UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
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September 13, 2001

Craig Anderson, Vice President Operations
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S.R. 333
Russellville, Arkansas 72801-0967

SUBJECT: NRC INSPECTION REPORT 50-313/01-10; 50-368/01-10; 72-13/01-01

Dear Mr. Anderson:

On August 15-16, 2001, the NRC completed an inspection at your Arkansas Nuclear One, Units 1 and 2. The enclosed report documents the inspection findings, which were discussed on August 16, 2001, with you and members of your staff.

This inspection reviewed activities associated with your Independent Spent Fuel Storage Installation (ISFSI), including verification of compliance with technical specifications and license requirements. During this inspection, loading of the 21st cask was completed. Activities related to movement of the cask to the ISFSI were observed by the NRC Inspectors. No violations of NRC regulations were identified.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/NRC/ADAMS/index.html (the Public Electronic Reading Room).

Should you have any questions concerning this inspection, we will be pleased to discuss them with you.

Sincerely,
/RA/

Dwight D. Chamberlain, Director
Division of Nuclear Materials Safety

Docket Nos.: 50-313
50-368
72-13
License Nos.: DPR-51
NPF-6

Enclosure:
NRC Inspection Report
50-313/01-10; 50-368/01-10; 72-13/01-01

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ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket Nos.:	50-313; 50-368; 72-13
License Nos.:	DPR-51; NPF-6
Report No.:	50-313/01-10, 50-368/01-10; 72-13/01-01
Licensee:	Entergy Operations, Inc.
Facility:	Arkansas Nuclear One, Units 1 and 2 Arkansas Nuclear One, Independent Spent Fuel Storage Installation
Location:	1448 S. R. 333 Russellville, Arkansas 72801
Dates:	August 15-16, 2001
Inspectors:	J. V. Everett, Senior Health Physicist T. H. Carter, High Level Waste Project Manager
Approved by:	D. Blair Spitzberg, Ph. D., Chief Fuel Cycle & Decommissioning Branch
Attachments:	1) Supplemental Information 2) List of Loaded VSC-24 Casks at ANO

EXECUTIVE SUMMARY

Arkansas Nuclear One, Units 1 and 2
NRC Inspection Report 50-313/01-10; 50-368/01-10; 72-13/01-01

Dry cask storage operations of spent fuel have been underway at the Arkansas Nuclear One (ANO) site for the past 5 years. During this time, the ANO staff has continued to conduct loading and storage operations safely. As experience is gained, the licensee has been able to reduce the time required to load casks. Compliance with technical specifications has been demonstrated through the use of detailed procedures, extensive documentation of work activities and a strong quality assurance process. A significant number of personnel associated with the Independent Spent Fuel Storage Installation(ISFSI) project have been involved since the loading of the first cask. This consistency of staff personnel has been a key element in the efficiencies gained in the program and the continued safety record of the project. Discussions with the ANO staff during this inspection continued to demonstrate the strong technical knowledge that has been gained by the ISFSI project personnel related to the VSC-24 cask system.

Operation of an ISFSI

- A review was conducted of selected technical specifications related to thermal performance of the storage casks, selection of spent fuel for storage, boron level in the spent fuel pool during spent fuel movement, placement of the casks on the ISFSI pad and inspection of the condition of the concrete casks. The licensee was complying with the requirements in the technical specifications (Section 1).

- Radiological limits established in the technical specifications for surface dose rates for the casks were verified. Environmental exposure levels near the ISFSI pad were reviewed and found acceptable. The ISFSI pad was properly posted as a radiation area (Section 1).

Review of 10CFR72.48 Evaluations

- The licensee was conducting safety evaluations of changes, tests and experiments at the ISFSI in accordance with the new requirements issued by the NRC in 10 CFR 72.48 effective April 5, 2001. A review of the safety evaluations conducted over the past 1½ years did not identify any concerns related to the conclusions reached by the licensee's staff (Section 2).

Report Details

Summary of Plant Status

The licensee completed the loading of the 21st cask during this inspection. Three additional Ventilated Storage Casks (VSC-24) are scheduled for placement at the ISFSI during the next several months. This will complete the loading of the current ISFSI pad. The licensee plans to transition to the Holtec HiStorm cask design for the next phase of the ISFSI and to expand the ISFSI pad.

Nine casks were currently located at the ISFSI with Unit 1 (Babcock and Wilcox) spent fuel and 12 with Unit 2 (Combustion Engineering) spent fuel. The highest heat loading of any of the casks was 14.67 kW for Cask #18 containing Unit #1 spent fuel. The average dose to load the Unit 1 casks has been 0.320 person-rem/cask. The Unit 2 casks have been 0.587 person-rem/cask. The higher Unit 2 doses were due to the Unit 2 fuel being 18 inches longer than the Unit 1 fuel, and thus extending closer to the lid. Average time to load a cask and move it to the ISFSI has been 1400 to 1500 man-hours. As the licensee became more proficient in the process, loading times dropped. Loading of the last three casks has ranged from 936 to 1000 hours. The licensee has been loading three to five casks/year since 1997. So far this year, five casks have been loaded. Three more are planned for loading by the end of calendar year 2001. A list of loaded casks and technical data concerning each cask is provided as an attachment to this report.

1 Operation of an ISFSI (60855)

1.1 Inspection Scope

The spent fuel stored at the ANO ISFSI was stored in VSC-24 casks licensed under the general licensing provisions of 10 CFR Part 72. The current Certificate of Compliance for the VSC-24 casks is Certificate Number 1007, Amendment 3, dated May 21, 2001. The Certificate of Compliance included a number of technical specifications related to the safe storage of spent fuel at the ISFSI which were reviewed during this inspection. Radiological conditions at the ISFSI pad were also evaluated.

1.2 Observation and Findings

Technical Specifications 1.2.3, “Maximum Permissible Air Outlet Temperature,” and Technical Specification 1.3.4, “Cask Thermal Performance,” established criteria for thermal performance monitoring of the casks. Technical Specification 1.2.3 required the air temperature at the outlet of the casks to be checked on a daily basis and to not exceed ambient temperature by 110°F. Technical Specification 1.3.4 required the licensee to evaluate the cask’s thermal performance to determine if any significant unexplained differences in temperature had occurred that could adversely affect the fuel cladding or the concrete in the cask. If there was evidence that the concrete temperature exceeded 350°F for more than 24 hours, then the cause of the excessive temperature level must be determined and the cask temperature returned to normal.

Temperature data for August 16, 2001, was reviewed for all 20 casks at the ISFSI pad. Ambient temperature at 3:00 p.m. was 89°F. The highest outlet temperature reading recorded

for this time of day was measured on cask #19. The outlet temperature was 145°F. This was 56°F above ambient and well below the 110°F limit in Technical Specification 1.2.3.

Temperature data for Casks #19 and #20 were reviewed for the period of August 9-15, 2001. For cask #19, the highest outlet temperature recorded during this period was 157°F on August 9, 2001, with an ambient temperature of 98°F. This was 59°F above ambient. For cask #20, the highest outlet temperature was also on August 9, 2001, with a temperature of 152°F. This was 54°F above ambient. All temperatures reviewed were in compliance with technical specification.

Temperature data for Cask #6 was reviewed for the period of July 1999 through July 2001. When comparing the ambient temperature value with the outlet temperature reading, no pattern was evident. The differences between the two readings fluctuated significantly from 1°F to 37°F. The temperature reading differences were affected by seasonal changes and by daily affects such as wind direction, weather conditions (i.e. rain showers) and whether a cold front or warm front was entering the area.

The use of the temperature differences between ambient and the outlet vent of the cask provided only limited value for tracking thermal performance of the cask. However, the fact that the difference in temperature readings between ambient and the outlet vent of the cask remained below the 110°F technical specification limit and the concrete temperatures were well below the 350°F value were confirmed.

Technical Specification 1.2.11, “Placement of the Ventilated Storage Cask on the Storage Pad,” required the casks to be placed in a storage array 15 feet ± 1 foot apart, center-to-center. The licensee ensured the spacing by measuring the proper storage location for each cask prior to placement and marking the location on the ISFSI pad. During the tour of the ISFSI, the casks located on the pad were observed to be properly spaced.

To ensure proper air flow around the casks in order to maintain good thermal performance, Technical Specification 1.3.1, “Visual Inspection of Air Inlets and Outlets,” required daily verification that the wire mesh screens covering the air inlets and air outlets were clear of any blockage. The licensee performed the daily visual inspection using Procedure 1015.003B, “Unit Two Operations Log,” Change # 046-00-0. Visual inspections were being performed and documented every 12 hours.

Technical Specification 1.3.2, “Exterior Ventilated Storage Cask Surface Inspection,” required the licensee to annually inspect the casks for any damage such as chipping and spalling and to repair any defects larger than ½ inch in diameter and deeper than 1/4 inch. The licensee performed this inspection using Procedure QCI-DFS-2, “Exterior Surface Inspection of the Ventilated Concrete Cask,” Revision 2. The procedure contained repair criteria consistent with the repair criteria specified in the technical specification. The annual inspection conducted on December 7, 2000, was reviewed. A number of small indications were reported on the casks and several required minor repair. No significant defects or damage was noted on the casks.

Technical Specification 1.2.1, “Fuel Specifications,” established the requirements for the spent fuel allowed for storage in the VSC-24 cask. Table 1, “Characteristics of Spent Fuel to be Stored in the VSC-24 System,” provided the specific parameters for the fuel. Note 1 to Table 1 stated that for casks loaded with fuel assemblies having burnup greater than 35,000 MegaWatt-days(MWd)/Metric Ton Uranium (MTU), specific analysis must be performed to demonstrate that neutron and gamma source strengths do not exceed the specified values in Table 1. The spent fuel placed in Casks #18 and #21 were reviewed for compliance with the neutron and gamma source strength limits. The licensee performed an evaluation of the spent fuel using procedure 1302.028 “Fuel Selection Criteria for Dry Storage,” Change # 006-00-0. Form 1302.028A was included in the procedure for documenting the analysis. A separate Form 1302.028A was generated for each spent fuel assembly placed in the casks. A review of the forms for each spent fuel assembly found adequate documentation to support compliance with the requirements in Table 1 for the neutron and gamma source strengths. Also confirmed was that none of the spent fuel assemblies individually exceeded the 1 kw decay power limit specified in Table 1. The highest decay power for any spent fuel assembly placed in Cask #18 was 0.736 kw. For Cask #21, the highest decay power was 0.696 kw.

Technical Specification 1.2.1 also requires that spent fuel assemblies be intact. Prior to selecting fuel assemblies for placement in a cask, a review is conducted of various records including cycle history, end of cycle reports, sipping tests and ultrasonic tests to verify that the assembly is intact and can be placed in dry storage. As the assemblies are moved from the spent fuel pool to the cask, each assembly is inspected for defects. Defects include assemblies that are structurally deformed or have damaged cladding or spacers to the extent that special handling may be required. Damaged cladding would include gross cladding failures which would be any hole in the surface of an exterior fuel pin larger than a pinhole. ANO currently has 55 fuel assemblies that contain failed fuel elements. Forty-three are Unit 1 fuel and 12 are Unit 2 fuel.

Technical Specification 1.2.6, “Boron Concentration in the Multi-Sealed Basket Cavity Water,” required a minimum boron concentration level of 2850 parts/million (ppm) in the spent fuel pool during loading of a cask. Figure 2 to this technical specification identified higher born concentration limits when loading or unloading Unit 1 fuel containing burnable poison rod assemblies if the spent fuel assembly enrichment exceeded 3.3 percent. Figure 3 to the technical specification identified higher boron concentration levels for Unit 2 fuel when enrichment exceeded 3.8 percent. The licensee had included requirements in Procedure 1302.028, “Fuel Selection Criteria for Dry Storage,” Change 006-00-0 to verify the spent fuel pool boron concentration during cask loading. Boron levels for Cask #21 were reviewed. For Cask #21, the highest enrichment of any of the spent fuel assemblies was 4.01percent. Based on Figure 3 of Technical Specification 1.2.6, the required minimum boron level in the spent fuel pool would be approximately 3080 ppm. Data reviewed for the period the cask was in the spent fuel pool documented that the boron level had been maintained above 3300 ppm.

Technical Specification 1.2.4, “Maximum External Surface Dose Rate,” established external dose rate limits of 20 mrem/hr on the sides of the concrete cask and 50 mrem/hr on the top. Air inlet and outlet dose rates were limited to 50 mrem/hr. The radiological dose rate surveys conducted for Cask #20 were reviewed. The cask was surveyed in the train bay prior to

movement to the ISFSI pad on July 26, 2001. The licensee had performed a thorough survey of the cask and generated a well documented report of the surveys conducted. The maximum contact dose rate on the sides of the concrete cask was 1.6 mrem/hr. Of this dose rate, 1.4 mrem/hr was from gamma and 0.2 mrem/hr from neutron. On the top of the cask, the maximum dose rate was 12 mrem/hr gamma plus 16 mrem/hr neutron for a total of 28 mrem/hr. The highest reading measured on the cask, 38.4 mrem/hr, was at the inlet vent opening at the bottom of the cask. Only 0.4 mrem/hr of this total was due to neutron.

Past NRC inspections of radiological conditions during cask loading had indicated that gamma and neutron radiation levels and accumulated exposures by personnel were related to the heat load of the cask. The higher the heat load, the higher the radiological exposures. It was also found that for casks below 9.5 kw, neutron exposures were insignificant. Neutron exposure levels are related to per cent U^{235} enrichment of the fuel, decay times and burnup. Radiological data was reviewed for Casks #15 through #20. All casks had a heat load above 13 kw except Cask #15, which was 9.86 kw. Total dose for completing the loading of the six casks ranged from 0.528 person-rem to 0.695 person-rem per cask. Approximately 10-25 percent of this dose was due to neutron. Personnel who could be in neutron fields while working around the casks wore neutron dosimetry, however, no neutron doses were being measured on the neutron dosimetry. Neutron doses for personnel were being assigned based on neutron surveys of the work area and time keeping for individuals in an area where neutron exposures were possible. The neutron fields were typically measured in the work areas as less than 1 mrem/hr.

The licensee is required by 10 CFR 72.44(d)(3) to submit an annual report to the NRC within 60 days of January 1 of each year concerning effluent releases from the ISFSI. ANO submitted their annual report to the NRC on February 28, 2001. The report stated that no effluent releases had occurred from the ISFSI.

The licensee monitored environmental radiation levels around the ISFSI pad with two TLDs located on the ISFSI fence approximately 45 feet from the pad. The ISFSI fence was located within the security area of the site. Both TLDs measured approximately 245 mrem for the second quarter of 2001. This was consistent with previous quarters. Though the ISFSI has had an increase in the number of casks placed on the pad, the exposure rates had been consistent over the past 2 years. The licensee had originally placed the first several casks along the edge of the pad. As additional casks were added, the casks along the pad edge provided shielding for the inner casks, resulting in minimal increase in the dose rates at the fence.

During a tour of the ISFSI, the NRC Inspectors took radiation measurement readings around the ISFSI. The ISFSI pad was posted as a radiation area. The highest dose rate measured around the ISFSI fence was 0.450 mR/hr. This was near the 21st cask while still on the railcar waiting movement to its assigned location on the pad. Readings near the Administration Building indicated that background radiation levels for the site were 7 microR/hr.

1.3 Conclusions

A review of selected technical specifications related to thermal performance of the storage casks, selection of spent fuel for storage, boron level in the spent fuel pool during spent fuel movement, placement of the casks on the ISFSI pad and inspection of the condition of the concrete casks was completed. The licensee was complying with the requirements in the technical specifications.

Radiological limits established in technical specifications for surface dose rates for the casks were verified. Environmental exposure levels near the ISFSI pad were reviewed and found acceptable. The ISFSI pad was properly posted as a radiation area.

2 Review of 10 CFR 72.48 Evaluations (60857)

2.1 Inspection Scope

Safety evaluations performed by the licensee were reviewed to verify compliance with the requirements in 10 CFR 72.48.

2.2 Observation and Findings

On October 4, 1999, the NRC issued a revision to 10 CFR 72.48 that became effective on April 5, 2001. This revision changed the criteria that licensees must use to determine when NRC approval is needed before a change to an ISFSI can be made or a test or experiment conducted. The licensee's procedure for conducting 10 CFR 72.48 reviews for the ANO ISFSI was reviewed. Procedure LI-112, "10 CFR 72.48 Review Program," Revision 0, dated April 5, 2001, was used by the licensee for conducting safety evaluations in compliance with 10 CFR 72.48. The procedure incorporated the provisions and requirements established in the new revision to the regulation.

The licensee was required by 10 CFR 72.48(d)(2) to submit to the NRC a report containing a brief description of any changes, tests or experiments related to the ISFSI including a summary of the evaluation of each. The report is to be submitted at intervals not to exceed 24 months. The licensee had submitted this report on December 15, 2000. The previous report had been submitted on December 15, 1999. During the one year from December 1, 1999, to November 30, 2000, six safety evaluations were performed. Since November 30, 2000, through the period of this inspection, one additional safety evaluation had been conducted. The licensee had performed an adequate safety review of each of the issues and generated the proper paperwork to demonstrate compliance with 10 CFR 72.48.

2.3 Conclusions

The licensee was conducting safety evaluations of changes, tests and experiments at the ISFSI in accordance with the new requirements issued by the NRC in 10 CFR 72.48 effective April 5, 2001. A review of the safety evaluations conducted over the past 1½ years did not identify any concerns related to the conclusions reached by the licensee's staff.

3 Exit Meeting

The inspectors presented the inspection results to members of the licensee management at the conclusion of the inspection on August 16, 2000. The licensee acknowledged the findings presented. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspectors.

ATTACHMENT 1

PARTIAL LIST OF PERSONS CONTACTED

Licensee

S. Pyle, Licensing Engineer
C. Walker, Engineer
J. Wellwood, Engineer
D. Williams, Engineer
P. Williams, Engineer

INSPECTION PROCEDURES USED

60855	Operation of an ISFSI
60857	Review of 10 CFR 72.48 Evaluations

LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

Opened

None

Closed

None

Discussed

None

LIST OF ACRONYMS

ANO	Arkansas Nuclear One
CFR	Code of Federal Regulations
ISFSI	Independent Spent Fuel Storage Installation
kw	kilowatts
mR/hr	milliRoentgen/hour
mrem/hr	millirem/hour
NRC	Nuclear Regulatory Commission
ppm	parts per million
TLD	Thermoluminescent Dosimeter
VSC	Ventilated Storage Cask

ATTACHMENT 2

LOADED VSC-24 CASKS AT THE ANO ISFSI

LOADING ORDER	CASK #	UNIT	DATE PLACED ON PAD	HEAT LOAD (kw)	BURNUP MWd/MTU	FUEL ENRICHMENT	MANHOURS TO LOAD	Person-Rem DOSE
1	#1	Unit 1	12/96	5.2	19905	2.067	not tracked	0.185
2	#3	Unit 1	1/97	10.7	32599	3.190	1750	0.384
3	#5	Unit 2	4/97	4.18	20318	1.930	1852	0.291
4	#6	Unit 2	4/97	6.2	30149	2.939	1463	0.469
5	#12	Unit 2	9/98	10.8	34938	3.384	2479	0.900
6	#11	Unit 2	10/98	8.0	33075	2.938	1416	0.553
7	#7	Unit 2	10/98	8.0	34891	3.328	1844	0.567
8	#2	Unit 2	11/98	8.1	34773	3.337	1542	0.483
9	#4	Unit 1	4/99	9.1	33051	3.059	2036	0.236
10	#8	Unit 1	4/99	9.2	33255	3.059	1186	0.231
11	#9	Unit 1	5/99	9.1	33194	3.205	1324	0.189
12	#13	Unit 1	6/99	7.3	33066	3.048	1380	0.112
13	#14	Unit 1	7/99	10.7	34646	3.213	1130	0.383
14	#10	Unit 2	4/00	12.16	40211	3.374	1700	0.602
15	#15	Unit 2	6/00	9.86	40220	3.372	1233	0.603
16	#16	Unit 1	7/00	13.37	40180	3.206	1233	0.528

LOADING ORDER	CASK #	UNIT	DATE PLACED ON PAD	HEAT LOAD (kw)	BURNUP MWd/MTU	FUEL ENRICHMENT	MANHOURS TO LOAD	Person-Rem DOSE
17	#18	Unit 1	1/01	14.67	38794	3.454	1348	0.628
18	#17	Unit 2	6/01	14.23	41188	4.010	1225	0.695
19	#19	Unit 2	6/01	14.17	41193	4.010	1000	0.659
20	#20	Unit 2	7/01	14.24	41204	4.010	940	0.554
21	#21	Unit 2	8/01	14.26	40931	4.010	936	0.666

Unit 1: 9 casks loaded, average heat load = 9.9 kw; average man-hours to load = 1423 hrs; average dose = 0.320 person-rem
Unit 2: 12 casks loaded, average heat load = 10.3 kw; average man-hours to load = 1469 hrs; average dose = 0.587 person-rem
Note: Unit 2 fuel is 18 inches longer than Unit 1 fuel

Note:

- Heat Load (kw) is the sum of the heat load values for all 24 spent fuel assemblies
- Burnup is the value for the spent fuel assembly with the highest individual discharge burnup
- Fuel Enrichment is the spent fuel assembly with the highest individual enrichment per cent of U-235