INSPECTION REPORT

Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards

Docket No.:	72-1007
Inspection Report:	72-1007/97-212
Certificate Holder:	Sierra Nuclear Corporation
Inspection Locations:	Sierra Nuclear Corporation, Scotts Valley, California March Metalfab, Incorporated, Hayward, California Arkansas Nuclear One, Russelville, Arkansas
Dates:	July 8-10
Inspectors:	Patricia L. Eng, Team Leader Allen G. Howe, SFPO C. Kenneth Battige, SFPO James E. Spets, SFPO Phillip V. Joukoff, OI, RIV, WCFO

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EXECUTIVE SUMMARY

Sierra Nuclear Corporation
U.S. Nuclear Regulatory Commission Inspection Report 72-1007/97-212

The team performed an unannounced inspection at Sierra Nuclear Corporation (SNC) in Scotts Valley, California; and at March Metalfab, Incorporated (MMI), in Hayward, California; and an announced inspection at the Arkansas Nuclear One (ANO) power plant, to review the disclosure of undocumented welding on the multi-assembly sealed basket (MSB) shell of the Ventilated Storage Cask (VSC) dry spent fuel storage system, Model VSC-24.

The team observed non-destructive examination (NDE) and destructive examination results for the ten unloaded MSBs at ANO and interviewed personnel involved.

The team reviewed procedures, specifications, drawings, and other documents associated with the fabrication and certification of completion for those casks fabricated by MMI from mid-1994 through mid-1995 and interviewed SNC and MMI staff and managers.

The initial indication of undocumented welding occurred in March 1995, when the Palisades Nuclear Plant (Palisades) experienced cracking adjacent to the seal weld between the shield lid and the MSB shell. The 1995 root-cause analysis of the weld crack performed by Palisades identified the presence of welding material in the vicinity of the crack, and hydrogen-induced cracking as a possible root cause. SNC subsequently stated that no welding was done to the inside of the MSB wall and that the cracking was most likely caused by defects in the base metal. In late December 1996 and in March 1997, ANO experienced weld cracking, similar to that of Palisades, on two different MSBs.

A March 1997, NRC inspection found that SNC failed to perform a comprehensive root-cause analysis for the weld cracks at Palisades and ANO. In response to the March 1997, inspection finding and Confirmatory Action Letter, CAL 97-7-001, issued on May 16, 1997, SNC assembled a group of welding experts to perform a root-cause analysis of the weld cracks. As a part of the analysis, the licensee for ANO performed NDE of ten unloaded MSBs to check for the presence of welds. An examination, performed by acid etching approximately the top 12 centimeters (five inches) of the MSB inner surface, indicated the presence of undocumented weld material on all ten MSBs.

NRC initiated this inspection to assess the extent and safety significance of undocumented welds on the MSB shell. Based on its examinations, the team identified the following:

- ANO performed a number of non-destructive and destructive examinations to assess the condition of the MSBs. These examinations uncovered numerous undocumented welds. The number and location of these undocumented welds are of concern since they may affect the quality of the closure welds of the MSBs. In addition, the high material hardness obtained from an uncontrolled welding process is a concern because it may render the material unable to meet Charpy impact test requirements. To address this concern, ANO plans to remove the undocumented welds and repair the affected areas

per the American Society of Mechanical Engineers (ASME) Code before loading the MSBs.

- SNC had not designated one person to manage overall resolution of the weld issues. Information on the weld issues appeared, in some cases, to be compartmentalized within SNC.

- Welding to repair MSB shell material on multiple MSBs was performed without written procedures, without control of welding material, and without NDE of the repaired areas. Welding without adequate controls is a nonconformance of 10 CFR 72.158, "Control of Special Processes."

- Although SNC had multiple processes in place to ensure that MMI met procurement specifications and had information on potential problems, SNC's oversight of MMI was inadequate as evidenced by numerous examples where MMI performed undocumented repair of material by welding. SNC's failure to ensure that MMI met fabrication requirements is a nonconformance of 10 CFR 72.154, "Control of Purchased Material Equipment and Services."

- Several corrective actions in response to NRC Inspection Report 72-1007/97204 had not been implemented by SNC's commitment date of June 30, 1997. SNC informed the team that all corrective actions were in progress. Following the inspection, SNC sent a letter, dated July 30, 1997 to NRC updating the completion dates.

Table 1 summarizes the nonconformances.

Table 1
Summary of Nonconformances

10 CFR Section	Description of Nonconformance	Number	Report Section
72.158	"Control of Special Processes"	1	3.4
72.154	"Control of Purchased Material Equipment and Services"	1	3.5

PERSONS CONTACTED

The team held an entrance meeting on July 8, 1997, to present the scope and objectives of the NRC inspection. On August 28, 1997, the NRC held an exit meeting with SNC management at NRC Headquarters in Rockville, Maryland, to present the findings of the inspection. Key individuals present at the entrance and exit meetings and principal contacts are listed in Table 2.

Table 2
Entrance/Exit Meeting Attendees/Principal Contacts

NRC		
***	W. F. Kane	Acting Director, Nuclear Material Safety and Safeguards
***	C. J. Haughney	Acting Director, Spent Fuel Project Office (SFPO)
***	S. F. Shankman	Acting Deputy Director, SFPO
*	P. L. Eng,	Technical Assistant, SFPO
***	A. G. Howe	Nuclear Engineer, SFPO
+#	C. K. Battige	Materials Engineer, SFPO
**	J. E. Spets	Safety Inspection Engineer, SFPO
**	P. V. Joukoff	Senior Special Agent, Region IV, Walnut Creek Field Office
***	T. J. Kobetz	Project Manager, SFPO
***	F. C. Sturz	Chief, Technical Review Section, SFPO
Sierra Nuclear Corporation		
***	J. V. Massey	President and CEO
**	A. J. McSherry	President
***	G. N. Dixon, Jr.	Vice President, Quality Assurance/Control
*	W. McConaghy	Manager of Licensing, Vice President Business Development
*	T. J. Wenner	Executive Vice President of Operations
***	B. A. Chechelnilsky	Manager of Engineering
****	K. E. Moeckel	Manager of Products, Principal Engineer
Entergy , Arkansas Nuclear One Plant		
#	Glen Ashley	Licensing
+#	Kirk Dixon	Mechanical Engineer, Modifications
+	M. R. Eisenhower	Lead Welder
+#***	John Dosa	Licensing Engineer
#	Mike Hall	Welding Engineer
****	Joel Harrison	NDE Level III, Raytheon
+#***	Ray Kellar	Dry Fuel Project Manager
+#	Kris Kennedy	NRC Senior Resident Inspector
+#	Jim McWilliams	Manager Modifications
#	Dwight Mims	Licensing Director
+	Jerry Ray	Non Destructive Examination Supervisor
#	Rick Thomas	Unit 1 Operations
+#	Darrell Williams Design Engineering	
March Metalfab Incorporated		
****	R. Allmon	Project Manager
****	B. Rogers	Quality Assurance/Quality Control Manager

*	Present at the entrance and exit meetings.
**	Present at the entrance meeting only.
***	Present at the exit meeting only.
+	Present at entrance meeting at ANO on 7/8/97.
+#	Present at interim exit meeting at ANO on 7/10/97.
****	Principal contacts but not at the entrance and exit meetings.

REPORT DETAILS

1. INSPECTION OBJECTIVES AND SCOPE

The objective of the Nuclear Regulatory Commission's team inspection was to examine information related to the disclosure of undocumented welds on the Multi-assembly Sealed Basket (MSB) shell materials of the dry spent fuel storage system manufactured under Certificate of Compliance (CoC) No. 72-1007. These welds include temporary attachment welds and welding to repair surface indications on shell materials.

The NRC team performed the inspection at Sierra Nuclear Corporation (SNC) in Scotts Valley, California; at one of SNC's fabrication contractor's facilities – March Metalfab Incorporated (MMI) in Hayward, California – and at the Arkansas Nuclear One (ANO) nuclear power plant in Russelville, Arkansas.

The team reviewed the fabrication records for selected casks manufactured by MMI, interviewed personnel involved in the fabrication, examined the fabrication facilities, and examined the nondestructive examination (NDE) of MSBs at ANO.

2. BACKGROUND

In March 1995, Palisades Nuclear Plant (Palisades) discovered cracking adjacent to the seal weld between the shield lid and the MSB shell. This cracking was found by the helium leak test performed during cask loading. The leak test is used to verify that the fuel has been successfully confined in an inert atmosphere to prohibit cladding and fuel corrosion as discussed in the CoC. The MSB shell, shield lid, and the seal weld form part of the confinement boundary for the Ventilated Storage Cask (VSC)-24 dry spent fuel storage system manufactured under CoC No. 72-1007 and are designated as important to safety.

The 1995 root-cause analysis of the weld crack performed by Palisades identified the presence of welding material in the vicinity of the crack and hydrogen-induced cracking as a possible root cause. Palisades then questioned SNC as to how and why an apparently undocumented weld was made to the inside of the canister. SNC stated that no welding was done to the inside of the MSB wall and that the cracking was most likely caused by defects in the base metal.

In December 1996, ANO experienced an incident similar to that of Palisades; the loaded, and welded-shut canister was unable to pass the helium leak test. During removal of the shield lid for repairs, ANO discovered a defect cavity 7.6 centimeters (3 inches) long and 1.3 centimeters (½ inch) high. ANO identified the root-cause for this crack as lamellar tearing. The licensee adopted SNC's suggested corrective action of ultrasonic inspection for laminations. The NRC subsequently found that the acceptance standards for this examination technique were inadequate during a March 1997 inspection.

In March 1997, NRC inspected SNC and its primary fabricator, MMI, to evaluate the vendor's analysis of the root cause for the weld failures at both Palisades and ANO. Staff from both SNC and MMI consistently stated that no welding was performed for any reason on the inside of the MSB. MMI acknowledged that fit-up aids were occasionally used on the outside of the MSB

shell, to align specific parts, but that no welds were made in the top region inside of the MSB shell. Consequently, at that time, NRC found that the root causes for the weld cracks were indeterminate.

During the March 1997 inspection, NRC noted that despite two prior helium leak test failures at the shield-lid-to-MSB-wall interface, SNC had failed to perform a comprehensive root-cause analysis for the weld cracks. NRC also identified two additional nonconformances in the area of inadequate corrective actions: incomplete and limited resolution of inappropriate drain-down times for use during the loading of the VSC-24 system, as identified in April 1996, and failure to update the Safety Analysis Report to require NDE after the removal of any temporary attachments. Shortly after the NRC inspection in March 1997, dye-penetrant (PT) examination revealed a crack in a second canister at ANO. As in the first two cases, the cracking occurred at the shield lid/MSB wall interface.

As discussed in detail in NRC inspection report IR 72-1007/97-204, there is a potential for delayed cracking of the shell-to-shield-lid seal weld. However, if both the cask's inner shield-lid seal weld and the outer-lid structural weld failed, there is not an off-site threat to public health and safety because of the limited amount of radioactive material that would be released due to the small size of the crack, the lack of a dispersal mechanism, and the relatively large size and weight of fuel particles. Such an occurrence would cause loss of the helium atmosphere inside the cask. This loss could result in eventual cladding degradation and potential future fuel handling and retrieval problems.

In response to the NRC nonconformance found during the March 1997 inspection and a Confirmatory Action Letter, CAL 97-7-001, issued on May 16, 1997, SNC assembled a group of welding experts, the VSC Weld Review Team, to perform a root-cause analysis of the weld cracks. As a part of the analysis, the licensee for ANO performed NDE on ten unloaded MSBs, to check for the presence of weld material. An examination, performed by acid etching approximately the top 12 centimeters (five inches) of the MSB inner surface, indicated the presence of undocumented weld material on all ten MSBs.

The ten MSBs examined at ANO were fabricated by MMI under contract to SNC. MMI had fabricated the MSBs that experienced the shell-to-shield-lid seal weld cracking at both Palisades and ANO. ANO provided the examination results to SNC, which forwarded them to MMI for evaluation. In a memorandum dated June 30, 1997, MMI informed SNC that the weld indications were caused by removal of temporary attachments or by "weld pick-up" of indentations caused by the clamp used for handling the shell sections and assembly. SNC issued a corrective action request (CAR) on July 1, 1997, and informed the licensees at ANO, Palisades, and Point Beach (VSC-24 general licensees) of the undocumented welds via a faxed memorandum dated July 2, 1997, and subsequently revised July 9, 1997. SNC informed NRC of MMI's disclosure of undocumented welds on July 2, 1997.

NRC initiated this inspection to assess the extent and safety significance of undocumented welds on the MSB shell. Although an inspection in March 1997 was intended, in part, to review fabrication practices, including welding on the MSBs, the existence of welds similar to those found on the MSBs at ANO was not brought to the attention of NRC.

After the inspection, SNC's response to the CAL was sent to the NRC by letter dated July 30, 1997. Staff review of the CAL response is ongoing and is being addressed separately.

3. INSPECTION RESULTS

3.1 CHRONOLOGY

The team developed a chronology of significant fabrication activities, correspondence, notifications, and other actions. This chronology is included as Appendix A to this inspection report.

3.2 NDE OF MSBs AT ARKANSAS NUCLEAR ONE

Inspection Scope

In response to the recommendations of the VSC Weld Review Team, ANO performed NDE to determine the existence and extent of undocumented welds believed to be present in the MSB wall. ANO performed visual (VT), dye penetrant (PT), ultrasonic (UT), and acid etch NDE on the region where the shield and structural lids are welded to the MSB shell.

The team observed the condition of 10 unloaded MSBs at the ANO site and reviewed both NDE and destructive examination results. The team also discussed the examination results, with licensee personnel, and discussed the licensee's plan of action.

Observations and Findings

ANO examined the ten unloaded MSBs to determine if undocumented welds existed in the region of the MSB where the shield and structural lids are welded. ANO removed the protective coating from the top inside surface of each MSB and examined the top 12 centimeters (five inches) of the shell 360 degrees around the circumference.

ANO performed VT and PT examinations on the inside surface. The licensee informed the team that the PTs identified several minor indications on the inside surface and top rim of the MSB, however, no cracks were found. ANO that stated they plan to remove the indications and repair the affected areas in accordance with ASME Code requirements before using the MSBs. PT examination revealed no unacceptable indications.

The examination surface was etched with a nitric acid solution to determine if any weld material was present. Acid etching reveals the microstructure of the material; thus, any change in microstructure from welding becomes readily visible. Each of the ANO MSBs (AMSBs) examined, specifically AMSBs 2, 4, and 7 through 14, showed evidence of one to four undocumented welds. The most common case was two small semi-circular or globular welds, several inches apart, located roughly diagonally opposite of the longitudinal seam weld (about 180 degrees from the seam weld). The acid etch examination results were documented in the "Report of Acid Etching on Dry Fuel Storage Multi-Assembly Sealed Basket Shells," dated July 3, 1997. ANO stated it plans to remove these undocumented weld indications and repair the

affected areas in accordance with the ASME Code before using the MSBs. Photos of the weld indications, as well as a description by ANO are contained in Appendix B.

The team examined several weld metal and heat affected zone (HAZ) indications made visible by the acid etch process on several MSBs and agrees with the licensee that the indications are characteristic of weld material. These weld indications agreed with the location of and shape of the indications caused by the plate-handling tool described in MMI's June 30, 1997, letter to SNC.

After the inspection period, ANO removed additional protective coating and performed acid etch examinations of an additional 18 centimeters (7 inches) down the inside wall of two MSBs to check for additional undocumented welds. The licensee reported that no further indications of welding were found.

ANO performed an automated UT of the entire volume on the top 12 centimeters (5 inches) of the MSB to detect laminations and other volumetric indications. The examination used the Projection Image Scanning (P-scan) technique to locate laminar and planar flaws. The team reviewed the printed P-scan output for straight beam examination for all 10 MSBs, and selected angle beam examinations. The P-scan found a number of subsurface indications. Only three indications had any measurable depth. None of the welds identified through the acid etch process appeared on the P-scan, suggesting that the welds were not very deep and that there was no lack of fusion under the welds. ANO stated it plans to remove the indications and repair the affected areas in accordance with the ASME Code, before using the MSBs.

To gain information on the indications identified through the acid etch and P-scan examinations, ANO removed "boat" samples from several sites on MSB walls for destructive examination. The samples included undocumented welds identified through the acid etch test and one sub-surface indication identified with the P-scan.

These samples were analyzed by an outside contractor, Southwest Research Institute (SwRI) for chemistry, hardness, and microstructure. The team reviewed a facsimile from SwRI dated July 9, 1997 -- SwRI Project No. 06-8381-162 -- which contained hardness testing results from Sample MSB10-1A, an undocumented weld indication. Subsequent to the inspection period, SwRI chemically analyzed a sample of the base material. ANO stated that the base metal chemistry met the requirements for ASME SA-516 plate material and correlated well to the stated chemistry for the Certified Material Test Report for the sampled plate.

The team noted that the SwRI hardness values confirm the existence of a welded structure in carbon steel plate. However, the HAZ exhibited very high hardness and thus was not as ductile as the base material. Although these repairs may be small and shallow, the team notes that the high hardness observed in the HAZ may render this material unable to meet impact requirements stipulated in the ANO MSB fabrication specification. The fabrication specification states that base material, deposited weld filler metal, and weld HAZ shall have Charpy impact tests showing toughness not lower than 15 ft-lb at -50°F. In addition, harder materials are more susceptible to delayed or hydrogen induced cracking.

Conclusions

ANO performed a number of non-destructive and destructive examinations to assess the condition of the MSBs. These examinations uncovered numerous undocumented welds. The number and location of these undocumented welds are of concern as they may affect the quality of the closure welds on the MSBs. In addition, the high material hardness obtained from an uncontrolled welding process is a concern to NRC because it may render the material unable to meet Charpy impact test requirements. To address this concern, ANO plans to remove the undocumented welds and repair the affected areas in accordance with the ASME Code before loading the MSBs.

3.3 PERSONNEL INTERVIEWS

Inspection Scope

The team interviewed SNC and MMI staff and managers to determine their knowledge of the undocumented weld repairs of materials, to develop a sequence of events, and to gain an understanding of SNC's response to MMI's disclosure of undocumented welds. In support of the interviews, the team reviewed those procedures, drawings, and other documents associated with the fabrication and certification of completion for those casks fabricated by MMI from mid-1994 through mid-1995.

Observations and Findings

SNC project managers stated that during fabrication, they visited the MMI fabrication shops two or more times a week for at least half-day or longer per visit. SNC corporate officers also visited the fabrication shops often, but less frequently than the project managers. SNC staff and corporate officers stated that they did not recall seeing or hearing about the use of temporary attachments or other fabrication fit-up aids that were welded to the inside of the MSBs. In most cases, SNC employees stated that they became aware of the temporary attachments during this NRC inspection.

The MMI project manager for the SNC fabrication work and the MMI Quality Assurance Manager in place during the time of interest stated that they had known about temporary attachments welded to the inside of the MSB, but had not mentioned them either SNC or NRC staff. They also stated that no records were kept, because the use of temporary attachments was considered "skill of the craft," and therefore not noteworthy. However, MMI personnel stated that they believed that both SNC and the utilities should have been aware of the use of temporary attachments because of their frequent visits to the MMI shops.

MMI staff stated that welding of temporary attachments on the inside of the MSB ended in late 1995 when the current fabrication specifications were issued. These fabrication specifications were more detailed in that they addressed temporary attachments and repairs to materials by welding.

The team was unable to identify one point of contact at SNC responsible for managing overall resolution of the weld issue. For example, the SNC employee investigating the weld cracking at

ANO was not conversant with the weld crack at Palisades, while the SNC employee familiar with the Palisades weld crack was not involved in the root cause analyses of the two ANO weld cracks. Also, the SNC project manager for ANO had only a limited awareness of the weld failures at ANO. Further, the SNC President and several Vice Presidents, stated that they were unfamiliar with both the 1995 weld crack at Palisades and the first weld crack at ANO in 1996, until the NRC inspection in March 1997.

The team observed that during the period January 1994 - April 1994, the position of Manager (now Vice President) of Quality Assurance was vacant.

Conclusions

SNC had not designated one person to manage overall resolution of the weld issues. Information on the weld issues appeared, in some cases, to be compartmentalized within SNC.

3.4 CONTROL OF SPECIAL PROCESSES

Inspection Scope

The team reviewed portions of SNC's control of special processes, including fabrication specifications, procedures, and SNC and MMI correspondence. The team interviewed management and staff at SNC and MMI. The team also reviewed specific American Society of Mechanical Engineers (ASME) Code sections, corrective action reports (CARs), and nonconformance reports (NCRs).

Observations and findings

As discussed in section 3.2 above, undocumented welds were located on each of the ten unloaded MSBs examined at ANO. AMSBs 1 through 14 were fabricated by MMI between April 1994 and May 1995. AMSBs 1, 3, 5, and 6 are loaded.

After reviewing photographs and examination reports of the MSBs examined by ANO, MMI stated, in a June 30, 1997, letter to SNC that "the welding of indications caused by handling was performed, in lieu of blending . . . ." MMI further stated that "this welding was determined to be within fabrication workmanship requirements." In a memorandum faxed to VSC-24 users dated July 2, 1997, SNC stated that MMI had performed undocumented weld repairs to base metal of MSBs fabricated in the 1994-to-1995 time frame. In a July 9, 1997, correction to the July 2, 1997, memorandum SNC stated, that MMI would either blend, by grinding, or repair by welding, surface imperfections that were greater than 0.025 centimeters (0.010 inches) but less than the actual shell thickness minus the minimum required thickness, and that these repairs were not documented.

SNC informed the team that MMI's weld repair practices did not meet SNC requirements. Specifically, SNC stated that the requirements of ASME, Section III, NC-2538 applied to the repair of indications in materials. NC-2538 authorizes removal of defects by grinding or machining to blend the defect into the surrounding surface. If the elimination of the defect reduces the thickness of the section below the minimum required by the design, the material

shall be repaired in accordance with NC-2539 "Repair by Welding." NC-2539 requires repair be performed by a qualified welder and welding procedure and that each repair weld shall be non destructively examined.

SNC's fabrication specifications provided detailed MSB technical requirements to the fabrication subcontractor (fabricator), including the control of special processes. It is important to note that the fabrication specifications are the primary means governing how fabrication meets SAR commitments. Although ASME Code sections are referenced and followed for significant portions of the fabrication, the MSB is not required to be Code stamped. The team observed the following regarding the ANO MSB fabrication specification, AMSB-92-001, Revision 3, applicable to AMSBs 1 through 14:

- Section 3.4.6 specifies that "the Vendor [MMI] shall maintain complete and accurate records of all pressure boundary materials so that every pressure boundary component of the finished MSB can be related to . . . and the fabrication history of the component."

- Section 3.5.2 specifies that "all machining, welding, and forming shall be in accordance with Section III, Article NC-4000, of the ASME Code unless otherwise specified in the referenced drawing."

- Section 3.7 specifies that 1) "all welding shall be in accordance with referenced drawings;" 2) "all welding procedures shall be written and qualified in accordance with Section IX of the ASME Code;" and 3) "all welds shall conform to the requirements of ASME, Section III, Article NC-4400."

The team made the following observations from its review of applicable portions of the ASME Code referenced in the fabrication specifications:

- NC-4130, "Repair of Material," references NC-2500, "Examination and Repair of Pressure Retaining Material," for repair of material if defects are discovered during fabrication.

- NC-2510(b) states that the requirements of this Subarticle [NC-2500] for repair by welding ... shall be met wherever repair welds are made to pressure retaining material and material welded thereto.

- NC-2539.2 requires qualification of the welding procedures and welders in accordance with NC-4000 and Section IX.

Based on its independent review of the ANO fabrication specifications and the referenced ASME Code articles, the team agreed with SNC's statement that ASME, Section III, NC-2538, was applicable to repair of material by welding.

MMI fabricated Consumers Power Company (CPCo) MSBs (CMSBs) 5 through 10 for Palisades from February 1994 to March 1995. The team observed that: 1) these fabrication specifications were similar to ANO's; 2) the fabrication periods for Palisades and ANO overlapped; 3) the SNC July 2, 1997, letter stated that undocumented welds were made during 1994 and 1995; and 4) undocumented weld material on MSB-05 was described in CPCo Condition Report, C-PAL-95-

0192. Based on the above, the team judged that undocumented welds to repair shell materials were also probable for these MSBs.

MMI's current fabrication run, for CMSBs 15 through 22, started in December 1995. The current fabrication specification, CMSB2-95-001, "Fabrication Specification for the Multi-Assembly Sealed Basket (MSB)," Revision 0, Section 3.7.8, MMI, specifically states: "Repair of material by welding shall be accomplished in accordance with the requirements of ASME, Section III, Article NC-2500." This new requirement was added in August 1995 and after SNC was notified by Palisades of the crack near the MSB-05 Shield Lid weld. However, SNC personnel stated that they could not recall nor could they locate documentation to fully explain the basis for adding this new requirement.

The team identified the following concerns with uncontrolled repair of material by welding:

- Existing undocumented welds in the MSB shell increase the susceptibility of the material to hydrogen induced cracking.

- Because no records were kept, there is no evidence demonstrating that: 1) the weld filler material was controlled; 2) the welding procedure and the welders were qualified; 3) post weld examination was performed; and 4) the depth of the original indications and post-repair thicknesses were verified .

The team found that SNC failed to establish adequate controls of special processes in that MMI performed welding to repair MSB shell material on AMSBs 2, 4, and 7 through 14, without written procedures, without control of welding material, and without NDE of the repaired areas. Welding without adequate controls is a nonconformance of 10 CFR 72.158, "Control of Special Processes," which requires the establishment of measures to ensure that special processes, including welding, heat treating, and nondestructive testing, are controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable Codes, standards, specifications, criteria, and other special requirements.

Conclusions

The team found no evidence that welding to repair MSB shell material on multiple AMSBs was performed with written procedures, with control of welding material, and with NDE of the repaired areas. Welding without adequate controls is a nonconformance of 10 CFR 72.158, "Control of Special Processes."

3.5 SNC OVERSIGHT OF MMI

Inspection Scope

The team reviewed SNC oversight processes and measures to ensure MMI performed welding in accordance with specifications.

Observations and Findings

The team observed the following routine oversight processes that provided measures for SNC and MMI personnel to ensure that welding was performed in accordance with specifications:

- SNC and MMI held readiness review meetings before fabrication started, to systematically review how each fabrication specification would be met. These meetings included how specific ASME Code requirements were satisfied.

- From interviews with SNC and MMI personnel, the team determined that SNC project managers visited the MMI facilities several times a week, for at least a half-day per visit, during production of AMSBs 1 through 14. SNC Corporate Officers also visited the MMI facilities but less frequently than the project managers.

- SNC stated that they placed a full time Quality Assurance (QA)/Quality Control (QC) inspector at the MMI facility in 1994; however, SNC did not provide the team with an exact date. Also, in a letter from SNC to CPCo on May 30, 1995, SNC committed to 100% QA/QC coverage at MMI for fabrication of Palisades CMSBs 15 to 22.

- SNC performed QA audits V94-14, in July 1994; V94-17, in October 1994; V94-18, in November 1994; and INT 95-001, in February - March 1995. Apparently, none of the audits detected MMI's undocumented welding practices to repair material. Audit V94-14, however, included a finding that stated: "Need to assure that special processes (such as welding, heat treating and nondestructive testing) are controlled to meet codes, specifications and special requirements." The finding was general and provided no specific details nor instances to assist in the development of adequate corrective actions. This item was closed by Audit V94-18, but a detailed basis for closure was not reported.

  However, the team's review of recent (1996 and 1997) SNC QA audits and surveillances found broader scope and greater detail. This was consistent with the overall results found during a 1996 NRC inspection.

The team reviewed SNC's corrective actions provided in response to previous NRC nonconformances regarding SNC oversight of MMI. The cover letter for NRC Inspection Report 72-1007/94-207 requested SNC to perform a root-cause analysis of the numerous QA issues and a description of the practices planned for improved management involvement, to ensure the effectiveness of current and future corrective actions.

SNC's root-cause analysis, submitted on September 22, 1994, stated the ". . . biggest cause of the deficiencies was that SNC procurement requirements were not being complied with by the approved vendors" and ". . . the failure to comply with procedures." The letter cited an inadequate review by SNC vendors of the technical and quality requirements of the procurement specifications and drawings and further stated that the lack of compliance was compounded by SNC's weak monitoring and surveillance of its vendor's activities. Short-term corrective actions included improved vendor control, such as increased surveillance of vendors, readiness reviews to verify the capability and intent to comply with requirements, and increased QA monitoring and trending. Long-term actions included a quality improvement program, indoctrination and training

of SNC staff on quality requirements, and management restructuring. The team observed that SNC's analysis clearly indicated weaknesses in oversight of its subcontractors including MMI. The team noted that the SNC response did not provide any discussion of a "look back" to assess the scope of the problems or determine their impact on previous or current work.

SNC and MMI had information that uncontrolled welding occurred after Palisades discovered an undocumented weld in the shell of MSB-05 and Palisades requested SNC to review the issue. A letter from SNC to Palisades, dated May 30, 1995, stated "A thorough review of both the material supply and the fabrication process has shown that no unauthorized welds were made on the plates shipped from Lukens Steel facility, nor were undocumented weld repairs performed by March Metalfab personnel." The team observed that the letter discusses MMI's review of fabrication practices but does not discuss whether SNC independently verified MMI's review or their fabrication practices.

The team identified multiple processes, both general and specific, by which SNC oversaw its subcontractor and had opportunities to identify the practice of uncontrolled welding. The practice of welding without controls appears to be another example where SNC's subcontractor either failed to follow fabrication requirements or did not understand them. The fact that SNC was unable to identify MMI's repeated practice of conducting uncontrolled welding, in spite of known weaknesses in MMI's QA program and identification of an undocumented weld, in March 1995, is of significant concern to the team.

The team found that SNC failed to establish adequate measures to control its subcontractor, MMI, during the fabrication of AMSBs 2, 4, and 7 through 14. Specifically, SNC certified that the AMSBs met requirements but did not implement adequate measures to ensure that MMI performed welding to repair material in conformance with the requirements of the fabrication specifications. SNC's failure to ensure that MMI met procurement requirements is a nonconformance of 10 CFR 72.154, "Control of Purchased Material Equipment and Services," which requires the establishment of measures to ensure that purchased material, equipment, and services conform to the procurement documents.

Conclusions

Although SNC had multiple processes in place to ensure that MMI met procurement specifications and had information on potential problems, SNC's oversight of MMI was inadequate as evidenced by numerous examples where MMI performed undocumented repair of material by welding. SNC's failure to ensure that MMI met fabrication requirements is a nonconformance of 10 CFR 72.154, "Control of Purchased Material Equipment and Services."

3.6 REVIEW OF PREVIOUS CORRECTIVE ACTIONS

The team reviewed the status of corrective actions, resulting from a previous NRC Inspection Report, No. 72-1007/97-204. The team observed that several corrective actions had not yet been implemented. Specifically, in SNC letter, SNC-97-042, dated May 15, 1997, SNC committed to NRC to complete specific corrective actions by June 30, 1997 (i.e., modification of SNC Corrective Action procedure). SNC informed the team that all corrective actions were in progress. On July 30, 1997, SNC sent a letter to NRC updating the completion dates.

4. CONCLUSIONS

The team concluded that:

ANO performed a number of non-destructive and destructive examinations to assess the condition of the MSBs. These examinations uncovered numerous undocumented welds. The number and location of these undocumented welds are of concern since they may affect the quality of the closure welds on the MSBs. In addition, the high material hardness obtained from an uncontrolled welding process is a concern because it may render the material unable to meet Charpy impact test requirements. To address this concern, ANO plans to remove the undocumented welds and repair the affected areas in accordance with the ASME Code before loading the MSBs.

SNC had not designated one person to manage overall resolution of the weld issues. Information on the weld issues appeared, in some cases, to be compartmentalized within SNC.

Welding to repair MSB shell material on multiple AMSBs was performed without written procedures, without control of welding material, and without NDE of the repaired areas. Welding without adequate controls is a nonconformance of 10 CFR 72.158 "Control of Special Processes."

Although SNC had several processes in place to ensure that MMI met procurement specifications and had information on potential problems, SNC's oversight of MMI was inadequate as evidenced by numerous examples where MMI performed undocumented repair of material by welding. SNC's failure to ensure that MMI met fabrication requirements is a nonconformance of 10 CFR 72.154, "Control of Purchased Material Equipment and Services."

Several corrective actions in response to NRC Inspection Report 72-1007/97204 had not been implemented by SNC's commitment date of June 30, 1997. SNC informed the team that all corrective actions were in progress. Following the inspection, SNC sent a letter, dated July 30, 1997 to NRC updating the completion dates.

5. EXIT MEETING

The team presented the inspection results to SNC's management on August 28, 1997. SNC acknowledged the findings presented.

CHRONOLOGY

CHRONOLOGY OF EVENTS	
DATE	EVENT
10/22/91	SNC issues MSB-87-001, "Fabrication Specification for the Multi-Assembly Sealed Basket," Revision 5
10/30/91	Start of production for Palisades CMSBs 1-4 at Richmond Enterprises
04/01-02/92	NRC Inspection Report No. 72-1007/92-01, inspection of SNC and Richmond Enterprises , total number of nonconformances 14
05/03/93	Certificate of Compliance issued for SNC VSC-24
4/30/93	SNC issues CMSB-89-001, "Fabrication Specification for the Multi-Assembly Sealed Basket," Revision 4 for Palisades CMSBs 1-4 at Richmond Enterprises
1/13/94	SNC issues CMSB1-93-001, "Fabrication Specification for the Multi-Assembly Sealed Basket," Revision 0 for Palisades CMSBs 5-10 at MMI
02/25/94	Start of production for Palisades CMSBs 5-10 at MMI
02/25/94	Start of production for Palisades CMSBs 11-14 at Richmond Rhodes (RRI)
04/13/94	Start of production for ANO-1 AMSBs 1-14 at MMI
04/21/94	Complete fabrication of Palisades (1-4) at RRI
05/03/94	SNC issues AMSB1-92-001, "Fabrication Specification for the Multi-Assembly Sealed Basket," Revision 3 for ANO AMSBs 1-14 at MMI
08/23/94	NRC Inspection Report No. 72-1007/ 94-207, inspection of SNC, RRI, and MMI, total number of nonconformances 29
11/20/94	Complete fabrication of Palisades CMSBs 5-10 at MMI
94	SNC site QA/QC representative established as stated by SNC
1/4/95	SNC issues CMSB1-93-001, "Fabrication Specification for the Multi-Assembly Sealed Basket," Revision 1

CHRONOLOGY OF EVENTS	
DATE	EVENT
02/95	CPCo informs SNC of ASME Code Section III omission regarding inspections after the removal of temporary attachments. SNC initiates modifications to the fabrication specifications and drawings.
03/95	Palisades finds shield weld crack on MSB-05
03/95	Palisades informs SNC of the shield weld crack first verbally and then in writing. Palisades identifies undocumented weld material in the area of the crack.
3/3/95	SNC writes CAR 95-06 on Palisades shield weld problem
04/01/95	Complete fabrication of Palisades CMSBs 11-14 at RRI
05/10/95	Complete fabrication of ANO AMSBs 1-14 at MMI
05/11/95	Sperko Engineering Report Letter written addressing Palisades shield weld problem
05/15/95	Lukens Steel informs Energy & Process Corporation/MMI that they have performed no weld repairs (information requested by MMI)
05/17/95	Lukens Steel states in letter to SNC: "Therefore, I conclude that . . . .the leak was probably caused by a low-quality weld repair that was presumably not authorized"
05/19/95	MMI letter, SNC 848, to SNC states: "no indication of undocumented welds"
05/25/95	SNC issues CMSB1-93-001, "Fabrication Specification for the Multi-Assembly Sealed Basket," Revision 2 for Palisades CMSBs 5-10 at MMI. Specifically addresses the temporary attachment requirement identified in 2/95.
05/30/95	SNC issues letter to CPCo on shield weld problem stating unknown root cause. SNC also states that no undocumented welds were performed by March Metalfab. SNC commits to ultrasonic testing of material at the mill and that SNC will provide 100% QA/QC surveillance throughout fabrication of CMSB-15 through CMSB-22.
08/18/95	SNC issues CMSB2-95-001 Revision 0, "Fabrication Specification for the Material-Assembly Sealed Basket" for Palisades CMSBs 15-22 at MMI. Specifically addresses repair of material by welding and temporary attachment requirement.
12/16/95	Start of production for Palisades CMSBs 15-22 at MMI

CHRONOLOGY OF EVENTS	
DATE	EVENT
03/20/96	Letter to SNC from MMI requesting clarification on material tolerances during fabrication, machining, and receipt inspection
03/20/96	Letter to MMI from SNC providing clarification of requirements for material repair and material tolerances
11/96	ANO notes shield weld problem on MSB-1
12/96	NRC informed of shield weld problem at ANO and subsequently informed by ANO staff of similar problem at Palisades .
03/17-21/97	NRC inspection of SNC, Report No. 72-1007/97-204, 4 nonconformances identified
03/19/97	SNC issues CAR NO: 97-04 for ANO shield weld problem,
03/27/97	NRC informed of ANO MSB-5 shield weld problem
05/06/97	NRC holds meeting with SNC on shield weld problem and inspection report
05/15/97	SNC responds to notice of nonconformances stemming from Inspection Report No.72-1007/97-204
05/16/97	NRC issues CAL to SNC, Entergy Operations, Consumers Power Company, and Wisconsin Electric Power Company regarding shield weld problem.
05/20/97	First VSC Lid Weld Review Meeting
06/21/97	Second VSC Lid Weld Review Meeting
06/97	ANO, as part of a corrective action, performs UT, PT, acid etching, and takes "boat samples" in the area of noted shield weld problem
06/23/97	ANO informs SNC of test results (telecon). Test results indicate undocumented repair by welding in the area of shell to shield-lid and shell to structural-lid weld areas.
06/25/97	ANO notifies NRC Region IV of test results
06/26/97	ANO issues test report CR-C-97-0219 addressing UT, PT, and acid etching results in the area of noted shield weld problems

CHRONOLOGY OF EVENTS	
DATE	EVENT
06/27/97	SNC informs MMI of ANO test results via phone call
06/30/97	MMI provides letter to SNC stating undocumented welds were performed
07/1/97	SNC issues CAR No. 97-11 addressing initial corrective actions of investigating MMI and performing a root cause evaluation.
07/02/97	SNC issues letter to utilities informing them of MMI letter
07/02/97	SNC informs NRC of MMI letter
07/08/97	NRC to SNC for inspection
07/09/97	SNC revises July 2, 1997 letter to correct errors

PHOTOGRAPHS

Photographs of Undocumented Welds Identified Through Acid etch Examination

NOTE: The following text was provided by ANO.

Photograph captions.

The circular indications on photographs #9, #14, and #14A were found by nitric acid etching of the surface and are weld fusion areas. These are typical of indications found on other empty MSB's currently on site. The largest circular indications are typically 61-63 inches from the zero circumference mark, are approximately an inch from the edge, and are approximately 1.6 inches in diameter. The shape of the other weld fusion regions vary from circular to more elongated and irregular, with a "C" shape on several.

Photograph #14 also illustrates some round indentations apparently made by a clamping device or punch, and some linear (serration-like) indentations which appear to be caused by another type of clamp or grapple. The linear and round indentations are noted on several other empty MSB's.

Photograph #4 illustrates the positions of the samples taken from AMSB-009 which were subsequently sent for analysis.

Note that none of these imperfections were found to be deep enough to intrude upon the minimum wall thickness

Photo #4

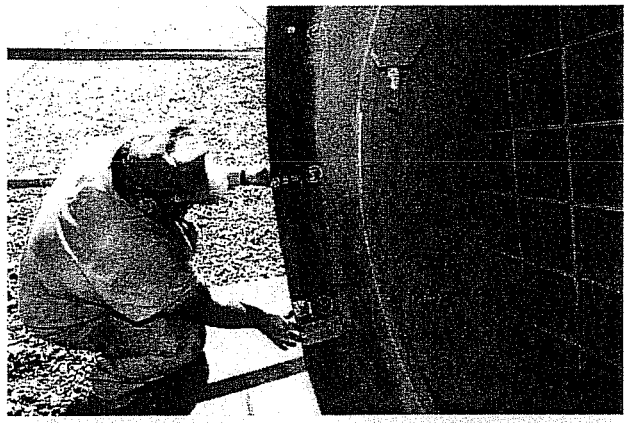


Photo #9

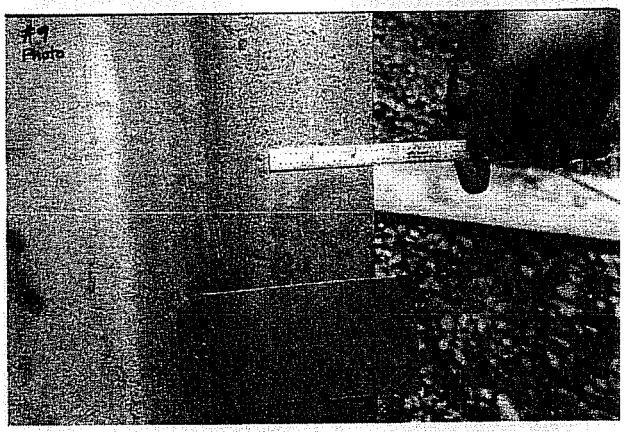
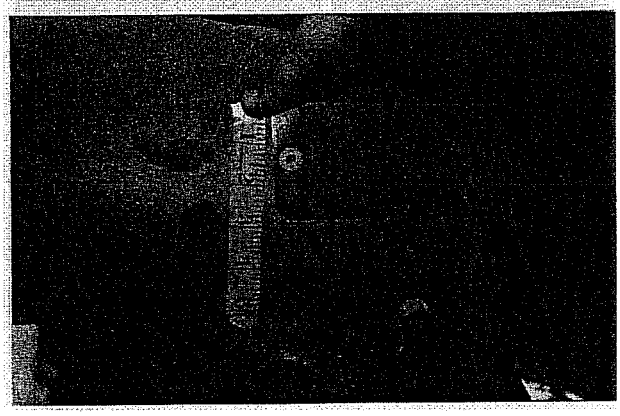


Photo #14

Photo #14A



LIST OF ACRONYMS USED

AMSB	Arkansas Nuclear One Multi-assembly Sealed Basket
ANO	Arkansas Nuclear One
ASME	American Society of Mechanical Engineers
CAR	Corrective Action Request
CFR	U.S. Code of Federal Regulations
CMSB	Consumers Power (Palisades) Multi-assembly Sealed Basket
COC	Certificate of Compliance
CPCo	Consumers Power Company (Palisades)
HAZ	Heat Affected Zone
IP	Inspection Procedure
IR	Inspection Report
MMI	March Metalfab Incorporated
MSB	Multi-assembly Sealed Basket
NCR	Nonconformance Report
NDE	Nondestructive Examination
NMSS	Office of Nuclear Material Safety and Safeguards
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
OE	Office of Enforcement
P-scan	Projection Image Scanning
PT	Liquid Penetrant Test
QA	Quality Assurance
QC	Quality Control
RRI	Richmond Rhodes Incorporated
SFPO	Spent Fuel Project Office
SNC	Sierra Nuclear Corporation
SwRI	Southwest Research Institute
UT	Ultrasonic Test
VSC	Ventilated Storage Cask

INSPECTION PROCEDURES

IP 60851	"Design Control of ISFSI Components"
IP 60852	"ISFSI Component Fabrication by Outside Fabricators"
IP 60853	"On-Site Fabrication of Components and Construction of an ISFSI"