on June 27, 2005. Flowmeter PT868, Serial # 1594 was calibrated March 3, 2005. The test data collected by ANO was sent to Holtec for analysis. Holtec issued Report HI-2094415 "Validation of First Use of Supplemental Cooling System at Arkansas Nuclear One" on August 8, 2009 (proprietary). The Holtec analysis was submitted to the NRC by ANO on September 29, 2009 (ADAMS Accession ML092810250).

The Holtec analysis used a computational fluid dynamics heat transfer model to calculate the converged temperature contours in the canister based on the data collected at ANO for an MPC-24 cask containing a 20 kW heat load. The calculations and the ANO test results determined that the resulting peak fuel cladding temperature would be 437 degrees F, which was well below the design limit of 752 degrees F (400 degree C) stated in the CoC (Amendment 2), Appendix B, Section 3.7.2.5. This confirmed that the thermal methods described in the FSAR were adequate for determining the type and amount of supplemental cooling necessary.

g. <u>Annulus Cooling Temperature Issue</u>

On February 16, 2012, ANO issued Condition Report CR-ANO-2012-00399 documenting an issue with the SCS cooling capability to maintain adequate annulus cooling for canisters containing high decay heat loads. The SCS circulated water between the annulus region (gap between the canister and HI-TRAC transfer cask) using an air cooled heat exchanger after the canister was dried and backfilled with helium. This was required by Technical Specification 3.1.4 under certain conditions. The condition report stated that fuel assemblies were being selected for the 2012 loading campaign that could result in the canister having heat loads greater than 28 kW. During a previous loading campaign, difficulty was experienced in maintaining acceptable cooling of a canister with a heat load of 27.64 kW. During that time, steaming had been observed in the annulus region. Subsequent canisters had been limited to approximately 26 kW to reduce the likelihood of the water boiling in the

annulus gap. Use of the SCS to provide annulus cooling supplied several benefits including reducing both the transfer cask and canister temperatures, which had become a personnel safety issue for the higher heat load canisters; reducing the temperature during the dye-penetrant examination of the port and vent cap welds, which was limited to 350 degree F; and reducing the temperature during the preparation for downloading of the canister from the transfer cask to the HI-STORM storage cask using Kevlar slings, which were limited to 300 degree F.

The condition report stated that the SCS system designed by the cask vendor (Holtec) was originally rated to have a cooling capacity for casks up to 36.9 kW. The original system design had made certain assumptions related to system operations and cooling capacity and had taken credit for the cooling effects of the adjacent environment around the cask. No assumption had been made to account for the use of temporary shielding on the cask or other constraints to the thermal air flow. ANO's loading process included placing the cask in a work space in an enclosed cask pit with work platforms placed around the upper area of the transfer cask. Foreign material exclusion (FME) blankets and thermal blankets were placed around the work platform and transfer cask. The canister lid was also covered with a neutron shielding material and lead blankets to reduce radiation levels. The use of the blankets and shielding basically insulated the canister and reduced the free flow of heat to the environment. These features had not been incorporated into the Holtec calculations. In addition, inspection of the heat exchanger cooling fins on the ANO system found fouling (presence of small amounts of dust, debris, and particles) that reduced cooling capacity by an estimated 10%. Temperatures in the work areas around the cask may have exceeded 90 degree F during the day. The ANO SCS had been in operations approximately 12 years and had received no yearly preventive maintenance.

ANO requested Holtec to perform a review of the ANO specific configuration being used for cask loading of the high decay heat casks. ANO requested that a maximum lid temperature of 325 degree F be used as the limiting factor due to personnel and operational safety concerns. Holtec provided ANO with analysis HI-2125213 "Evaluation of MPC Lid Temperature Under HI-TRAC Operation at the ANO Nuclear Station," Revision 0 on June 15, 2012. The evaluation considered both the MPC-24 and MPC-32 canisters. Input assumptions to the model included an ambient temperature of 110 degree F and neglected canister heat dissipation to the HI-TRAC transfer cask or atmosphere to account for the use of the blankets and shielding at ANO. The SCS was used to provide annulus cooling and the water in the annulus was assumed to be maintained within four inches of the lid. The methodology used in the calculations of cladding temperature were the same as described in the FSAR, Section 4.5 "Thermal Evaluation of Short Term Operations." The calculations determined that limiting the decay heat load to 26 kW would achieve the goal of a lid temperature below 325 degree F. The analysis calculated that the peak cladding temperature would reach 540 degree F for the fuel. This maintained the fuel below the limits in NRC Interim Staff Guidance (ISG)-11 "Cladding Considerations for the Transport and Storage of Spent Fuel," Revision 3. The NRC guidance established a 752 degree F (400 degree C) limit on the cladding temperature of high burnup fuel inside the canister under short term operations.

Condition Report CR-ANO-2012-00399 stated that several procedural controls would be required to be introduced into site procedures to insure the assumptions within the calculation were maintained. These controls included a maximum heat load of 26 kW

and a required minimum flow rate of 8 gpm on the SCS. These procedural controls were being tracked by the condition report to be placed in the appropriate procedures.

ANO revised Procedure 3403.005 “HI-STORM 100 System Loading Operations” as Revision 27 to include Step 6.1.27 and as a note prior to Step 9.1.29 which stated “The maximum decay heat load limit for an MPC-24/32 is less than 26 kW. This is an administrative limit based on the physical limitations of the SCS and recommendations from Holtec (refer to Holtec Report HI-2125213).”

h. Condition 9: Thermal Validation Test

Condition 9 of CoC No. 1014 for the Holtec HI-STORM 100 cask system required an air mass flow rate test (thermal validation test) to be performed on the first HI-STORM cask system placed into service by any user with a heat load equal to or greater than 20 kW. An analysis of the data was required to demonstrate validation of the analytic methods and thermal performance predicted by the licensing-basis thermal models in Chapter 4 of the FSAR.

ANO uses two HI-STORM cask designs, the HI-STORM 100S and the HI-STORM 100S Version C. The ANO thermal validation test was performed on the HI-STORM 100S Version C. The HI-STORM 100S Version C is a “hybrid” version of the HI-STORM 100 system overpack. This overpack has inlet vents like the HI-STORM 100S overpack and outlet vents like the HI-STORM 100S Version B overpack. The inlet vents on the HI-STORM 100S are taller and narrower than the 100S Version B. Other than the differences in the inlet vents and in the geometry and material of the pedestal underneath the canister, the Version B is identical to the Version C. The thermal analysis described in the FSAR used the HI-STORM 100S Version B. The thermal model for the analysis of the ANO test data was modified to account for the differences in the geometry between the Version B and Version C overpacks. The geometry changes were input data and not elements of the methodology, which was independent of specific geometry.

ANO performed the required thermal validation test data collection on July 21, 2010 and submitted the results of the test to Holtec for analysis. The thermal validation test was performed on Cask 30, a HI-STORM 100S, Version C cask (overpack), serial number 105. The cask contained MPC 24-052 which had been loaded on April 20, 2009 with a heat load of 23.21 kW. The test was performed by ANO site personnel under Work Order 00197971. ANO had coordinated the test process and equipment with Holtec. On the day of the test, wind speeds were less than 1 meter per second and wind direction was indeterminate. Equipment used for the test included a hot wire anemometer with one flexible and one fixed probe (DANTEC LVFA wind tunnel 435-1010, calibration date February 07, 2009); a 90 degree measurement tool; a resistance temperature detector (RTD) air temperature monitoring system for eight probes (required for the four inlet and four outlet vents); modified upper HI-STORM vent screens; a handheld hygrometer, humidity and temperature meter; and a mobile personnel lift.

The work instruction required the installation of an RTD on each of the eight vent screens to measure the inlet and outlet temperatures on the HI-STORM during the test. The RTDs on the outlet screens were installed facing inward. The RTDs on the inlet screens were installed facing outward. A data logger was used to track temperature readings. The technician positioned himself on a personnel lift and inserted the

anemometer probe, attached to the 90 degree insertion tool, through the upper modified vent screen and down 11.375” from the bottom edge of the outlet vent into the annulus between the canister and HI-STORM storage cask. Temperature and flow readings were monitored for 10 minutes to ensure stable conditions. When stable conditions were verified, the probe was positioned against the HI-STORM interior wall and air velocity readings were recorded every half second for one minute. For the next measurement, the probe was moved 1/8” inward toward the canister. Readings were repeated at 1/8” intervals until measurements were taken across the entire gap between the HI-STORM and the canister. The measurements were repeated for each outlet vent of the HI-STORM. For the purposes of the test, the outlet vents were labeled north, west, south, and east. The corresponding inlet vents were labeled north-east, north-west, south-west, and south-east. Average annular air velocities measurements ranged from 0.7221 to 1.0441 m/s for the north vent, 0.6977 to 1.3233 m/s for the west vent, 0.8429 to 1.1986 m/s for the south vent, and 0.8050 to 1.4905 m/s for the east vent. A December 18, 2012 meeting between NRC, ANO, and Holtec reviewed the test methodology and results. An in-office review of the material collected during that meeting was conducted by the NRC. As a result of further discussions with the ANO staff, it was identified that the ANO thermal validation test had not fully implemented the ANO quality assurance program in that the instrumentation used for the test had not been controlled and calibrated in accordance with the ANO calibration program for safety related and important-to-safety instruments. The anemometer had been calibrated seventeen months prior to the test and had not undergone a post calibration after the test to confirm the instrument was functioning properly during the test. Temperature measurements during the thermal validation test were taken on the four inlet vents and the four outlet vents. The outlet vent values were used by Holtec in their analysis to determine the air densities used to convert velocities into mass flow rates. The RTDs had originally been tested by the vendor, OMEGA Engineering in accordance with American National Standard Institute (ANSI) International Electrotechnical Commission (IEC) 60751 “Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors.” Four accuracy classes were established in IEC 60751. The RTDs used at ANO were Class A with an accuracy of +/- 0.15 + 0.002 times temperature for temperatures from -30 degree F to 300 degree F. The RTDs had not been post calibrated or tested after the thermal validation test.

Information was provided by ANO concerning their position on the applicability of the ANO quality assurance program calibration requirements to the instrumentation used for the thermal validation test. ANO and Holtec took the position that the data was not being used in any design basis calculations, but as an operational support for the canister after loading which was not an important-to-safety activity. As such, the anemometer and the resistance temperature monitors were not required to be calibrated in accordance with the ANO quality assurance program. The NRC reviewed the ANO/Holtec position and on February 13, 2013 conducted a conference call with ANO and Holtec. The NRC’s position is that the thermal validation test is a required test to satisfy the conditions of the CoC with the purpose of confirming the adequacy of the cooling provided to the loaded canister inside the HI-STORM overpack during the storage configuration to prevent unacceptable temperature levels from being reached that could degrade the spent fuel cladding. As stated in the Holtec FSAR, Section 4.3, the long term integrity of spent fuel is ensured by the HI-STORM system thermal evaluation which demonstrates that fuel cladding temperatures are maintained below design basis limits. The thermal validation test was intended to validate the model, and as such, to validate the thermal performance of the HI-STORM 100 cask system

components used for storage, which are “important-to-safety” components, to demonstrate that they would perform their safety function. As such, the requirements of 10 CFR 72, Subpart G “Quality Assurance Program” would apply to the Condition 9 thermal validation test. Specifically, 10 CFR 72.164 required that measuring and test equipment were required to be properly controlled and calibrated.

10 CFR 72.164 “Control of Measuring and Test Equipment” requires, “The licensee, applicant for a license, certificate holder, and applicant for a CoC shall establish measures to ensure that tools, gauges, instruments, and other measuring and testing devices used in activities affecting quality are properly controlled, calibrated, and adjusted at specific periods to maintain accuracy within necessary limits.” Contrary to the requirements in 10 CFR 72.164, the anemometer and the resistance temperature detectors were not being controlled and calibrated in accordance with the ANO quality assurance program. Because this violation was entered into the licensee’s corrective action program and the issue was not a repetitive violation or willful, this violation is being treated as a Non-Cited Violation (NCV 72-13/1201-01), consistent with Section 2.3.2 of the NRC Enforcement Policy.

The validity of the data collected by ANO during the thermal validation test for use in the Holtec thermal model analysis is currently considered indeterminate and requires additional confirmation. This issue will be tracked as an Unresolved Item (URI 72-13/1201-02).

The ANO thermal validation test results had been forwarded to Holtec by Entergy for evaluation. Holtec issued Holtec Report HI-2114925 “HI-Storm 100 Cask System Thermal Performance Validation Using Air Flow Test Data,” Revision 0 (Proprietary) to document the results of their analyses. The report stated that the acceptance criteria for the thermal validation test was that the total air mass flow rate through the annular space predicted by the thermal model must be less than or equal to the total air mass flow rate determined from the test data. Holtec’s thermal model calculated a mass flow rate of 0.313 kg/s through the annulus between the canister and the HI-STORM interior cask surface. The ANO thermal validation test measured the mass flow rate as 0.399 kg/s.

On February 3, 2012, Entergy submitted a letter to the NRC informing the agency of the completion of the thermal validation test and the completion of the Holtec analysis (ADAMS Accession ML12038A177). The Holtec Report HI-2114925 was attached to the ANO letter. On September 14, 2012, Holtec also informed the NRC of the completion of the ANO thermal validation test and provided a copy of Holtec Report HI-2114925 (ADAMS Accession ML12264A541). The Holtec report indicated that the thermal model utilized in the licensing-based analysis methodology had predicted an air mass flow rate lower than the values measured in the ANO thermal test and, as such, demonstrated an overall conservatism of the licensing-based methodology, thereby confirming the suitability of the methodology for demonstrating the thermal-hydraulics safety of the HI-STORM 100 cask system and satisfying the requirement of Condition 9.

Holtec issued a statement to the other HI-STORM 100 users concerning the ANO test on a HI-STORM 100S Version C overpack and whether the results could be applied to other cask models of the 100 series. Holtec Licensing Position Paper HL-2011-01 was distributed to Holtec cask users dated August 5, 2011. The position paper stated that Condition 9 did not specify that the thermal validation test was required for each configuration of the overpack. Holtec noted that Table 1.0.1 of the FSAR for the

HI-STORM casks listed several overpack models such as the HI-STORM 100, 100S, and 100S Version B and that the requirement in Condition 9 was to “validate the analytical models” in Chapter 4 of the FSAR. The licensing basis models in the FSAR for the thermal modeling were based on the geometry of the HI-STORM 100S Version B overpack. Holtec concluded that the ANO test data demonstrated the validity of the thermal models and as such, the results of the ANO test could be applied to any of the HI-STORM 100 overpack configurations. During a meeting on December 18, 2012 between the NRC, ANO and Holtec, the applicability of the ANO test to the other HI-STORM overpacks was discussed extensively. The position taken by Holtec that the ANO test was to validate the thermal models in Chapter 4 of the FSAR and not to validate a particular overpack configuration was agreed to as the intent of Condition 9. However, a number of questions remained as to the sensitivity of the test results to the various configurations of the overpack dimensions and vent sizes. As such, the NRC is performing an independent evaluation to confirm Holtec’s position. Until the NRC completes this evaluation, the conclusion reached by Holtec has been accepted. This issue will be tracked as an Unresolved Item (URI 72-13/1201-03).

i. Failure to Perform Helium Leak Testing of Canisters During Fabrication, Holtec Information Bulletin (HIB) - 39

During a 2009 inspection of Holtec, Int., the NRC identified an issue related to the helium leak testing of the canisters during fabrication. Holtec had revised their FSAR to eliminate the requirement for a shop helium leak rate test after fabrication on the canister confinement boundary welds (shell seam weld and shell-to-baseplate weld). The NRC considered this test as one of the tests to demonstrate the integrity of the canister confinement boundary. The NRC issued a Non-Cited Violation to Holtec for discontinuing the helium leak test in a letter dated August 6, 2009 (ADAMS Accession # ML092180140 *incorrectly dated as August 5, 2009*) entitled “Exercise of Enforcement Discretion – Holtec International.” Holtec agreed to re-instate the helium leak test requirement. Between the time the helium leak testing was discontinued during canister fabrication until the time the testing was re-initiated, several canisters had been manufactured and sent to reactor sites. Holtec informed the affected users of the issue in Holtec Information Bulletin (HIB)-39.

When ANO became aware of the NRC finding, they issued Condition Report CR-ANO-C-2009-0307 on February 20, 2009 to document the issue as an emerging condition and to follow progress between the NRC and Holtec to resolve the issue. The day after the NRC issued the August 6, 2009 letter to Holtec with the Non-Cited Violation, ANO opened Condition Report CR-ANO-C-2009-1531 documenting the new information and began an assessment to determine the operability of the loaded casks at ANO that were impacted. Seven loaded canisters were affected at ANO (MPC Serial Nos. 24-47, 24-48, 24-49, 24-50, 24-51, 32-66, and 32-67). The heat load of the affected canisters ranged from 9.74 kW to 27.64 kW. Two canisters had been loaded with a heat load greater than 21 kW. These were MPC 32-67 loaded with Unit 2 spent fuel and a heat load of 27.64 kW and MPC 32-66 also loaded with Unit 2 spent fuel and a heat load of 26.67 kW. Holtec provided a letter to the NRC dated September 2, 2009 (ADAMS Accession # ML092470363) in response to the Non-Cited Violation issued in the August 6, 2009 NRC letter. Holtec’s response included analysis that supported continued use of the loaded canisters that had not been leak tested during fabrication, including those currently loaded at the ANO ISFSI.

On November 2, 2010 (ADAMS Accession # ML103090653), Entergy provided information to the NRC related to the seven loaded ANO canisters. The Entergy letter provided information that had been requested by the NRC during a teleconference on December 1, 2009 (ADAM Accession # ML093510008). Entergy noted that the maximum heat load for the canisters was 27.64 kW and that no discernable increase in offsite dose had been detected since the loaded casks were placed in the ISFSI. The non-conforming condition of the canisters was entered into the site corrective action program and an operability determination was performed which concluded that the affected canisters continued to perform within their designed safety function. The heat load of the highest canister, MPC 32-67 at 27.64 kW, was projected to be below the 21 kW value discussed in the December 1, 2009 teleconference, by December 1, 2015. This would be a drop of 6.6 kW over an 8 ½ year period. The NRC responded to Entergy by letter dated January 26, 2011 (ADAMS Accession ML110270139) stating that the NRC had reviewed the information provided by Holtec and the information provided by Entergy and had determined that the affected canisters currently stored at the ANO ISFSI were acceptable for continued use. No further actions were necessary.

j. <u>Thermal Issues During Canister Loading, NRC Information Notice 2011-10</u>

NRC Information Notice (IN) 2011-10, "Thermal Issues Identified During Loading of Spent Fuel Storage Casks" (ADAMS Accession ML111090200) was distributed to all holders of a Part 72 license on May 2, 2011. The purpose of the notice was to inform the addressees of an incident that occurred during the loading of spent fuel storage canisters at the Byron Generation Station. The NRC expected recipients to review the information for applicability to their facilities and take appropriate actions to avoid similar problems. Byron, using the HI-STORM 100 system, experienced a canister cooling system malfunction. The circulating water in the annulus between the canister and transfer cask (annulus cooling) used to keep the fuel cladding temperatures below allowable limits was found to be inoperable after being left unattended during the night shift. The annulus cooling system was required when loading higher kW canisters using the vacuum drying option. The information notice discussed six potential issues related to the incident, five of which related to vacuum drying and one related to the use of nitrogen for blowing down the canister. Holtec issued two notifications to their users in HIB-45 and HIB-48 that also addressed the same issues identified in the NRC information notice regarding the use of vacuum drying. Entergy headquarters issued condition reports CR-HQN-2010-1026 for HIB-45/HIB-48 and CR-HQN-2011-0498 for NRC Information Notice 2011-10. All Entergy sites were asked to determine if the issues affected their site. ANO had utilized vacuum drying for the first six Holtec casks that were loaded on site. ANO issued condition report CR-ANO-C-2010-2534. ANO's review concluded that the issues identified in HIB-45, HIB-48, and NRC Information Notice 2011-10 were not applicable to the first six canisters that used the vacuum drying technique. The fuel loaded in the first six canisters was below the limits identified in the notices, such that the canisters did not require annulus cooling or an additional evaluation.

The sixth issue of the NRC information notice related to the use of nitrogen for blowing down a canister to remove water prior to backfilling with helium and sealing the canister. Since ANO used helium for the blowdown, this issue was also not applicable.

k. Determination of Total Heat Load, Holtec Information Bulletin (HIB) - 51

Holtec issued HIB-51, Revision 0, on October 25, 2011 and Revision 1 to the bulletin on December 14, 2011 to the Holtec users group. The bulletin applied to users of the CoC No. 1014, Amendment 5 or greater. The bulletin discussed an operational issue that was discovered at Tennessee Valley Authority (TVA) by Holtec, when providing technical support to that user. Holtec determined that TVA had calculated the total heat load of their MPC canisters by using a simple summation of the individual assembly heat loads. This practice was later found to be the case for many Holtec users, including ANO. Holtec Casks 30 - 37 had been loaded at ANO to CoC, Amendment 5 prior to the date of issuance of HIB-51.

Summing the individual storage cell heat loads to determine compliance with canister threshold heat load limits was not consistent with FSAR Revision 7, Section 2.1.9.1.2. This section in the FSAR contained a discussion on the total canister heat load (Q_{CoC}) and how to calculate it for compliance to various technical specifications. For uniform loading (which is how ANO loaded fuel), Q_{CoC} was defined as the highest heat load assembly multiplied by the number of locations in a canister (r_{max} * n). ANO used the MPC-24 and MPC-32 canister with 24 or 32 fuel storage locations. Holtec stated that the conservative method of calculating total heat load was necessary as otherwise the system designer would have to consider an infinite number of heat load distributions and that would be practically impossible. It was easier for the system designer to assume all locations were generating a heat load of r_{max} to run the thermal model to ensure peak fuel cladding temperature limits were not exceeded. The FSAR Section 2.1.9.1.2 method of calculating heat load Q_{CoC} applied to the helium backfill requirement (TS Table 3-2), the supplemental cooling system requirement (TS 3.1.4), the requirement for use of the forced helium dehydration system (TS Table 3-1), the heat removal system requirement (TS 3.1.2), and the vacuum drying time limit requirement (TS 3.1.1).

ANO had loaded all eight CoC, Amendment 5 canisters using the uniform heat load criteria but had calculated each canister's heat load using the simple summation method of summing all individual assembly's heat loads instead of using the method described in FSAR Section 2.1.9.1.2 ($Q_{CoC} = r_{max}$ * n). Upon receiving HIB-51, Revision 0, from Holtec, ANO initiated Condition Report CR-ANO-2-2011-3355 on October 25, 2011. The condition report documented the issue and stated that information on the content of the affected casks had been sent to Holtec for analysis. Holtec submitted an analysis to ANO in "Response to Request for Technical Information (RRTI) # 2010-002" dated November 4, 2011. The RRTI documented that of the eight vulnerable casks, all of which were initially calculated to be less than 28.74 kW (using summation method); MPC serial numbers 32-84, 32-159, 32-163, and 32-164 were in fact above 28.74 kW when calculated in accordance with the FSAR guidance (Q_{CoC}). These four canisters should have been filled with the higher helium backfill pressure (≥ 45.5 psig and ≤ 48.5 psig) per Technical Specification Table 3-2. When loading the higher kW assemblies as allowed in Amendment 5, only the higher backfill pressure scenario had been previously analyzed in the FSAR. The actual backfill pressure for MPC 32-84, MPC 32-159, MPC 32-163, and MPC 32-164 was 36.3 psig, 32.7 psig, 37.1 psig, and 37.9 psig respectfully. In accordance with the Technical Specification action requirements, ANO, with assistance from Holtec, performed an evaluation to demonstrate all FSAR limits for cask components were still met. The RRTI stated that the thermal models using the fuel characteristics of the four canisters and the actual amount of helium in those canisters demonstrated that the peak cladding temperature limits for both the short-term

operations and long-term storage conditions stayed below the 752°F (400°C) limit for all four casks. The RRTI concluded that the as-loaded canisters met all applicable acceptance criteria set forth in the system's FSAR.

Condition 2 of CoC No. 1014, Amendment 5, stated that written operating procedures shall be prepared for cask handling, loading, movement, surveillance, and maintenance, and that user's site-specific written operating procedures shall be consistent with the technical basis described in Chapter 8 of the FSAR. Contrary to this requirement, ANO's site-specific written operating procedures were not consistent with the technical basis described in Chapter 8 of the FSAR. Section 8.1.5 "MPC Closure," Step 6.n stated "… backfill the MPC in accordance with technical specifications." ANO's Procedure EN-DC-215 "Fuel Selection for Holtec Dry Cask Storage," Revision 2 was not consistent with the technical basis because it did not contain the correct methodology to calculate cask heat load (Q_{CoC}). As a result, from May 4, 2009 through November 3, 2010, the heat loads were incorrectly calculated for Casks 31, 35, 36, and 37 (MPC serial numbers 32-84, 32-59, 32-163, and 32-164), which resulted in backfilling the casks with less helium than specified in the technical specifications. The NRC has determined that this is a Severity Level IV Violation of Condition 2 of CoC No. 1014. Because this violation was entered into the licensee's corrective action program, an analysis was performed demonstrating that the canisters still met all criteria set forth in the FSAR, the licensee's Procedure EN-DC-215 was changed in Revision 3 to correctly calculate future cask heat load (Q_{CoC}) values, and the issue was not a repetitive violation or willful, this violation is being treated as a Non-Cited Violation (NCV 72-13/1201-04), consistent with Section 2.3.2 of the NRC Enforcement Policy.

l. <u>Isolation of Loaded Canisters, Holtec Information Bulletin (HIB) - 53</u>

Holtec Information Bulletin HIB-53 was issued to the Holtec users group on December 6, 2011. The bulletin described an issue that was observed by NRC inspectors at the Waterford nuclear plant (ADAMS Accession ML12124A387). While Waterford was loading their first canister, operators isolated the canister by closing both the vent and drain port caps during installation of the remote valve operating actuators. Having both port caps closed at the same time isolated the canister without having any release path or relief valve available while the canister was filled with water and fuel. This could have pressurized the canister due to the thermal heat of the spent fuel. The Holtec bulletin reminded users that the vent and drain port caps should not be closed simultaneously and that the remote valve operating actuators must be installed one at a time in the open position when the canister is filled with water. ANO issued Condition Report CR-ANO-C-2012-2056 to review the bulletin and document the applicability of the issue at their site. The condition report documented a change that was made to Procedure 3403.005 "HI-STORM 100 System Loading Operations" Revision 27 which added a caution note to avoid hydraulic isolation of the canister when loaded and generating heat.

m. <u>Stack-Up During Canister Downloading Into the HI-STORM Storage Cask</u>

Arkansas Nuclear One initiated condition report CR-ANO-C-2011-0736 after another Entergy plant, the Perry Nuclear Power Plant, received a Non-Cited Violation from NRC Region III regarding the use of a freestanding stack-up configuration of the Holtec cask system. The stack-up configuration occurs when the HI-TRAC transfer cask containing a canister loaded with spent fuel is placed on top of the HI-STORM concrete storage cask to allow for lowering of the canister into the HI-STORM cask. This is performed

within the ANO auxiliary building. Concerns at the Perry Nuclear Power Plant had been raised related to the stability of this stack-up configuration during a seismic event when the HI-TRAC and HI-STORM were not constrained and were freestanding. As a freestanding structure, the stacked cask configuration could move or rock during a seismic event. ANO had also been utilizing a freestanding stack-up configuration without seismic restraints to perform dry cask storage operations. The original calculations for the acceptability of the freestanding stack-up and railcar configuration used at ANO was performed for the total static weight on the floor, dynamic analysis for cask movement and floor loads, dynamic analysis for the railcar, and combined dynamic analysis for the stack-up and the railcar. The dynamic analyses had shown that the stack-up configuration at ANO would not tip over during a seismic event.

The ANO condition report documented the generic findings identified by NRC's review of Perry's stack-up seismic analysis. Based on the NRC's findings at Perry, a general critical review of the original ANO Dry Cask Stack-Up Dynamic Analysis, CALC-01-E-0012-003, and supporting calculations was performed to determine if the same issues identified at Perry were applicable to ANO. The licensee's review of the their stack-up calculations identified the following technical issues: (a) the calculations assumed the rail car was detached from the stack-up and did not consider the interaction of the nearby railcar with the rocking cask during a seismic event; (b) the calculation assumed the cask was in full contact with the floor, however this did not match the loading sequence (the cask was supported by shims); (c) the trainbay beam that is in the floor acts like a large spring, which was not included as part of the analysis; and (d) the HI-TRAC transfer cask was assumed to be unable to slide on the mating device, however the alignment pins and mating device lift lugs had not been evaluated to verify they would prevent sliding. In addition, a number of issues identified at Perry by the NRC had not been included in the ANO analysis. These included: (a) assuming a range of friction factors instead of a fixed friction factor; (b) addressing local impact effects if the cask tips; (c) assuming greater safety factors for rocking of the cask to provide for a greater confidence level; (d) using multiple time histories based on actual events for performing the non-linear analysis of the stack-up; and (e) using finite element computer programs such as ANSYS or LS-DYNA. ANO had used ALGOR.

Based on the technical issues identified by the licensee, ANO contracted with Holtec to perform additional analysis to provide a high level of confidence that the stack-up would not tip over during a seismic event. The new stack-up analysis was performed by Holtec. The floor loads that were calculated in the new stack-up calculation were used as inputs into the U1 Auxiliary Building Trainbay Floor Analysis, CALC-01-E-0012-05. Using the new floor loads and upon further review of CALC-01-E-0012-05, the licensee identified that several technical issues required further evaluation. Condition report CR-ANO-C-2012-1865 was issued July 17, 2012 which stated that errors had been found in the trainbay floor calculation CALC-01-E-0012-05. The errors included:

(a) The calculation arbitrarily assumed the load applied to the floor from the stack-up analysis was reduced by 10%. If the cask was rocking, the entire load would be applied in a single location on the floor so this assumption was not valid. The floor would potentially have exceeded the design allowable if an additional 10% of the load was applied.

(b) The calculation only considered stack-up rocking in the east and west directions, not north and south. During a seismic event, the rocking could

occur in any direction. (Note: a concrete beam in the trainbay floor runs east to west and is 90 inches in width and four feet three inches thick. The stack-up straddles the beam, however, the HI-STORM's 134 inch diameter is larger than the 90 inch wide beam. The floor to either side of the concrete beam is one foot nine inches thick).

(c) Shims were installed all the way around the cask. The north and south shims were located under the HI-STORM on the thinner one foot, nine inch thick portion of the concrete slab. The calculation did not analyze for rocking on the north and south floor shims. It was determined, based on re-analysis, that the north/south shims located on the one foot nine inch thinner concrete would have exceeded design limits if rocking occurred on the shims during an earthquake.

(d) Rocking of the cask in the north/south direction on the support beam would cause torsion loading on the beam which was not evaluated in the floor calculation. Preliminary indications through re-analysis showed the floor would have potentially exceeded design limits due to the torsion loading.

(e) The calculation did not include the steel support plate (spring board) that was embedded in the trainbay floor. This steel support plate was cantilevered under the stack-up to provide support of the load, but its presence would be a potential for additional rocking and would cause other structural stresses in the supporting floor and walls that were not considered in the calculation.

(f) The analysis did not evaluate the floor directly east and adjacent to the stack-up. The east slab could rotate at the joint due to the presence of the spring board.

(g) The calculation did not address live loads such as personnel or other equipment that was normally present during the stack-up evolution.

As a result of the discovery of the errors in the trainbay floor calculations, ANO has stopped all loading activities until the seismic and floor loading concerns have been resolved. The last cask was loaded in November 2010. Spent fuel pool capacity is being approached and will become a problem. Unit 1 currently has full core offload capacity. However, after the planned refueling outage in the spring of 2013, full core offload capability will be lost. Unit 2 currently does not have full core offload capability. Their next outage for Unit 2 is the spring 2014. ANO is reviewing several options for resuming cask loading. These include adding floor supports to the trainbay, enhancing crane hoist capability such that the crane does not disengage from the transfer cask during stack-up and thereby provide support during a seismic event to prevent rocking, performing the stack-up at a different location in the trainbay, or installing a cask transfer facility (CTF) outside the trainbay to facilitate the stack-up.

Federal Regulation 10 CFR 72.212(b)(6), states that a general licensee must review the Safety Analysis Report, the Certificate of Compliance, and the NRC Safety Evaluation Report, prior to use of the general license, to determine whether or not the reactor site

parameters, including analyses of earthquake intensity, are enveloped by the cask design bases considered in these reports. Contrary to this requirement, ANO's U1 Auxiliary Building Trainbay Floor analysis, CALC-01-E-0012-05, was determined to be inadequate to demonstrate that the trainbay floor could withstand the stack-up floor loading that could occur during a seismic event. As a result, from December 2003 through November 2010, ANO had loaded 37 Holtec casks within the Auxiliary Building on the trainbay floor which was inadequately analyzed to withstand the possible floor loading that could occur during a seismic event. The NRC has determined that this is a Severity Level IV Violation of 10 CFR 72.212(b)(6). Because the licensee took appropriate actions by halting the loading operations within the Auxiliary Building and entered the issue into the corrective action program, and because the issue was not a repetitive violation or willful, this violation is being treated as a Non-Cited Violation (NCV 72-13/1201-05) consistent with Section 2.3.2 of the NRC Enforcement Policy.

n. Five Year Surveillance Requirement for the VSC-24 Casks

Energy Solutions CoC No. 1007, Technical Specification 1.3.3 "Interior VSC Surface Inspection," Revision 4 required a five year inspection of the interior of the VSC and the exterior of the Multi-Assembly Sealed Basket (MSB) for the first cask placed in service. The results of the inspection were required to be reported to the NRC. The first VSC-24 cask was placed in service at ANO on December 17, 1996. The first five-year inspection was conducted in November 2001 and reported to the NRC on January 10, 2002 (Adams Accession ML020110560). The second five-year inspection was performed in April 2007 and reported to the NRC on April 30, 2007 (Adams Accession ML071240085). The third five-year inspection was completed in January 2012 and reported to the NRC on February 29, 2012 (Adams Accession ML12061A220). The 2012 inspection was performed by the licensee using Work Order 52256537-01 "Five Year Surveillance. The inspection involved a borescope/video camera inserted into each of the inlet vents and the outlet vents to allow a visual examination of the annulus area between the MSB and VSC. The inspection did not reveal any significant problems. The condition of the interior annulus area was similar to what had been seen in the previous inspections. The interior VSC storage cask surface had small amounts of oxidation. Several small stalactite deposits were noted on the outlet vent area at the edge of the annulus region. Samples of these deposits had been taken during the 2001 inspection and shown to be primarily calcium carbonate leached from the concrete due to moisture seeping through the VSC inner shell joint. There was also a small piece of debris (less than 0.25 inches) forming on the inside ledge of the air duct. On the exterior surface of the MSB, small areas of light to medium oxidation were noted. The MSB is a carbon steel basket covered with a zinc based epoxy coating. Approximately the top three inches and the bottom three inches of the MSB were found to be oxidized along with random spots along the side of the cask which showed minor pitting. Overall, the inspection did not identify any problems with air flow or degradation of the cask that would affect performance.

o. Annual Exterior VSC Surface Inspection

Energy Solutions CoC No. 1007, Technical Specification 1.3.2 "Exterior VSC Surface Inspection," Revision 4 required an annual inspection of the 24 concrete VSCs for damage such as chipping or spalling of the concrete on the outer surface of the cask. If defects larger than ½ inch in diameter (or width) and deeper than ¼ inch were found, repair of the defect was required by re-grouting. The annual inspections for 2009, 2010,

2011, and 2012 were reviewed. The 2009 inspection was performed using Work Order 51700831-01 and completed on June 16, 2009. Of the twenty-four casks, thirteen had some level of grout repair completed. Though it was not stated in the 2009 documentation, these types of repairs were typically described in the later annual reviews as pop-outs that required grouting per the technical specification requirement. Screws on several screens were tightened. The status of several cracks were also reviewed that had been identified in 2008 that were approximately 1/16 inch and had originally shown growth. Condition Report CR-ANO-2-2008-01328 had been issued April 23, 2008 to document the cracks. During the 2009 inspection it was noted that the cracks had not shown additional growth. No significant issues were identified in the 2009 annual inspection. The 2010 annual inspection was performed using Work Order 52036675-01 and completed on May 13, 2010. All screens were in good condition. Of the twenty-four casks, sixteen had some level of grout repair completed. The repairs were all referred to as pop-outs. No significant changes in the concrete cracks related to Condition Report CR-ANO-2-2008-01328 were observed. No significant issues were identified related to the casks.

The 2011 annual inspection was performed using Work Order 52255646-01 and completed on September 28, 2011. Seventeen of the twenty-four casks required grouting of pop-outs. A crack on Cask 24 was chipped out and grout applied. The concrete crack on the corner of the northwest vent of Cask 20 identified in Condition Report CR-ANO-2-2008-01328 showed additional growth from 1/16 inch to 3/32 inch. In addition, some of the spider cracks were showing an increase in length and pattern. Condition Report CR-ANO-C-2011-02607 was issued October 13, 2011 to document the cracks. The 2012 annual inspection was performed using Work Order 52346428 and completed on August 27, 2012. Fifteen of the twenty-four casks had pop-outs that were grouted. In addition, eleven of the casks were noted as having spider web cracking, some of which were grouted.

During the tour of the ISFSI pad by the NRC inspectors, the condition of the concrete on the VSC-24 casks was observed. Most casks had some level of spider web cracking and all casks showed evidence of repairs of pop-outs. These types of defects were minor and had minimal impact on the structural and shielding ability of the casks. However, on VSC 24-01, VSC 24-11, and VSC 24-13, efflorescence was observed on cracks of these casks. This condition occurs when water penetrated into the concrete on the cask and dissolves the salts (calcium carbonate) in the concrete. The long term effect is to weaken the concrete such that damage during freeze/thaw cycles becomes more severe. Though the problem was not severe at this time, the licensee agreed that addressing the issue early was a more prudent approach than allowing the issue to become a problem. Several of the Holtec casks were also showing the white deposits around the vents indicating water was affecting the concrete. Holtec HI-STORM 100 serial number 325 (Cask 32) had white deposits on three of the four lower vents. The issue with the Holtec casks is less significant than that with the VSC-24 casks because the Holtec casks have a steel outer shell and inner shell around the concrete to maintain its integrity even if the concrete strength degrades.

p. Records Related to Fuel Stored in the Casks

Permanent records describing the spent fuel stored in the casks is required by 10 CFR 72.212(b)(12). A review of the ANO records was performed to determine if an adequate description of the spent fuel loaded in the HI-STORM casks was documented as a

permanent record. The content of each HI-STORM cask at ANO was documented in a separate binder maintained by the reactor engineering group. For the first thirty-three HI-STORM casks, Procedure 1302.028 "Fuel Selection Criteria for Dry Storage" was used to document the cask content. Starting with Cask 34, Procedure EN-DC-215 "Fuel Selection for Holtec Dry Cask Storage" was used. Both procedures had specific fuel information for each assembly in the cask including information on enrichment, burnup, uranium content, cooling time, discharge date, decay heat, and a table showing the CoC requirements. As each cask loading was completed, the original procedures were forwarded to the permanent records system. The quality assurance program had also reviewed the records for the spent fuel as documented in Procedures 1302.028 and EN-DC-215 for selected casks loaded during 1997, 2006, and 2010 for both the VSC and the HI-STORM casks. Quality Assurance Audit Report QA-20-2012-ANO-1 issued September 18, 2012, found that the records had adequately documented the key technical specification requirements for the spent fuel assemblies for each of the casks reviewed.

1.3 Conclusions

Quality assurance audits and surveillances were being implemented that included ISFSI related activities. A recent 2012 quality assurance audit had reviewed a wide range of topical areas associated with dry cask storage and found that the ISFSI programs were being effectively implemented.

The Unit 1 and the Unit 2 spent fuel were different designs which affected the radiation levels during cask loading. The Unit 2 spent fuel was approximately 18 inches longer than the Unit 1 spent fuel and resulted in the top of the spent fuel being closer to the multipurpose canister (MPC) lid. The licensee used a tungsten shield for neutron shielding and lead blankets to reduce the radiation levels during cask loading.

Personnel doses during cask loading ranged from 0.079 to 0.499 person-rem for the Holtec MPC-24 canisters and 0.331 to 0.665 person-rem for the MPC-32 canisters for the last seventeen casks loaded by the licensee.

Radiological dose rates around the ISFSI pad were less than 1 mrem/hr gamma and neutron. No unexpected radiological conditions were observed during the ISFSI tour. The ISFSI pad area was properly posted.

Vent surveillances of the loaded casks were being implemented in accordance with Technical Specifications.

Selected condition reports were reviewed for the period 2009 thru 2012. A wide range of issues had been identified and resolved. Resolution of the issues was appropriate for the safety significance of the issue. No adverse trends were identified during the review.

The supplemental cooling system (SCS) validation test required by Condition 9 of Holtec's CoC No. 1014 was completed on a loaded cask with a 20 kW heat load. The test involved taking temperature and flow measurements of the SCS inlet and outlet to verify the system was adequately sized to maintain adequate cooling to the annulus gap between the canister and the HI-TRAC transfer cask during onsite transport operations to keep the temperature of the spent fuel cladding below design basis limits. The data was provided to Holtec for analysis. Holtec determined that the data collected by ANO

validated that the SCS was adequately sized to maintain acceptable temperatures of the fuel cladding.

While using the supplemental cooling system on a 27.64 kW cask, steaming was observed in the annulus area between the HI-TRAC transfer cask and the canister. Though the SCS was sized for canisters with heat loads up to 36.9 kW, it had not been sized to account for ANO's use of neutron shielding, lead blankets, and fire blankets placed on the canister lid to provide personnel protection for high heat load (kW) canisters. This configuration reduced the effectiveness of the SCS to cool the canister. ANO established a 26 kW limit on their casks to reduce the lid temperature to below 350 degree F due to personnel and operational safety concerns.

The thermal validation test required by Condition 9 of Holtec's CoC No. 1014 was performed on a 23 kW cask. The test involved monitoring inlet and outlet vent temperatures and taking air flow measurements from locations within the annulus between the HI-STORM cask and the loaded canister to verify predictions made by the licensing-basis thermal model. ANO performed the test using instrumentation that had been certified and/or calibrated by the vendors, but had not applied the requirements of the ANO quality assurance program to the control and calibration of the test instruments. The NRC has identified this failure to follow the ANO quality assurance program for the thermal validation test instrumentation as a Non-Cited Violation of 10 CFR 72.164. The validity of the data collected during the test has been identified as an Unresolved Item.

The ANO thermal validation data was provided to Holtec for analysis. Holtec determined that the data collected by ANO validated the analytic methods and thermal performance of the HI-STORM 100 cask system. Holtec concluded that the ANO test results could be applied to the other HI-STORM 100 overpack designs specified in the Certificate of Compliance No. 1014. The NRC is performing an independent evaluation of Holtec's position and will track this issue as an Unresolved Item.

In 2009, a concern related to Holtec's decision to stop the helium leak testing of the Holtec canisters during fabrication was identified by the NRC. As a result, Holtec agreed to reinstate the helium leak test. However, during the interval in which testing had been suspended, a number of canisters had been distributed by Holtec that had not been leak tested. ANO had received seven of the affected canisters and had loaded the canisters with spent fuel and placed them on the ISFSI pad. The NRC determined after review of information provided by Entergy and Holtec, that the seven loaded canisters were acceptable for continued use.

Arkansas Nuclear One had reviewed a number of industry issues that could have an impact on the ANO dry fuel storage program. These included issues related to NRC Information Notice 2011-10, vacuum drying issues related to Holtec Information Bulletin (HIB) - 45/48, heat load calculations related to HIB-51, and isolation of the canister while filled with water related to HIB-53. A Non-Cited Violation was identified for ANO's failure to place the required amount of helium into Casks 31, 35, 36, and 37 due to miscalculating the total heat loads of those casks.

The licensee identified errors and unjustified assumptions in a previous analysis that was performed to validate the structural adequacy of the auxiliary building floor during stack-up operations. A Non-Cited Violation was identified for failure to adequately

demonstrate that the trainbay floor could withstand the stack-up floor loading that could occur during a design basis seismic event.

The licensee had completed the VSC-24 five year interior inspection as required by Technical Specifications. The surveillance did not reveal any significant problems.

The work orders for the VSC-24 annual exterior inspections were reviewed for the years 2009, 2010, 2011, and 2012. All issues requiring attention were addressed. The types of defects identified were minor and had minimal impact on the structural and shielding ability of the casks. Efflorescence deposits were observed by the NRC inspectors on cracks on several of the VSC-24 casks and around the vent areas of several Holtec casks.

Records were maintained that described the specific fuel parameters for the spent fuel stored in each of the licensee's loaded casks.

2 Review of 10 CFR 72.212(b) Evaluations at Operating Plants (60856.1)

2.1 <u>Inspection Scope</u>

Changes to the 72.212 Evaluation Report since the last NRC inspection were reviewed to verify site characteristics were still bounded by the Holtec HI-STORM 100 design basis and the Energy Solutions VSC-24 design basis.

2.2 <u>Observations and Findings</u>

The current version of the VSC-24 72.212 Evaluation Report was Revision 3. The current version of the Holtec HI-STORM 100 72.212 Evaluation Report was Revision 6. Two revisions had been completed to the VSC-24 72.212 Evaluation Report since the last NRC inspection and were reviewed during this inspection. These were Revision 2 and Revision 3. Both revisions were administrative in nature and did not have any programmatic impacts. Inspectors reviewed the 10 CFR 72.48 screening that was performed for each revision. No issues were identified. One revision had been completed to the Holtec HI-STORM 100 72.212 Evaluation Report since the last NRC inspection. This was Revision 6. This revision was also administrative in nature and did not have any programmatic impacts. No issues were identified with the 10 CFR 72.48 screening that was performed for that revision.

2.3 <u>Conclusions</u>

Two revisions to the 10 CFR 72.212 Evaluation Report for the VSC-24 casks and one revision to the 10 CFR 72.212 Evaluation Report for the HI-STORM 100 casks had been issued since the last NRC inspection. The changes were administrative in nature and did not have any programmatic or safety impacts.

3 Review of 10 CFR 72.48 Evaluations (60857)

3.1 <u>Inspection Scope</u>

The licensee's 72.48 screenings and evaluations since the 2009 NRC inspection were reviewed to determine compliance with regulatory requirements.

3.2 Observations and Findings

The licensee is required by 10 CFR 72.48(d)(2) to submit a report to the NRC containing a brief description of any changes, tests, and experiments related to the ISFSI at an interval not exceeding 24 months. Reports were reviewed back to April 2009. One report was issued for the period January 1, 2009 through December 31, 2010. During this time period, no evaluations were performed. The licensee informed the NRC inspectors that from January 1, 2011 through the date of the inspection there was also no evaluations performed.

The licensee utilized Procedure EN-LI-112, "10CFR72.48 Evaluations," Revision 9 for preparing, reviewing, approving, and documenting 72.48 evaluations. Procedure EN-LI-100 "Process Applicability Determination," Revision 11 was used to perform a screening of an issue to determine if a 10 CFR 72.48 evaluation was required. The licensee's system does not have the capability to list all 72.48 process applicability determinations (screenings) that have been performed since the last inspection. Instead, specific plant modification packages must be requested and the package reviewed to find the 72.48 process applicability determination. Since the last inspection in April 2009, the licensee has not significantly modified anything regarding the ISFSI, the pad, the dry cask storage equipment, or anything related to the L-3 cask handling crane. The only screenings that were performed since April 2009 were for procedure changes and the screenings for the revisions to the 72.212 Evaluation Reports. The changes made to the 72.212 Evaluation Reports that were reviewed using the 10 CFR 72.48 process are discussed in the preceding section (Section 2) of this inspection report.

3.3 Conclusions

The 10 CFR 72.48 screenings reviewed during this inspection met requirements. No 10 CFR 72.48 evaluations had been performed in the past three and a half years.

4 Exit Meeting

The inspectors reviewed the scope and findings of the inspection during an initial exit conducted on November 1, 2012. A final telephonic exit was conducted February 18, 2013, upon completion of the inspection, which reviewed the thermal validation test that was performed by ANO to comply with Condition 9 of CoC, No. 1014.

ATTACHMENT 1

SUPPLEMENTAL INSPECTION INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel

J. Bacquet	Radiation Protection Supervisor
S. Bradshaw Sr.	Radiation Protection Technician
M. Chisum	General Manager Plant Operations
B. Clark	Licensing
B. Daiber	Design Engineering
C. Garbe	Reactor Engineer
J. Meyers	Dry Fuel Storage Project Manager
S. Pyle	Licensing Manager
C. Schwarz	Site Vice President
A. Tate	Reactor Engineer
C. Walker	Reactor Engineer

Vendor Personnel

D. Mitra-Majumdar, Ph.D. Holtec Corporate Director, Engineering Analysis

INSPECTION PROCEDURES USED

IP 60855.1	Operations of an ISFSIs at Operating Plants
IP 60856.1	Review of 10 CFR 72.212(b) Evaluations at Operating Plants
IP 60857	Review of 10 CFR 72.48 Evaluations

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

72-13/1201-01	NCV	Failure to calibrate M&TE equipment used on the thermal validation test under the ANO quality assurance program.
72-13/1201-02	URI	Validation of the ANO data collected during the thermal validation test and used in the Holtec analysis.
72-13/1201-03	URI	Applicability of the ANO thermal validation test results to other HI-STORM 100 overpack configurations.
72-13/1201-04	NCV	Failure to meet CoC Condition 2 to have adequate procedures which resulted in backfilling Casks 31, 35, 36, and 37 with less helium than specified in the technical specifications.

72-13/1201-05	NCV	Inadequate review and analysis required by 10 CFR 72.212(b)(6) to ensure cask design parameters were encompassed within the site's parameters regarding earthquake intensity.

Discussed

None

Closed

72-13/1201-01	NCV	Failure to calibrate M&TE equipment used on the thermal validation test under the ANO quality assurance program.
72-13/1201-04	NCV	Failure to meet CoC Condition 2 to have adequate procedures which resulted in backfilling Casks 31, 35, 36, and 37 with less helium than specified in the technical specifications.
72-13/1201-05	NCV	Inadequate review and analysis required by 10 CFR 72.212(b)(6) to ensure cask design parameters were encompassed within the site's parameters regarding earthquake intensity.

LIST OF ACRONYMS

ALARA	as low as reasonably achievable
ANO	Arkansas Nuclear One
B&W	Babcock & Wilcox
C	Centigrade
CE	Combustion Engineering
CFR	Code of Federal Regulations
CoC	Certificate of Compliance
CR	condition report
CTF	Cask Transfer Facility
DLR	Dose of Legal Record
DNMS	Division of Nuclear Materials Safety
F	Fahrenheit
FSAR	Final Safety Analysis Report
HIB	Holtec information bulletin
IN	Information Notice
IP	inspection procedure
ISFSI	Independent Spent Fuel Storage Installation
kW	kilo-watt
MPC	multi-purpose canister
mR	milliRoentgen
mrem	milliRoentgen equivalent man
MSB	multi-assembly sealed basket
MWD/MTU	megawatt days/metric ton uranium
NRC	Nuclear Regulatory Commission

psi	pounds per square inch
psig	pounds per square inch gauge
RRTI	Response to Request for Technical Information
RTD	resistance temperature detector
SCS	Supplemental Cooling System
SFST	Spent Fuel Storage and Transportation
TLD	thermoluminescent dosimeter
TS	technical specification
TVA	Tennessee Valley Authority
VCT	Vertical Cask Transporter
VSC	Ventilated Storage Cask
WO	Work Order

ATTACHMENT 2:

CONDITION REPORTS REVIEWED DURING THE INSPECTION

Condition Report	Severity Level	Description
CR-ANO-1-2006-0930	B	After completion of drying MPC 24-047, the port cap on the drain tube nozzle would not fully close and galled at approximately 50% of its normal travel. The forced helium dehydration system was used to keep helium in the canister. The cap was removed and the drain tube nozzle was found to be damaged beyond repair due to the damage of the threads. A portion of the drain tube was machined away and a shortened portion of a new tube was welded to the remaining portion of the drain tube in the canister lid. A new cap was obtained from Holtec that was made of Nitronic 60 as a replacement for the stainless steel cap. The new cap was successfully installed. It was determined that a manufacturing defect had occurred in the production of a batch of the port caps.
CR-ANO-C-2009-0307	C	This condition report documented that canisters that had been procured from Holtec had not undergone final helium leak testing during fabrication. This is discussed more in Section 1.2.i and relates to HIB-39.
CR-ANO-C-2009-0611	C	The newly adopted Revision 7 of the FSAR identified an ISFSI cask spacing array that was different from the previously used FSAR revision, such that the current condition at the ISFSI was not in compliance. Holtec perform a site specific analysis for the ANO spacing, as allowed by the FSAR, to ensure the spacing array was acceptable. Holtec Report HI-2104696, "Evaluation of Influence of Neighboring HI-STORM Casks at ANO ISFSI" Revision 2 concluded that the cask spacing array used at ANO was within the FSAR limitations. The evaluation limited the casks' heat loads to a maximum of 30 kW.
CR-ANO-C-2009-0655	C	This was an administrative condition report to direct the Dry Fuel Storage team to develop lessons learned and perform readiness reviews for particular cask operations. This included: HI-TRAC being orientated properly in the cask pit, excess water being removed from the canister prior to welding, and when to take the spent fuel pool water temperature to determine time-to-boil.
CR-ANO-C-2009-0701	C	This condition report was written to document the lack of support for dry fuel activities. More prep time was requested as well as time to clean up and properly store dry fuel storage equipment.
CR-ANO-C-2009-0711	C	This condition report documented that Procedure OP-1022.012 "Storage, Control, and Accountability of Nuclear Fuel" required a revision to include MSB014 as containing a potentially failed fuel assembly. This procedure listed the canisters containing failed fuel that required additional analysis before shipment and had inadvertently omitted MSB014 from the list.

Condition Report	Severity Level	Description
CR-ANO-C-2009-0715	C	During the inspection of April 2009, an NRC inspector questioned if the current sequence of placing casks on the ISFSI pad being used by ANO for the HI-STORM casks matched the applicable engineering calculation that was performed for seismic stability of the ISFSI pad. An Engineering Change EC-20234 was performed to mark up the appropriate calculation (CAL-01E-0012-01) to provide increased flexibility in the required loading sequence used at ANO to match the current ISFSI pad configuration.
CR-ANO-C-2009-0916	C	During the ISFSI inspection conducted in April 2009, the NRC inspector questioned if the calibration of the gauge used to perform the hydrostatic test of the canister was calibrated in accordance with ASME Section III, Subsection NB, Article NB-6000. ANO documented they were not in compliance with the calibration requirements up through cask #30. Calibration requirements specified calibration of the gauge within two weeks of use. An operability of the canisters loaded was performed. Previous post calibration data revealed that no canisters were found to be outside the hydrostatic test acceptance criteria due to gauge inaccuracies. A revision to Procedure OP-3403.005 was issued to ensure the user was aware of the calibration frequency required by the ASME code.
CR-ANO-C-2009-1531	C	This condition report related to CR-ANO-C-2009-0307 regarding the helium leak testing requirement that was removed by Holtec during cask fabrication. This condition report was written to administratively monitor the issue for ANO. This issue is discussed in more detail in Section 1.2.i.
CR-HQN-2010-1026	C	This condition report was written by Entergy HQ to track the issues identified in HIB-45 and HIB-48 concerning annulus cooling. This issue is discussed in more detail in Section 1.2. j.
CR-ANO-C-2010-2444	C	During operations of the L-3 crane, the operator identified unusual noise when lowering and/or raising the main hoist when no load was on the main hook. A vendor representative was brought onsite to assist in determination of the source of the noise. It was determined that the coupling between the hoist drive motor and the brake assembly was worn and allowed slack in the drive assembly. Work order WO 260027 was issued to replace the coupling.
CR-ANO-C-2010-2534	C	This condition report was issued to track the HQ Entergy CR-HQN-2010-1026 which tracked the issues identified in HIB-45 and HIB-48 concerning annulus cooling. This issue is discussed in more detail in Section 1.2.j.

Condition Report	Severity Level	Description
CR-ANO-C-2010-2641	C	The drain port cap would not close on MPC-159 (Cask #35). The canister was placed in a safe condition with the forced helium dehydration system running to keep the fuel cool. After removal of the drain port and vent port caps, the threads on the drain and vent port nozzles were found to be undamaged. Both caps were replaced and the helium backfill operation was successfully completed.
CR-ANO-C-2010-3206	D	This condition report was related to CR-ANO-2010-2444. Noise was documented as coming from the drive motor of the L-3 crane. The main hoist brake coupling was identified as the issue. This condition report was closed to WO 260027 which was issued to replace the coupling.
CR-ANO-1-2010-3305	D	This condition report was issued to document that the person-mrem exposure for Holtec Cask #34 was higher than expected. The actual dose was 141 person-mrem. The ALARA goal was 95 person-mrem. The higher person-mrem was attributed to the longer operation time in the stack-up and lowering of the canister.
CR-HQN-2011-0498	C	This condition report was issued by Entergy Headquarters to document and resolve issues identified by the NRC in Information Notice 2011-10. This is discussed in more detail in Section 1.2.j.
CR-HQN-2011-1030	C	This condition report was issued by Entergy Headquarters to document the issues identified in HIB-43 which notified users of several inconsistencies with Amendment #5. This condition report did not apply to ANO.
CR-HQN-2011-1228	C	This condition report was issued by Entergy Headquarters to document the receipt of Holtec Information Bulletin 51 which described the correct way of calculating a canister's total heat load for compliance to the helium backfill technical specification. This is discussed in more detail in Section 1.2.k.
CR-ANO-1-2011-0289	C	This condition report documented that a caliper dial was found out of tolerance during calibration. The caliper dial was identified as being used in the annual inspection of the L-3 crane. The caliper was used to check the brake pad thickness and wire rope diameter. The caliper dial was found to be reading more conservative, and as such, the minimum criteria for the brake thickness and wire rope diameter was still met.
CR-ANO-C-2011-0736	C	This condition report was issued to document the NRC Region III inspection report on Perry nuclear plant that gave a Non-Cited Violation for use of a freestanding stack-up. The NRC position changed, such that a freestanding stack-up was acceptable if a proper evaluation showed with a high confidence that no accident could occur during a seismic event. This is discussed in more detail in Section 1.2.m.

Condition Report	Severity Level	Description
CR-ANO-C-2011-1070	C	During routine surveillances it was discovered that two rubber non-slip mats had been blown against two VSC-24 casks and were blocking the vents. The mats were removed. This is discussed more in Section 1.2.d.
CR-ANO-C-2011-2585	D	This condition report was issued to document additional findings associated with the stack-up analysis related to CR-ANO-C-2011-0736. This condition report was closed and issues included in the 0736 CR.
CR-ANO-2-2011-3355	C	This condition report was issued to document ANO's specific response for the Entergy headquarters' CR-HQN-2011-01228. This was in response to the error in calculating heat load for compliance with the helium backfill technical specification. This was brought to the attention of ANO per the Holtec Information Bulletin HIB-51. This issue is discussed in more detail in Section 1.2.k.
CR-HQN-2012-0834	C	Entergy Headquarters issued a condition report to document the recent Operating Experience from Comanche Peak. During a loading campaign at Comanche Peak a canister drain port cap became stuck and would not close. This condition report was intended to capture repeat issues for trending purposes.
CR-ANO-1-2012-0007	C	While performing crane checkout for the L-3 spent fuel pool crane, a mechanic found a crack in the rail that the crane rides on. A work order was issued to repair the rail.
CR-ANO-1-2012-0135	C	Oil analysis from the L-3 crane showed a large amount of metallic debris. The condition report stated the condition would be corrected using Work Request 262129.
CR-ANO-C-2012-0399	C	This condition report documented that canisters loaded at ANO may need a maximum heat load limitation less than what is specified in the technical specifications. This was issued because the SCS had difficulty cooling Cask # 26 that had a total heat load of 27.64 kW. An analysis was performed by Holtec in HI-2125213 that agreed with ANO personnel that the maximum heat load should be limited to 26 kW. This is discussed in more detail in Section 1.2.g.
CR-ANO-C-2012-0577	C	This condition report was issued to address NRC Information Notice 2011-20 regarding concrete degradation by alkali-silica reaction. This notice applied to Seismic Category 1 structures such as Reactor Buildings and Auxiliary Buildings. The licensee identified that their structures, when constructed, were tested to ASTM C295. This test was listed as one of the tests acceptable to prevent alkali-silica-reaction for potential reactivity.
CR-ANO-C-2012-0579	C	It was discovered that the new heat limitation imposed on dry cask storage activities per CR-ANO-C-2012-0399, due to the supplemental cooling system, limited the number of MPC-32 canisters that could be loaded from Unit 2.

Condition Report	Severity Level	Description
CR-ANO-C-2012-1334	C	This condition report documented the deficiency identified during the removal of the spent fuel overhead crane (L-3) rails. At the expansion joint rail beam structure, the Unit-1 beam structure was 1/8 inch higher than the Unit-2 beam structure. This could have been a contributing cause of the cracked rail that was identified in CR-ANO-1-2012-0007. A tapered shim was added to allow a smooth transition of the new crane rail at the affected area.
CR-ANO-C-2012-1359	C	This was an administrative condition report that identified procedural requirements which had not been followed by the owner of the Holtec Contract for 2012 dry fuel storage materials.
CR-ANO-C-2012-1865	D	ANO requested that Holtec perform a new stack-up analysis per condition report CR-ANO-2011-00736. The floor loads calculated in the new stack-up calculation were used as inputs to the U1 Auxiliary Building Trainbay Floor Analysis, CALC-01-E-0012-05. The new floor loads along with other issues with the calculations were identified which resulted in a determination that the original calculations were inadequate. This is discussed in more detail in Section 1.2.m.
CR-ANO-C-2012-2056	C	This condition report documents the receipt of Holtec Information Bulletin 53. This is discussed in more detail in Section1.2.l.

ATTACHMENT 3

LOADED VSC-24 CASKS AT THE ANO ISFSI

LOADING ORDER	VSC ID No.	Unit	DATE ON PAD	HEAT LOAD (kW)	BURNUP MWd/MTU (max)	MAXIMUM FUEL ENRICHMENT %	PERSON-REM DOSE
1	24-01	Unit 1	12/17/96	5.2	19,905	2.07	0.185
2	24-03	Unit 1	01/28/97	10.7	32,599	3.19	0.384
3	24-05	Unit 2	04/02/97	4.2	20,318	1.93	0.291
4	24-06	Unit 2	04/06/97	6.2	30,149	2.94	0.469
5	24-12	Unit 2	09/23/98	10.8	34,938	3.38	0.900
6	24-11	Unit 2	10/01/98	8.0	33,075	2.94	0.553
7	24-07	Unit 2	10/21/98	8.0	34,891	3.33	0.567
8	24-02	Unit 2	10/30/98	8.1	34,773	3.34	0.483
9	24-04	Unit 1	04/13/99	9.1	33,051	3.06	0.236
10	24-08	Unit 1	04/27/99	9.2	33,255	3.06	0.231
11	24-09	Unit 1	05/18/99	9.1	33,194	3.21	0.189
12	24-13	Unit 1	06/16/99	7.3	33,066	3.05	0.112
13	24-14	Unit 1	07/14/99	10.7	34,646	3.21	0.383
14	24-10	Unit 2	04/18/00	12.2	40,211	3.37	0.602
15	24-15	Unit 2	06/06/00	9.86	40,220	3.37	0.603

LOADING ORDER	VSC ID No.	Unit	DATE ON PAD	HEAT LOAD (kW)	BURNUP MWd/MTU (max)	MAXIMUM FUEL ENRICHMENT %	PERSON-REM DOSE
16	24-16	Unit 1	07/25/00	13.37	40,180	3.21	0.528
17	24-18	Unit 1	01/21/01	14.67	38,794	3.45	0.628
18	24-17	Unit 2	06/06/01	14.23	41,188	4.01	0.695
19	24-19	Unit 2	06/26/01	14.17	41,193	4.01	0.659
20	24-20	Unit 2	07/25/01	14.24	41,204	4.01	0.554
21	24-21	Unit 2	08/14/01	14.26	40,931	4.01	0.666
22	24-22	Unit 1	08/30/02	14.69	38,909	3.46	0.407
23	24-23	Unit 1	09/11/02	14.66	38,981	3.46	0.567
24	24-24	Unit 2	06/12/03	9.36	36,021	3.49	0.296

Unit 1: 11 casks loaded, average heat load = 10.8 kW; average man-hours to load = 1374 hrs; average dose = 0.350 person-rem
Unit 2: 13 casks loaded, average heat load = 10.3 kW; average man-hours to load = 1477 hrs; average dose = 0.564 person-rem
Note: Unit 2 fuel is 18 inches longer than Unit 1 fuel.

VSC-24 Casks # 1 through 14 were loaded to CoC No. 1007, Amendment 0, FSAR Revision 0
VSC-24 Casks # 15 through 16 were loaded to CoC No. 1007, Amendment 1, FSAR Revision 1
VSC-24 Casks # 17 was loaded to CoC No. 1007, Amendment 2, FSAR Revision 1
VSC-24 Casks # 18 through 21 were loaded to CoC No. 1007, Amendment 3, FSAR Revision 2
VSC-24 Casks # 22 and 23 were loaded to CoC No. 1007, Amendment 3, FSAR Revision 4
VSC-24 Casks # 24 was loaded to CoC No. 1007, Amendment 4, FSAR Revision 5
All VSC-24 Casks are being monitored to CoC No. 1007, Amendment 4, FSAR Revision 5

NOTES:

- Heat load (kW) is the sum of the heat load values for all spent fuel assemblies in the cask
- Burn-up is the value for the spent fuel assembly with the highest individual discharge burn-up
- Fuel enrichment is the spent fuel assembly with the highest individual “initial” enrichment per cent of U-235

ATTACHMENT 4

LOADED HI-STORMS CASKS AT THE ANO ISFSI

LOADING ORDER	MPC Serial #	HI-STORM 100S No.	Unit	DATE ON PAD	HEAT LOAD (kW)	BURNUP MWd/MTU (max)	MAXIMUM FUEL ENRICHMENT %	PERSON-REM DOSE
1	Serial No. 24-3	Serial No. 44	Unit 1	12/13/03	16.4	41,045	3.50	0.525
2	Serial No. 24-4	Serial No. 23	Unit 1	01/13/04	16.7	41,130	3.50	0.755
3	Serial No. 24-2	Serial No. 24	Unit 1	01/21/04	17.5	41,044	3.50	0.707
4	Serial No. 24-1	Serial No. 43	Unit 1	02/15/04	15.5	39,807	3.50	0.667
5	Serial No. 24-5	Serial No. 45	Unit 1	02/23/04	12.1	38,697	3.50	0.267
6	Serial No. 24-6	Serial No. 46	Unit 1	03/05/04	10.5	37,751	3.50	0.277
7	Serial No. 24-10	Serial No. 52	Unit 2	09/10/04	14.4	42,043	4.02	0.498
8	Serial No. 24-14	Serial No. 47	Unit 2	09/19/04	17.7	45,798	4.02	0.745
9	Serial No. 24-43	Serial No. 48	Unit 2	09/25/04	18.6	47,116	4.02	0.492
10	Serial No. 32-1	Serial No. 49	Unit 2	11/16/04	18.3	43,960	4.02	0.430
11	Serial No. 32-2	Serial No. 50	Unit 2	11/20/04	18.6	42,934	4.02	0.355
12	Serial No. 32-9	Serial No. 51	Unit 2	12/03/04	21.0	43,903	4.01	0.511
13	Serial No. 32-3	Serial No. 96	Unit 2	12/12/04	18.2	43,840	4.01	0.422

LOADING ORDER	MPC Serial #	HI-STORM 100S No.	Unit	DATE ON PAD	HEAT LOAD (kW)	BURNUP MWd/MTU (max)	MAXIMUM FUEL ENRICHMENT %	PERSON-REM DOSE
14	Serial No. 24-44	Serial No. 97	Unit 1	07/01/05	18.02	40,158	3.50	0.755
15	Serial No. 24-45	Serial No. 98	Unit 1	08/09/05	19.99	45,141	3.49	0.776
16	Serial No. 24-46	Serial No. 99	Unit 1	08/18/05	19.31	45,007	3.50	0.624
17	Serial No. 32-19	Serial No. 114	Unit 2	09/17/05	25.38	52,294	4.01	1.001
18	Serial No. 32-26	Serial No. 115	Unit 2	11/14/05	23.33	46,788	4.02	0.624
19	Serial No. 32-49	Serial No. 113	Unit 2	11/21/05	23.39	51,778	4.02	0.378
20	Serial No. 32-16	Serial No. 229	Unit 2	04/05/06	23.50	51,542	4.01	0.331
21	Serial No. 32-24	Serial No. 230	Unit 2	04/10/06	25.91	50,363	4.02	0.376
22	Serial No. 32-25	Serial No. 243	Unit 2	05/19/06	25.57	50,465	4.02	0.358
23	Serial No. 24-47	Serial No. 245	Unit 1	08/05/06	11.51	43,171	3.45	0.274
24	Serial No. 24-48	Serial No. 246	Unit 1	11/10/06	12.54	43,386	3.46	0.189
25	Serial No. 24-49	Serial No. 247	Unit 1	02/11/07	9.74	36,982	3.21	0.079
26	Serial No. 32-67	Serial No. 244	Unit 2	07/27/07	27.64	52,088	4.16	0.665
27	Serial No. 32-66	Serial No. 248	Unit 2	08/04/07	26.67	54,078	4.02	0.485
28	Serial No. 24-50	Serial No. 61	Unit 1	08/24/07	18.16	46,101	3.89	0.409
29	Serial No. 24-51	Serial No. 62	Unit 1	09/01/07	14.31	44,919	3.90	0.182

LOADING ORDER	MPC Serial #	HI-STORM 100S No.	Unit	DATE ON PAD	HEAT LOAD (kW)	BURNUP MWd/MTU (max)	MAXIMUM FUEL ENRICHMENT %	PERSON-REM DOSE
30	Serial No. 24-52	Serial No. 105	Unit 1	05/04/09	23.21	44,801	4.06	0.499
31	Serial No. 32-84	Serial No. 104	Unit 2	05/29/09	26.59	52,605	4.32	0.493
32	Serial No. 32-85	Serial No. 325	Unit 2	11/05/09	26.01	54,232	4.32	0.616
33	Serial No. 24-53	Serial No. 324	Unit 1	12/10/09	10.86	41,358	4.05	0.095
34	Serial No. 24-54	Serial No. 326	Unit 1	09/29/10	10.99	41,478	4.06	0.141
35	Serial No. 32-159	Serial No. 474	Unit 2	10/20/10	26.36	49,952	4.30	0.645
36	Serial No. 32-163	Serial No. 475	Unit 2	10/28/10	26.15	48,000	4.30	0.473
37	Serial No. 32-164	Serial No. 476	Unit 2	11/03/10	26.46	47,778	4.29	0.420

NOTES:
- Heat load (kW) is the sum of the heat load values for all spent fuel assemblies in the cask
- Burn-up is the value for the spent fuel assembly with the highest individual discharge burn-up
- Fuel enrichment is the spent fuel assembly with the highest individual “initial” enrichment per cent of U-235

HI-STORM Casks # 1 through 9 were loaded to CoC No. 1014, Amendment 1, FSAR Revision 1
HI-STORM Casks # 10 through 13 were loaded to CoC No. 1014, Amendment 1, FSAR Revision 2
HI-STORM Casks # 14 through 22 were loaded to CoC No. 1014, Amendment 2, FSAR Revision 3
HI-STORM Casks # 23 through 29 were loaded to CoC No. 1014, Amendment 2, FSAR Revision 4
HI-STORM Casks # 30 through 37 were loaded to CoC No. 1014, Amendment 5, FSAR Revision 7
Use of the Forced Helium Dehydrator (FHD) commenced with HI-STORM Cask #7

The first two digits in the serial number under the column “MPC Serial #” indicates whether the cask is a MPC-24 or a MPC-32
Unit 2 is Combustion Engineering fuel and is 18 inches longer than the Unit 1 Babcock & Wilcox fuel