U.S. NUCLEAR REGULATORY COMMISSION

SPENT FUEL PROJECT OFFICE
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

Docket Nos.:	72-013, 50-313, 50-368
License Nos.:	DPR-51, NPF-6
Inspection Report:	72-013/97-215
Licensee:	Entergy Operations, Inc.
Facility:	Arkansas Nuclear One, ISFSI
Location:	Russellville, Arkansas
Dates:	November 4-6, 1997
Inspectors:	A. Howe, Nuclear Engineer, SFPO G. Hornseth, Materials Engineer, NRR J. Vincent Everett, Health Physics Inspector, RIV W. Ward, Safety Inspection Engineer, SFPO (Observer) D. Rice, Health Physics Inspector, RIV (Observer)
Approved by:	Susan Frant Shankman, Chief Transportation Safety and Inspection Branch Spent Fuel Project Office Office of Nuclear Material Safety and Safeguards

Enclosure

EXECUTIVE SUMMARY

Arkansas Nuclear One ISFSI
NRC Inspection Report 72-013/97-215

The inspectors performed an announced inspection at the Arkansas Nuclear One (ANO) power plant, to review the licensee's actions to examine for, and remove, undocumented welds on unloaded multi-assembly sealed basket (MSB) shells. The MSBs are part of the Ventilated Storage Cask (VSC) dry spent fuel storage system, Model VSC-24.

On September 5, 1997, NRC issued a supplement to Confirmatory Action Letter (CAL) 97-7-002 documenting agreement by Entergy Operations, Inc. to confirm, under oath and affirmation, that all unloaded MSBs which are intended for use at ANO, meet the design and the terms and conditions of the Certificate of Compliance (CoC) and are in conformance with the Safety Analysis Report (SAR) and Safety Evaluation Report (SER) for the VSC-24, including any referenced standards, criteria, or requirements contained therein.

As a part of its confirmation process, ANO removed the basket assemblies from four of its MSBs to perform detailed non-destructive examinations (NDE) of all the MSB shell surfaces to identify any undocumented welds. All undocumented welds were being removed by grinding. If grinding reduced the wall thickness below the design minimum, the examination procedure required repair of the affected area using an approved welding technique.

The team reviewed procedures, specifications, drawings, and other documents associated with ANO's MSB examination project, observed NDE and destructive examination results for two unloaded MSBs at ANO, and interviewed personnel involved. Of the two MSBs observed during this inspection, approximately 40 undocumented welds were found on each MSB. All welds examined were shallow (e.g. less than 0.1 inch).

MSB Examination Project

The inspectors concluded that ANO was implementing an effective examination and repair process to ensure that unloaded MSBs, numbers 2, 7, 11, and 12, met applicable requirements. The inspectors identified two inspection follow-up items to (1) review the detailed welding work package for the reinstallation of the shield-lid support rings and (2) review the calculation of the minimum wall thickness for the bottom plate.

Review of ANO Welding Procedures

Based upon the document review and discussions with the licensee staff, the inspectors found that the welding procedure specifications (WPSs) were appropriate and in compliance with ASME Code requirements. The Charpy impact test values in the procedure qualification records (PQRs) conformed with the requirements of the CoC. The inspectors also found that the addition of preheat, as specified in the work package, was in agreement with the commitments

of the CAL. Specification of temper bead welding on the repair welds further improved weld impact toughness and was beyond the requirements of the ASME Code.

Review of Vendor Welding Procedures

In response to the CAL, ANO licensee staff reviewed the WPSs and PQRs used by the MSB fabricator, March Metalfab, for initial MSB construction. The licensee identified incomplete documents, and was obtaining the missing documentation from the fabricator. As a result, the inspectors deferred review to allow the licensee staff to complete its review. Review of these procedures and ANO's resolution of the documentation problems is an inspection follow-up item.

Weld Crack on MSB No. 8

The inspectors found that the licensee's preliminary cause for the crack found on the base of MSB No. 8, localized stress due to grinding, appeared to be credible. Final resolution of this issue will be necessary for confirmation, in accordance with supplement to CAL 97-7-002, that this MSB meets the design criteria.

REPORT DETAILS

1. INSPECTION OBJECTIVES AND SCOPE

The objective of the Nuclear Regulatory Commission's inspection was to examine the licensee's plans and actions to identify and remove undocumented welds on selected, unloaded, Multi-assembly Sealed Basket (MSB) shells. The MSBs are part of the Ventilated Storage Cask (VSC) dry spent fuel storage system, Model VSC-24, manufactured under Certificate of Compliance (CoC) No. 72-1007. The inspectors performed the inspection at the Arkansas Nuclear One (ANO) nuclear power plant in Russellville, Arkansas.

2. BACKGROUND

The ANO Independent Spent Fuel Storage Installation (ISFSI) is located within the protected area of the ANO reactor facilities. Currently four MSBs, numbers 1, 3, 5 and 6, have been loaded with spent fuel elements and are being stored at the ISFSI. Ten unloaded MSBs are also at the ANO site.

On September 5, 1997, NRC issued a supplement to Confirmatory Action Letter (CAL) 97-7-002 documenting agreement by Entergy Operations, Inc. to confirm, under oath and affirmation, that all unloaded MSBs which are intended for use at ANO, meet the design and the terms and conditions of the Certificate of Compliance (CoC) and are in conformance with the Safety Analysis Report (SAR) and Safety Evaluation Report (SER) for the VSC-24, including any referenced standards, criteria, or requirements contained therein.

As a part of its confirmation process, ANO removed the basket assemblies from four of its MSBs to perform detailed non-destructive examinations (NDE) of all the MSB shell surfaces to identify any undocumented welds. All undocumented welds were being removed by grinding. If grinding reduced the wall thickness below the design minimum, the examination procedure required repair of the affected area using an approved welding technique. Of the two MSBs observed during this inspection, approximately 40 undocumented welds were found on each MSB. All welds examined were shallow (e.g. less than 0.1 inch).

3. INSPECTION RESULTS

3.1 MSB EXAMINATION PROJECT (60853)

a. Inspection Scope

The inspectors reviewed MSB examination project procedures, work procedures, and other documents to verify conformance with the SAR, the CoC, Quality Assurance requirements, and the ASME Code. The inspectors also observed work activities, met with licensee personnel, and verified selected qualification and training records.

b. Observations and Findings

ANO partially disassembled four MSBs, numbers 2, 7, 11 and 12, for a 100% examination of the MSB shell surfaces. In addition, ANO removed the shield lid support rings on the remaining six MSBs to support any future examinations. ANO procedure 1409.639, Revision 0, "Inspection of Multi-assembly Sealed Basket Components" provided overall control of work activities to partially disassemble, examine, and reassemble the MSBs and also controlled examination of the shield lid and structural lid surfaces. The work sequence for the MSB examination is summarized below.

- remove the shield-lid support ring and subsequent basket removal
- remove paint on all shell surfaces
- acid-etch all MSB shell surfaces to identify undocumented welds
- NDE to record as-found conditions
- remove undocumented welds via grinding
- blend affected areas that are greater than minimum wall
- repair, by welding, the affected areas that are less than minimum wall
- NDE affected areas as required
- re-coat surfaces
- reinstall the basket assembly and reinstall the shield-lid support ring

The inspectors found that procedure 1409.639 provided good control of the work, data collection, and quality assurance. The actions for removal of the undocumented welds, subsequent repair of the affected areas by welding, and post repair NDE were consistent with the Sierra Nuclear Corporation fabrication specification, AMSB-92-001, Revision 3, "Fabrication Specification for the Multi-Assembly sealed Basket," and the ASME Code, Section III, NC-2538.

The inspectors reviewed the following support procedures for procedure 1409.639. These procedures were general procedures, applicable to activities beyond the MSB examination project. No concerns were noted.

1415.001, Revision 3, "Ultrasonic Thickness Measurement (Digital or Meter Display)"
1415.002, Revision 10, "Liquid Penetrant Examination"
1415.007, Revision 4, "Manual Ultrasonic Weld/Wall Thickness Profile"
5120.119, Revision 1 PC-1, "Control of Plant Welding"
5120.120, Revision 1, "Weld Documentation Requirements and Controls"

During this inspection, the licensee staff was in the process of developing the detailed welding work package for the reinstallation of the shield-lid support rings. The licensee advised the inspectors that a new procedure qualification record (PQR) for automatic flux core arc welding (FCAW) would be performed. Review of this package was deferred as an inspector follow-up item (IFI 72-013/97-215-01).

The inspectors observed portions of the shield-lid support ring removal operation. The shield ring welds were removed via a machining tool that did not adversely affect shell base material. Prior to removal, ANO performed dye penetrant testing (PT) on the welds and noted rejectable indications on several of the welds. The PT, required by ANO, was beyond the requirements of the vendor's fabrication specifications. During weld removal, ANO observed on some of the welds, that the root pass did not completely fill the weld volume. The PT results and incomplete weld conditions were recorded on condition reports. The quality of these welds were of low safety significance on the unloaded MSBs since the welds were removed. However, they provide additional information to the licensee. ANO was in the process of evaluating the loaded MSBs regarding the need for this weld in the accident analysis.

The inspectors observed portions of the work on the MSBs. ANO completed acid-etching, PT, and ultrasonic testing (UT) for wall thickness measurements on MSB No. 11 during the inspection. A total of 40 undocumented welds, 30 on the exterior and 10 on the interior, were found and recorded. Of those welds, four (1 interior, 3 exterior) were found to have ASME Section III, Class 2 (NC) rejectable PT indications. The indications were characterized as clusters of porosity. This information was recorded on Condition Report CR-C-97-023. Grinding to remove weld material and heat-affected zones (HAZ) was also in progress. ANO collected data on initial wall thickness, depth of welds, and depth of the HAZ. ANO completed acid-etching on the exterior of MSB No. 12 and identified 36 undocumented welds on the shell walls and 6 on the bottom plate. Examinations of MSB Nos. 2 and 7 had not yet started.

The inspectors observed that the work conditions were excellent, that the workers were knowledgeable, and that the procedures were followed and kept up-to-date. No discrepancies were found from the inspectors' review of the qualification records of one NDE examiner and one welder involved with the examinations. ANO supervisors provided considerable oversight during the process. A strong quality control presence was also evident for both hold point verification and general surveillance.

Because minimum wall thickness acceptance criteria were not specified in the procedure, the inspectors questioned ANO staff on the acceptance criteria and their bases. The shell minimum wall thickness was 0.9 inch (nominal 1 inch), based on Section 5.3.1 of the "Safety Evaluation Report for Pacific Sierra Nuclear Topical Report on the Ventilated Storage Cask System for Irradiated Fuel," Revision 1, March 29, 1991. The inspectors independently confirmed this value by reviewing Sierra Nuclear Corporation MSB-24 Corrosion Calculation No. WEP-101.1101 (Proprietary), Revision 2, dated February 8, 1991. ANO stopped removing undocumented welds on the bottom plate until a calculation for the minimum wall thickness of the bottom plate (nominal 0.75 inch) was completed. This bottom plate minimum wall thickness calculation was in progress at the close of the inspection and its review is an inspection follow-up item (IFI 72-013/97-215-02).

c. Conclusions

The inspectors concluded that ANO was implementing an effective examination and repair process to ensure that unloaded MSBs, numbers 2, 7, 11, and 12, met applicable requirements. The inspectors identified two inspection follow-up items to (1) review the detailed welding work package for the reinstallation of the shield-lid support rings and (2) review the calculation of the minimum wall thickness for the bottom plate.

3.2 REVIEW OF ANO WELDING PROCEDURES (60853)

a. Inspection Scope

ANO's welding procedure specifications (WPSs) and PQRs for all proposed repair welds, and shield lid and structural lid welds were reviewed for compliance with cask design criteria and requirements of the CoC. Two welding processes are permitted by the licensee for the various welds: shielded metal arc (SMAW) and FCAW. Additionally, the corrective actions proposed in ANO's August 11, 1997, response to CAL 97-7-002 were compared, as appropriate, against the work plan for welding activities. The corrective actions included employing a 200° Fahrenheit (F) preheat.

b. Observations and Findings

The inspectors reviewed the following ANO WPSs and associated PQRs:

SMAW WPS E-P1-A-A1-CVN-1, Revision 2, and supporting PQR 398
FCAW WPS E-P1-F(S,M)-A1-CVN, Revision 1, and supporting PQR 399
SMAW WPS P1-A-B-CVN, Revision 1, and supporting PQR AS-028
FCAW WPS P1-F-B-M-CVN, Revision 1 and supporting PQR AS-030

The above were general procedures that could be applied to either the repair weld effort or the lid welds. A review of the essential variables supported that such dual use was acceptable and in accordance with the ASME Code.

Since the WPSs were general application procedures, addition of the CAL commitments will be accomplished through additional instructions in the welding work package. One such package reviewed, by the inspectors, was Welding Request (WR) #97-0621. This WR employs a 200°F preheat for all welding on the cask, regardless of whether it is a repair weld or the closure welds.

The Charpy impact test results reported by ANO on the reviewed PQRs were all in compliance with the fabrication requirement for a minimum 15 foot-pounds absorbed energy at -50°F. This included the impact values for the weld metal, HAZ and base metal. The inspectors noted that the reported impact values for the weld metal and HAZ had a wide range, as could be expected for material in the as-welded condition. To confirm the

reasonableness of the reported impact values, the inspectors compared the reported impact values with the certified material test report impact values from the plate manufacturer (Lukens Steel) and typical reported values from the electrode supplier (Lincoln Electric). In all cases, the material supplier impact test values bounded the PQR values, indicating that the PQR values were reasonable, and that the weld process was producing welds of the desired impact resistance.

To further enhance the impact properties of the repair welds, the licensee staff specified, in WR #97-0621, that a temper bead weld technique be employed. The inspectors noted the temper bead technique was an acceptable method, beyond the ASME Code requirements, to enhance weld impact resistance.

c. Conclusion

Based upon the document review and discussions with the licensee staff, the inspectors found that the WPSs were appropriate and in compliance with ASME Code requirements. The Charpy impact test values in the PQRs conformed with the requirements of the CoC. The inspectors also found that the addition of preheat, as specified in the work package, was in agreement with the commitments of the CAL. Specification of temper bead welding on the repair welds further improved weld impact toughness and was beyond the requirements of the ASME Code.

3.3 REVIEW OF VENDOR WELDING PROCEDURES (60853)

In response to the CAL, ANO licensee staff reviewed the WPSs and PQRs used by the MSB fabricator, March Metalfab, for initial MSB construction. The licensee identified incomplete documents, and was obtaining the missing documentation from the fabricator. As a result, the inspectors deferred review to allow the licensee staff to complete its review. Review of these procedures and ANO's resolution of the documentation problems is an inspection follow-up item (IFI 72-013/97-215-03).

3.4 WELD CRACK ON MSB No. 8 (60853)

a. Inspection Scope

The inspectors reviewed documentation, interviewed ANO staff familiar with the issue, and observed the site on MSB No. 8 where a small crack had been identified and subsequently removed.

b. Observations and Findings

During its external examination of the base on MSB No. 8, the licensee found a small crack at the location of an undocumented weld. The crack was approximately 0.25 inches long, 0.036 inches deep, and extended from the edge of the weld into the HAZ. The inspectors Reviewed Condition Report CR-C-97-0310 addressing the condition and photo-micrographs

taken from a replica of the crack. The undocumented weld, the HAZ, and the crack had been removed by the licensee as a part of its determination of the crack's depth and extent. The licensee's preliminary root cause for the crack was localized stress due to grinding to remove unneeded weld material from the undocumented weld. However, final evaluation of the root cause was not complete at the close of this inspection. The inspectors informed the licensee that resolution of this issue, in accordance with the supplement to CAL 97-7-002, would be necessary to confirm that the MSB meets the requirements and design criteria.

c. Conclusion

The inspectors found that the licensee's preliminary cause for the crack found on the base of MSB No. 8, localized stress due to grinding, appeared to be credible. Final resolution of this issue will be necessary for confirmation, in accordance with supplement to CAL 97-7-002, that this MSB meets the design criteria.

4. Exit Meeting

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection on November 6, 1997. The licensee acknowledged the findings presented and stated their interest in fully and quickly resolving the MSB welding issues.

PARTIAL LIST OF PERSONS CONTACTED

Entergy, Arkansas Nuclear One Plant

Randy Edington	General Manager
Jim McWilliams	Manager Modifications
Drew Binkley	Modifications
Darrell Williams	Design Engineering
John Dosa	Licensing Engineer
Ray Kellar	High Level Waste Project Manager
Mike Hall	Welding Engineer
M. R. Eisenhower	Lead Welder
N. Finney	NDE Level III

NRC

J. Melfi	Acting Senior Resident Inspector

INSPECTION PROCEDURES USED

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

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

72-013/97-215-01	IFI	Review of the Detailed Welding Work Package for Reinstallation of the Shield Lid Support Rings
72-013/97-215-02	IFI	Review of the Bottom Plate Minimum Wall Thickness Calculation
72-013/97-215-03	IFI	Resolution of the Vendor WPS and PQR Documentation Issues

Closed

none

Discussed

none

LIST OF ACRONYMS USED

ANO	Arkansas Nuclear One
CoC	Certificate of Compliance
F	Fahrenheit
FCAW	Flux Core Arc Welding
HAZ	Heat Affected Zone
IFI	Inspection Follow-up Item
ISFSI	Independent Spent Fuel Storage Installation
MSB	Multi-assembly Sealed Basket
NDE	Nondestructive Examination
NRC	Nuclear Regulatory Commission
PQR	Procedure Qualification Record
PT	Dye Penetrant Testing
SAR	Safety Analysis Report
SER	Safety Evaluation Report
SMAW	Shielded Metal Arc Welding
UT	Ultrasonic Testing
VSC	Ventilated Storage Cask
WPS	Welding Procedure Specification
WR	Welding Request

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