APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-313/94-14
50-368/94-14

Licenses: DPR-51
NPF-6

Licensee: Entergy Operations, Inc.
Route 3, Box 137G
Russellville, Arkansas

Facility Name: Arkansas Nuclear One, Units 1 and 2

Inspection At: Russellville, Arkansas

Inspection Conducted: March 7 through April 1, 1994

Inspectors: L. E. Ellershaw, Reactor Inspector, Maintenance Branch
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Dr. Dale A. Powers, Chief, Maintenance Branch Date
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Inspection Summary

Areas Inspected (Unit 1): Routine, announced inspection of the independent spent fuel storage installation pad, followup on corrective actions for a violation, and other followup.

Areas Inspected (Unit 2): Special, announced inspection of the in-core fuel loading and fuel storage configurations, core component performance, outage work controls and critical path scheduling, potential for fuel-related problems identified at other facilities, fuel handling procedures and practices, and disposition of degraded core components. Routine, announced inspection of the licensee's inservice inspection program and related nondestructive examination activities, independent spent fuel storage installation pad, and followup on corrective actions for a violation.

Results (Unit 1):

- Sufficient plans and specifications were in place to construct the independent spent fuel storage installation pad (Section 4.2).

Results (Unit 2):

- The licensee was proactive in reviewing industry information regardless of its applicability to their plant design. Procedures were established or enhanced to preclude the initiation of the types of events described in industry information documents (Section 2.1.2).

- In response to an inadvertent boration event, the licensee took appropriate corrective actions. With this exception, the licensee was maintaining good control over reactor coolant boron concentration during refueling outages (Section 2.2.2).

- A comprehensive and in-depth quality plan that outlined the attributes to be evaluated and verified during the licensee's surveillance audits of its fuel vendor's fabrication process had been developed and implemented (Section 2.3.2).

- The probabilistic shutdown safety assessments performed each shift was a programmatic strength. Refueling crews were suitably staffed to avoid excessive worker fatigue and overtime was properly controlled (Section 2.4.2).

- A well controlled program was established to process vendor-supplied service information for fuel handling equipment (Section 2.5.2).

- Contract fuel handlers were knowledgeable and experienced, and the provided training was sufficient in scope to ensure fuel movement activities were conducted in a safe manner (Section 2.6.2).

- The use of a computer program to aid in the development of the core shuffle sequence was commendable. Good communication existed between the fuel handling operators and the control room staff (Section 2.7.2).

- Because the licensee did not search for failed fuel at the end of Cycle 4, it is likely that seven failed fuel rods were carried over into the Cycle 5 core. The licensee has taken measures to improve the fuel design, and as a result of this conservative approach a significant reduction in the fuel failure rate has been realized (Section 2.8.2).

- The reload safety analyses were reasonably thorough and properly covered operational, design, and analytical changes (Section 2.9.2).

- Fuel modifications that were implemented significantly contributed to good fuel integrity (Section 2.10.2).

- The licensee was properly ensuring the operability of the fuel handling area ventilation system by performing the required surveillances (Section 2.11.2).

- Lessons learned from Unit 1 were applied to upgrade refueling task job orders to reflect greater detail with regard to performance of preventive maintenance activities (Section 2.12.2).

- The licensee did not have a program requiring post-irradiation examinations of spent fuel assemblies for recent cycles. If needed, procedures for use in fuel reconstitution activities were available (Section 2.13.2).

- Housekeeping in the spent fuel pool and reactor cavity areas was excellent. The establishment of a foreign material exclusion watch in the reactor building was a conservative measure. The placement of a fence around Unit 1 and 2 spent fuel pools to increase foreign material exclusion sensitivity was commendable (Section 2.14.2).

- Three new fuel assemblies were placed in the wrong spent fuel pool locations. Corrective actions, which included the revision of the subject procedure to provide for independent verification of fuel placement, were prompt and adequate. With this exception, the fuel storage program was well defined, with excellent records to provide a chronological history of fuel movement and storage locations (Section 2.15.2).

- Refueling water clarity was very good, and the refueling cavity lighting was good. The use of a refueling-mast-mounted television camera to aid the operators while moving fuel assemblies was a good practice (Section 2.16.2).

- The inservice inspection program was well defined and had been updated to include enhancements (Section 3.1.2).

- The inservice inspection program was being effectively implemented (Section 3.2.2).

- Nondestructive examination personnel were properly certified to perform the intended work (Section 3.3.2).

- Inservice inspection procedures contained sufficient details and instructions. The authorized nuclear inservice inspector was routinely involved in activity observations (Section 3.4.2).

- Sufficient plans and specifications were in place to construct the independent spent fuel storage installation pad (Section 4.2).

Summary of Inspection Findings:

- Inspection Followup Item 368/9414-01 was opened (Section 2.1.1.1).
- A noncited violation was identified (Section 2.15.1).
- Violation 313/9326-01; 368/9326-01 was closed (Section 5).
- Inspection Followup Item 313/9326-02 was reviewed and remained open (Section 6).

Attachments:

- Attachment 1 - Persons Contacted and Exit Meeting
- Attachment 2 - Documents Reviewed

DETAILS

1 PLANT STATUS

During this inspection period, Unit 1 was in Mode 1, while Unit 2 transitioned from Mode 1 and entered Refueling Outage 2R10 at 1 a.m. on March 12, 1994.

2 FUEL INTEGRITY AND REACTOR SUBCRITICALITY (60705/60710/86700/92701/92702)

The objectives of a Fuel Integrity and Reactor Subcriticality (FIRS) inspection are to review, inspect, and determine the adequacy of the licensee's activities related to the protection of reactor fuel. Attachment 2 to this inspection report is a tabulation of documents that were reviewed by the inspectors during the inspection and which provided some of the basis for the findings documented in this report. Other licensee documents that discussed fuel-related activities and associated equipment designs and operational characteristics were made available to the inspectors and were examined in much less detail. In general, the reviews of procedures and records were not detailed in nature, but rather were broad overviews to determine that essential issues were addressed in reasonable fashion. Many of the findings in this inspection report were the results of inspectors' observations of licensee activities in progress. Information on several aspects of the licensee's activities were based on interview statements verified by review of Technical Specifications or the licensee's procedures and records. Emphasis, however, was given to reviewing the following areas:

- In-core fuel loading and fuel storage geometrical controls to preclude configurations that have not been specifically approved by NRC in safety evaluation reports and that conceivably could result in situations involving inadequate shutdown margin or inadvertent criticality;

- Operational work control practices, communications, procedures, physical systems and equipment, and training that preclude unsafe fuel movements from occurring;

- Licensee evaluations and corrective actions that were performed subsequent to any self-identified problems that were indicative of accident sequence precursors or that had the potential to lead to fuel damage; and

- The susceptibility of the licensee's operations, procedures, and equipment to fuel-related problems that have occurred at other nuclear power plants.

NRC Inspection Manual Procedures 60705, "Preparation for Refueling"; 60710, "Refueling Activities; 86700, "Spent Fuel Pool Activities"; 92701, "Followup"; and 92702, "Followup on Corrective Actions for Violations and Deviations," provided guidance for this inspection effort.

This FIRS inspection of activities related to Unit 2 was reduced in scope inasmuch as NRC previously conducted a FIRS inspection of Unit 1 activities, and many of the licensee's policies, procedures, and practices are fundamentally alike for both Units. The Unit 1 FIRS inspection results are reported in NRC Inspection Report 50-313/93-26; 50-368/93-26.

2.1 Fuel-Related Incidents at Other Facilities

2.1.1 Discussion

The inspectors discussed with the licensee several fuel-related events that have occurred at commercial nuclear power plants. Specifically, the incidents that were discussed are described in NRC Information Notices (INs) and Bulletins that were issued during the past decade. Attachment 2 contains a listing of those INs that the inspectors reviewed and discussed with the licensee for this assessment. Certain INs were determined by the inspectors not to be directly applicable to the licensee's operations. This non-applicability was because, for instance, the licensee's designs, practices, or procedures at the time of IN issuances should have precluded such incidents from occurring. These nonapplicable INs are not discussed in this report.

2.1.' ' IN 88-65

N ⌣8-65, "Inadvertent Drainages Of Spent Fuel Pools," informed licensees of incidents in which the level of spent fuel pools were inadvertently lowered as a result of the failure to realign a valve in the spent fuel pool cleanup sys.em, and an inadequate procedure for lowering the level with a plugged anti-siphon device.

The inspec.o.s reviewed the licensee's response to IN 88-65, interviewed operations personnel, and examined the Unit 2 drawings for the spent fuel pool system. Unit 2 has siphon breakers on all cooling and purification lines that penetrate the surface of the spent fuel pool. The licensee informed the inspectors that the Unit 2 spent fuel pool has low and high level alarms, both of which undergo surveillance testing. The licensee stated that the low and high level alarms were operable and functioning properly. The licensee stated that the anti-siphon devices are never plugged, and that waste control operators routinely tour and visually observe fuel pool level every shift. In addition, during the tours the operators were stated to have recorded fuel pool level and temperature in the operator logs. The inspectors verified that these recordings were being taken.

The inspectors reviewed Procedure 2104.006, "Fuel Pool Systems," Revision 12, to determine if specific components (e.g., valves and pumps) that could cause inadvertent draindown were properly controlled during cooling and purification operations. The inspectors, with assistance from an operations representative, reviewed each step of the procedure, including all spent fuel pool cooling and purification evolutions that could potentially cause an unintentional draindown. The inspectors' review of the procedure, and discussions with operations personnel, indicated that procedural controls for those components were in effect.

Because of time limitations, the inspectors did not evaluate the licensee's actions in response to IN 88-92 and Supplement 1, "Potential for Spent Fuel Pool Draindown," which is very closely related to IN 88-65. Because of this relationship, the inspectors identified during the exit meeting that additional followup was needed to fully assess the licensee's actions in response to both INs. Therefore, the subsequent effort to evaluate all potential draindown paths and scenarios that could result in a reduced spent fuel pool level will be Inspection Followup Item 368/9414-01.

2.1.1.2 IN 93-70

IN 93-70, "Degradation of Boraflex Neutron Absorber Coupons," alerted licensees to a potentially significant problem pertaining to degradation of Boraflex neutron absorber coupons.

The licensee received this IN on September 21, 1993, and at the time of this inspection, was performing a plant impact evaluation. A preliminary assessment had been made and it was determined that a Boraflex problem did not exist based on the licensee's Boraflex surveillance program that had been established and implemented during 2R5 (June 1986).

The licensee, rather than taking 100 percent credit for its Boraflex surveillance program, was prudently and conservatively reassessing the IN via the plant impact evaluation.

2.1.1.3 IN 89-51

IN 89-51, "Poter ,i.l Loss of Required Shutdown Margin During Refueling Operations," a' ·.ed licensees to the potential loss of required shutdown margin during .ne movement and placement of highly reactive fuel during refueling operations. In addition, the licensee received Bulletin 89-03, "Potential Loss of Required Shutdown Margin During Refueling Operations," and Combustion Engineering Info Bulletin 89-01, "Shutdown Margin During Refueling," dated March 16, 1989. These three documents generally advised licensees to review their fuel shuffle procedures that control the location of highly reactive fuel and to be aware that the refueling boron concentration necessary to maintain the required shutdown margin, based on the final core configuration, may not be sufficient to ensure that their required shutdown margin will be maintained for all intermediate fuel assembly positions.

The licensee's evaluation of these three documents resulted in enhancements to their administrative controls over fuel movements. Specifically, Revision 25 to Procedure 2502.001, "Refueling Shuffle," required signed verification for the following: that reactor coolant system boron concentration was sufficient in regard to shutdown margin, that reactor engineering has reviewed any changes to refueling shuffle sequence or changes to core and/or temporary storage locations, and that there would not be any temporary placement of four or more fuel assemblies in adjacent storage locations. The revision also required refueling senior reactor operators and reactor engineering personnel to review Bulletin 89-03 and the licensee's response that was provided by the reactor engineering superintendent.

It appeared that the licensee had taken the necessary precautions to minimize a loss of required shutdown margin during refueling operations.

2.1.1.4 IN 87-19

IN 87-19, "Perforation and Cracking of Rod Cluster Control Assemblies," alerted licensees to identified problems with Westinghouse Electric Corporation supplied rod cluster control assemblies.

The licensee demonstrated a proactive approach by evaluating this information, even though Unit 2 is a Combustion Engineering designed plant. The evaluation included a determination of control element assembly life, and a cracked control element assembly failure analysis.

2.1.2 Conclusions

The inspectors concluded that the licensee had taken appropriate actions regarding the handling of industry information about possible fuel handling concerns. Procedures were established or enhanced to preclude the initiation of the types of events described in INs or other industry information documents. The licensee exhibited a proactive approach to reviewing industry information, regardless of its applicability to their plant design.

2.2 Shutdown Margin and Premature Criticality

2.2.1 Discussion

The licensee's representative informed the inspectors that an event involving inadequate control over boron concentration had been previously identified. On January 8, 1991, the licensee initiated Condition Report 2-91-0021, which addressed inadvertent boration of the reactor coolant system while adding boric acid to the spent fuel pool. During this event, there were about 56 gallons of borated water added during a 7-minute span that resulted in the reactor coolant system Tave decreasing from 580°F to 579°F and caused reactor power to decrease from 99.9 to 99.3 percent.

The licensee's evaluation of this event identified that procedural inadequacy was the root cause, in that Procedure 2502.001 did not adequately specify the required lineup of the boric acid system. The procedure was revised on August 8, 1991, to eliminate the confusion, and training of operations personnel was provided. The condition report was closed on August 30, 1991, subsequent to the completion of corrective actions.

The inspectors reviewed Unit 2 records showing boron concentrations for the spent fuel pool and the fuel transfer canal during 2R9, and for the spent fuel pool during the early part of 2R10. This review encompassed both logs and graphs, and included discussions with licensee representatives. The inspectors concluded that the licensee's documents showed that boron concentrations had been adequately maintained within the Technical Specification limit.

During a plant tour of Unit 2 spent fuel pool area, the inspectors questioned the licensee about an observed yellow tint around the walls of the spent fuel pool and on the tops of fuel assembly racks. The licensee stated that they noted the yellow tint after they installed the new high-pressure sodium lights in the spent fuel pool approximately 30 days earlier. The licensee informed the inspectors, after further investigation, that the high-pressure sodium light has a yellow tint.

The inspectors questioned why the Unit 1 spent fuel pool did not have the same appearance, because it also used similar high-pressure sodium lights. The licensee gave several reasons for the difference including the depth of the lights and the angle that they were turned. The licensee obtained a smear of the yellow substance and performed an analysis, which showed that the yellow tinted material consisted of iron solids that were well below the allowable maximum limit for suspended solids. The licensee also discussed this matter with Asea Brown Boveri-Combustion Engineering (ABB-CE) Nuclear Operations. ABB-CE's viewpoint was that small amounts of iron in the coolant would not cause a problem. Similarly, the licensee's metallurgist stated that small amounts of iron would not affect or degrade the fuel assemblies.

The licensee's representatives believe that the iron deposits may have been introduced into the spent fuel pool when fuel was discharged during earlier outages. On occasion during prior outages, the licensee's personnel have observed crud bursts as the fuel was being moved in the spent fuel pool. The licensee's current practice is to use hydrogen peroxide injection into the reactor coolant system to induce crud burst while the fuel is in the reactor.

2.2.2 Conclusions

While an actual event in which a loss of control over reactor coolant system boron concentration had occurred, the event consequences were minor. In response to the event, the licensee took appropriate actions, including the determination of the root cause, and the development and implementation of corrective actions. With this exception, the licensee was maintaining good control over boron concentrations in the reactor coolant before and during refueling activities. The licensee addressed the question regarding the yellow deposit in the Unit 2 spent fuel pool, and concluded that it was caused by iron solids.

2.3 Procurement and Receipt Inspection

2.3.1 Discussion

The inspectors reviewed the licensee's procurement and inspection activities regarding the ANO, Unit 2 reload Batch N fuel assemblies (reload fuel for Cycle 11) delivered to ANO, Unit 2 during February 1994.

The inspectors confirmed that the licensee's fuel supplier has always been a domestic source; consequently, 10 CFR 74.15 (b) receipt inspection requirements were not applicable.

The original contract (GAC-00393) was between General Atomic Company and Combustion Engineering, Inc., and was effective May 12, 1975. The contract later underwent an assignment on October 27, 1982, which in effect became a subcontract between Arkansas Power & Light Company and Combustion Engineering, Inc. The subcontract dealt with the supply of reload batches for ANO, Unit 2. The technical and quality assurance information provisions of the contract were rather general in nature; however, for evaluation purposes, the purchaser had access to technical, manufacturing, and inspection information. This also included access to required drawings, specifications, procedures, and the witnessing of manufacturing and inspection operations.

The inspectors reviewed the procedures (identified in Attachment 2) that dealt with supplier qualification and the performance of fuel vendor audits. The inspectors verified that both the Windsor, CT, and Hematite, MO, facilities for ABB-CE Nuclear Fuel were maintained on the qualified suppliers list based on the performance of five audits between March 27 and July 31, 1992, and an annual supplier evaluation dated October 1, 1992. In addition, due to the recent relocation of fuel fabrication activities from Windsor, CT, to the Hematite, MO, facility, Entergy Operations, Inc. performed an engineering assessment of the facility at Hematite, MO. The inspectors reviewed the resulting report (identified in Attachment 2) and found it complete. The planning and conducting of six surveillance audits during the fabrication of the Batch N nuclear fuel was established in the document "Quality Plan for Coverage of WSES-3 Batch J (Cycle 7), and ANO-2, Batch N (Cycle 11), Reload Nuclear Fuel Fabrication at ABB Combustion Engineering, Inc. (ABB-CE)," dated October 7, 1993. Review of the quality plan revealed it to be a comprehensive and indepth document that provided general and specific attributes to be verified during each of the scheduled audits. The inspectors' review of the six audit reports (identified in Attachment 2) indicated that they met the plan except for several observations of the manufacturing process that could not be performed because those particular tasks were not scheduled during the period the audit was conducted.

The inspectors reviewed the procedures (identified in Attachment 2) and documentation associated with receipt inspection activities conducted by the licensee regarding Batch N nuclear fuel assemblies. Receipt inspection was limited to assembly serial number verification, observation of the fuel assembly containers for physical appearance/condition (e.g., obvious damage that could have affected the assemblies), inspection of the fuel assemblies for obvious defects or debris, and review of supplied documentation.

The inspectors also performed a brief review of the quality assurance department's surveillance requirements regarding refueling activities (defined in Quality Assurance Operating Procedure QAO-9, Revision 8), particularly in the area of fuel inspection and handling. The inspectors were provided a copy of Quality Assurance Surveillance Report SR-94-003, "New Fuel Receipt and Handling Activities," documenting a surveillance that was conducted between February 8 and 17, 1994. There were seven tasks that constituted the surveillance activity: verify forms documenting possession and use of special nuclear material are accurate and updated/completed as the activity occurs; observe new fuel handling activities for adherence to procedure(s); verify the training requirements of the person(s) performing the handling of the fuel; verify the training requirements for the person(s) performing the fuel receipt inspection; verify the equipment used during the fuel inspection is properly identified and calibrated; verify radiation controls are adequate and in accordance with plant instructions; verify housekeeping is maintained in the inspection and temporary storage areas per Procedure 1000.018; and verify the new fuel documentation matches the fuel supplied (fuel serial numbers). The inspectors' review determined that considerable effort had been expended by the two quality assurance representatives who performed the surveillance, and that the surveillance was an in-depth assessment of receipt inspection activities.

The inspectors were also informed that three other surveillances were being performed during this inspection, and included: Level 1 housekeeping/foreign material exclusion, refueling activities, and shutdown operations protection plan. A brief review indicated that the surveillance plans were well organized and planned.

2.3.2 Conclusions

Procurement of nuclear fuel assemblies is currently based on a 1975 contract that established minimal quality requirements. Rather than performing an attribute verification upon receipt of fuel assemblies, the licensee had chosen to rely upon the performance of surveillance audits at the nuclear fuel vendor's facilities. The licensee developed a comprehensive and in-depth quality plan that provided the attributes/characteristics to be evaluated and verified at the time the surveillance audits were performed. The surveillance audit reports and their integral checklists reflected adequate implementation of the quality plan. The licensee had also established an internal surveillance/audit program that, based on the inspectors' review of the single completed surveillance, indicated a well thought out approach and good coverage of those elements that should provide the necessary indicators whether or not the program is being effectively implemented.

2.4 Outage Management, Work Controls, Responsibilities, Delegations, and Critical Path Scheduling

2.4.1 Discussion

The current refueling outage (2R10) had been planned and scheduled in accordance with Procedure 1001.002, "Outage Scheduling and Management," Revision 7. Nuclear safety and shutdown risk considerations were appropriately addressed in accordance with the "ANO Unit 2, 2R10 Shutdown Operations Protection Plan," Revision 2, which was responsive to current NRC and industry guidance.

The refueling crews were staffed to provide sufficient coverage of refueling activities with periodic relief from continuous duties. There were four individuals qualified as senior reactor operators in charge of refueling assigned to each of two, 12-hour shifts. There were also eight refueling equipment operators assigned to each shift. The senior reactor operator in charge of refueling was expected to direct the refueling crew no more than three continuous hours. It was also planned to rotate the duties for refueling equipment operators approximately every 3 hours. The inspectors observed that this was occurring. The refueling crews were scheduled to work the Technical Specification limit of 6 continuous 12-hour days prior to a day of rest. Management stated that no exemptions to this limit, as allowed by the Technical Specification, were expected to be granted. The refueling crews were suitably staffed to avoid excessive worker fatigue and overtime was properly controlled.

Outage reports were generated for each 12-hour shift. These reports were discussed during the management outage meetings that were held twice a day (i.e., 6:30 a.m. and 6:30 p.m.). Most of the 6:30 a.m. meetings during this inspection period were attended by an inspector. The reports addressed the status of significant plant parameters, including the estimated time to reactor coolant system boiling in the event of loss of decay heat removal. Expected work for the next 24 hours, the status of key safety functions, and safety concerns were discussed. The following key safety functions were considered: decay heat removal capability, inventory control, electrical power availability, reactivity control, containment closure capability, and instrumentation and instrument air status. These key safety functions were analyzed with the ORAM-TIP computer program. Probabilistic shutdown safety assessments were performed each shift and the results were analyzed by a nuclear safety engineer. The inspectors observed performance of one shutdown safety assessment, and verified that the nuclear safety engineer's analysis was based on the correct status of equipment condition. The inspectors concluded from the brief review that the results appeared comprehensive, and considered the performance of a probabilistic shutdown risk assessment during each shift to be a strength.

The inspectors reviewed various outage work schedules to look for any adverse impact of out-of-service equipment and systems on nuclear safety. It appeared that the impact of out-of-service equipment and systems was being considered each shift, and that probabilistic shutdown risk assessments indicated that the calculated core damage frequency was acceptably low during the outage.

The shutdown operations protection plan required performance of a detailed safety analysis of the outage schedule by the shutdown risk assessment task force for all planned outages. The shutdown risk assessment task force was comprised of representatives from operations, safety analysis, system engineering, industry events analysis, licensing operations training, and outage scheduling. A safety review was required before implementing any safety significant changes to the outage schedule after the initial review. The safety significance of changes could be determined by examining requirements for seven allowed shutdown conditions. These requirements were described in the protection plan and discussed in each shift report.

The protection plan listed numerous equipment requirements to minimize the risk of releasing radioactive materials. Among these were containment and spent fuel handling area ventilation requirements and requirements to control protected systems and their power supplies by physical barriers with signs that required plant personnel to contact the control room before entry.

2.4.2 Conclusions

The licensee had scheduled refueling outage work with appropriate concern for nuclear safety. Performance of computerized probabilistic shutdown safety assessments each shift was considered a strength. The refueling crews were suitably staffed to avoid excessive worker fatigue and overtime was properly controlled. Areas around protected systems and their power supplies were controlled by physical barriers.

2.5 Service Information on Fuel Handling Equipment

2.5.1 Discussion

The inspectors reviewed the licensee's program that controlled the process of handling vendor-supplied service information. The inspectors reviewed Procedures 1010.008, "Industry Events Analysis Program," Revision 6, and 5510.203, "Vendor Technical Manual Review And Update," Revision 1. Procedure 1010.008 provided the methodology for reviewing industry operating experiences and vendor-supplied information. The industry events analysis group had the overall responsibility to ensure that all vendor-supplied information at the site was screened. To ensure control of vendor service information, the industry event analysis group submitted a memorandum once a year to all supervisors at the site having responsibility for review of vendor information. The memorandum requested that vendor information be forwarded to the supervisor of the industry events analysis group for screening. The industry events analysis group had also sent letters out every 18 months to all vendors of supplied equipment indicating the proper points of contact for sending information about their equipment. Procedure 5510.203 identified responsibilities within design engineering for the review and update of technical manuals, and stated the requirements for control of information within the technical manual system.

2.5.2 Conclusions

The inspectors concluded that the licensee had established a well controlled program to process vendor supplied service information for fuel handling equipment.

2.6 Fuel Handling Personnel Qualification and Training Program

2.6.1 Discussion

The fuel handling activities during this refueling outage were conducted by Westinghouse Nuclear Services Division (NSD) field service fueling operations personnel. All refueling activities were overseen by a senior reactor operator who had been designated as the refueling supervisor. The inspectors reviewed Revision 2 of Westinghouse NSD Procedure, "Fueling Operations Training Program," dated October 1, 1989. This procedure defined the training and qualification program for Westinghouse fuel handling personnel. It outlined the phases of fuel handling training given by NSD to its fuel handling employees. Personnel received an introductory training session on refueling activities, an onsite demonstration using fuel handling equipment, plant specific training, and advanced fueling training. Portions of the training required the satisfactory completion of an examination.

The Unit 2 Westinghouse fuel handling team consisted of 17 individuals, 3 of whom were engineers. Of the 17 individuals, 14 had prior fuel handling experience at ANO, Unit 2. The individuals were also required to maintain a refueling qualification guide that took approximately 5 to 7 years to complete the training documented in the paperwork. The inspectors reviewed applicable portions of qualification cards for the Westinghouse personnel and verified that the personnel had completed the applicable fuel handling portions of the qualification cards.

Prior to beginning work onsite, Westinghouse personnel received classroom training in accordance with Revision 6 of Procedure AA52001-026, "Fuel Handling Equipment," dated January 31, 1994. This training, which was provided by the licensee, covered the purposes and provided operational descriptions of all major fuel handling equipment. The classroom training also covered various NRC, Institute of Nuclear Power Operation, and industry identified events involving fuel handling equipment. Contract personnel were also trained on the various interlocks associated with the ANO, Unit 2 fuel handling equipment. Training was also provided on the immediate actions required for emergency operation of the fuel handling equipment. In response to the inspectors' questions regarding the lack of proceduralized direction for placement of fuel assemblies after an accident, the licensee revised Attachment M, "Refueling Accident," of Procedure 2502.001, "Refueling

Shuffle," to provide immediate guidance to the senior reactor operator directing fuel movement, to be used in case a fuel handling accident occurred.

In addition to the classroom training given by the licensee and the training provided by Westinghouse, NSD personnel were also given on-the-job training. This training was documented for each designated fuel handler by completing Attachment I, "Refueling Machine Operator Checkout Sheet," and Attachment J, "Spent Fuel Bridge Operator Checkout Sheet," of Procedure 2502.003, "Preparation For Refueling." Completion of these attachments was provided to ensure NSD personnel were familiar with site equipment.

2.6.2 Conclusions

Fuel movement activities were conducted by Westinghouse personnel. The fuel handlers were knowledgeable and experienced, and the provided training was sufficient in scope to ensure fuel movement activities were conducted in a safe manner.

2.7 Fuel Handling Controls

2.7.1 Discussion

To assess the effectiveness of the licensee's fuel handling controls, the inspectors reviewed the following fuel handling procedures:

- Procedure 2502.001, "Refueling Shuffle," Revision 24;
- Procedure 2502.003, "Preparation For Refueling," Revision 13;
- Procedure 2503.003, "Operation of Fuel Handling Equipment," Revision 13; and
- Procedure 1022.013, "Preparation and Conduct of Refueling Activities," Revision 5.

The inspectors' review of Procedure 2502.003 determined that it was appropriate to ensure that all pre-refueling checkouts of equipment were satisfactorily completed. In addition to refueling equipment pre-operational checks, this procedure contained attachments to verify television and communication systems operability prior to fuel movement. Procedure 2502.001 delineated the necessary steps to remove, replace, and store irradiated fuel; shuffle irradiated fuel; and load new fuel during an outage. Also included were appropriate precautions while handling fuel in and around the core. In addition to the limited guidance about fuel handling emergencies, the licensee also had procedural guidance in the event a natural emergency occurred. If a natural emergency occurred, the fuel handling procedure referred operators to the natural emergency procedure.

During spent fuel movements, the inspectors accompanied the operators while they were using both the spent fuel machine and the refueling machine. All operators observed were knowledgeable and experienced. The inspectors noted that the communication between the fuel handling machine operators and the control room staff was good. On the refueling machine, all movements were carefully conducted under the direction of the refueling supervisor. On the spent fuel machine, the inspector noted that the operator had a practice of visually verifying that the proposed storage location was empty before installing the assembly into its storage rack. The fuel movement activities observed were completed without any identified problems.

The licensee used the SHUFFLEWORKS software program to develop the core off-load and reload fuel shuffle sequence. The program developed the shuffle sequence after the fuel shuffle plan was input. After the sequence was developed by SHUFFLEWORKS, it was verified by the reactor engineering staff.

The licensee had also instituted administrative controls over the spent fuel machine. The licensee had issued a hold card and locked open the power breaker for the machine. This action was taken to prevent unauthorized operation of the spent fuel machine. During non-outages, the shift supervisor maintained control over the key that locked open the power breaker. During the outage, the key was turned over to the refueling supervisor for control of locking and unlocking the breaker.

2.7.2 Conclusions

Adequate fuel handling controls were established to ensure fuel was moved in a safe and controlled manner. Good communication existed between the fuel handling operators and the control room staff. The use of a computer program to aid in developing the fuel shuffle sequence was commendable.

2.8 Fuel and Core Component Performance

2.8.1 Discussion

The licensee's representatives presented the inspectors with an overview of its fuel and core performance. The ANO, Unit 2 fuel assembly design is a 16 x 16 array.

For the first five operational cycles, the licensee experienced a relatively large number of fuel failures; however, later cycles have demonstrated an improved level of fuel performance. (The radiochemistry data to support the licensee's determinations of fuel failure occurrences was not reviewed during this inspection.) The improved ANO, Unit 2 fuel performance is largely attributable to improved fuel fabrication processes and design modifications (which reduced the potential for both grid fretting and debris wear). In Cycle 7, the licensee introduced a debris-resistant fuel design that employs extended solid lower end caps on fuel rods. This design reduces the potential for debris entry into the active core. It is notable that the last cycle, Cycle 10, which was the first core with all debris-resistant fuel, was the first core without fuel failures.

The licensee attributed historical fuel failures to fabrication deficiencies (33 percent), debris wear (26 percent), grid fretting (7 percent), fuel handling (2 percent), and unknown causes (33 percent). The fabrication problems, which occurred early in ANO, Unit 2 operation, were believed to have been due to excessive moisture content of fuel pellets. The number of failed fuel rods in the core at the end of each cycle of ANO, Unit 2 operation are given below.

TABLE 1

ANO FUEL FAILURES

CYCLE OF OPERATION	NUMBER OF FAILURES
1	18
2	7
3	~8
4	~8
5	17
6	2
7	2
8	1
9	~4
10	0

To identify fuel assemblies with failed fuel rods, the licensee performed fuel assembly sipping at the end of Cycles 1 and 2 and ultrasonic testing at the end of Cycles 5, 7, and 9. No special examinations were performed at the end of Cycles 3, 4, 6, and 8 to locate failed fuel rods. As a result of not conducting examinations at the end of Cycle 4, as many as seven failed fuel rods were likely carried over into the Cycle 5 core. Under the licensee's current philosophy, such continued use of failed fuel would appear contradictory to the explicit goal of zero leakage fuel (Company Directive C7.910, Nuclear Fuel Program and Division of Responsibility and Procedure 1022.028, "Fuel Integrity Monitoring").

2.8.2 Conclusions

Because the licensee did not examine fuel at the end of Cycle 4, it is likely that seven failed fuel rods were carried over into the Cycle 5 core. The licensee has taken measures to improve the ANO fuel design and resulting performance. As a result of this conservative approach, a significant reduction in the fuel failure rate has been realized.

?.9 Reload Analyses

2.9.1 Discussion

The inspectors performed an overview review of the licensee's 10 CFR 50.59 reviews and associated reload safety analyses reports for Cycles 7 through 11. (The reload analysis, dated January 28, 1994, for the upcoming Cycle 11 operation was in draft at the time of the inspectors' review. It should be noted that the licensee's fuel shuffle plan is dependent on the adequacy of the reload safety analysis, and if that analysis should be changed and necessitate a change in the core reload design, then unnecessary fuel handling might have occurred.) The inspectors' review focussed on parameters (burnup, mechanical design, analysis methods) that associated documentation showed had changed relative to that in the prior reload safety analysis report or the final safety analysis report submitted in justification for the initial operating license issuance. The licensee considered Cycle 2 as the "reference cycle" for core safety analysis purposes.

The inspectors noted that the Cycle 10 and 11 core designs appropriately employed low-leakage fuel management schemes to reduce neutron fluence on the reactor vessel. The inspectors noted that the licensee's core exposures had remained bounded by the specific burnup limits approved for ANO, Unit 2 or the generic burnup limits (currently 60 GWD/T) approved for Combustion Engineering pressurized water reactor fuel. The maximum fuel rod burnup for the upcoming Cycle 11 was given as 59.6 GWD/T.

The inspectors questioned the licensee's representatives on a confusing statement in the Cycle 11 reload safety analysis report. The statement indicated that the Cycle 11 core would have a 12.5 percent increase in core flow pressure drop over the Cycle 10 core. The inspectors were concerned about the impact of an increased core pressure drop on core bypass flow and control element assembly drop time. Subsequently, the licensee provided the inspectors with an Asea Brown Boveri letter dated March 7, 1994. The letter described that the fuel vendor had reevaluated spacer grid loss coefficients for 16x16 fuel. The letter explained that regardless of the new loss coefficients, there was, however, no actual increase in core flow pressure drop expected, inasmuch as the spacer grid designs for the ANO, Unit 2 16x16 fuel assemblies in Cycles 10 and 11 remained essentially hydraulically equivalent. Additionally, an Asea Brown Boveri letter dated April 15, 1993, stated that the projected change in bypass leakage was small and within the bounds of the present design bypass leakage values. The inspectors accepted the clarification, and noted that control element assembly drop times will be confirmed to be within Technical Specifications time requirements during plant restart rod drop testing.

In general, the licensee's analyses appeared reasonably thorough and addressed issues (i.e., operational, design, and analytical changes) normally associated with reloads. Each Batch had been evaluated in 10 CFR 50.59 reviews for Modes 1-6 regarding hydraulic flow, structural integrity, shoulder gap adequacy, rod burnup, and thermal design. The inspectors did not identify any deficiencies during their review.

2.9.2 Conclusions

The licensee's reload safety analyses for Cycles 7 through 11 appeared reasonably thorough and properly covered operational, design, and analytical changes.

2.10 Fuel Modifications

2.10.1 Discussion

Over the life of the plant, the licensee has instituted various fuel assembly design changes that included incorporation of debris-resistant features and redesign of anti-rotation devices. These changes occurred during the manufacture of Batches J and K fuel assemblies (Cycles 7 and 8, respectively), and consisted of lengthening the lower end caps; removal of one fuel pellet from each rod, thereby reducing the active fuel length; redesign of the plenum spring to minimize volume; shortening the lower end fitting; and changing the guide-tube-to-lower-end-fitting connection. In addition, the Batch K poison rod design was changed to incorporate a debris-resistant feature. Batch L (Cycle 9) fuel was of the same design as Batch K fuel, while Batch M (Cycle 10) fuel received minor modifications to the bottom end of the upper end fitting's outer posts and to the flange located at the upper end of the outer guide tube assembly.

The most significant design modification that the licensee implemented into the fresh fuel loaded for Cycles 7, 8, 9, and 10 was long, solid-end caps. This debris-resistant modification is generally known to be an effective measure in reducing fuel rod fretting failures due to foreign materials in the reactor coolant system.

2.10.2 Conclusions

The licensee has made significant fuel modifications that were responsive to available industry information on operating reactor fuel performance and that have subsequently contributed to good fuel integrity.

2.11 Fuel Handling Area Ventilation System

2.11.1 Discussion

The requirements for demonstrating operability of the fuel handling area ventilation system were governed by Technical Specification 3/4.9.11. The Technical Specification required that the fuel handling area ventilation system be operating and discharging through HEPA filters and charcoal absorbers whenever irradiated fuel was being moved, and during crane operation with loads over the spent fuel pool. Also required were monthly and 18-month surveillances. The inspectors reviewed select records and found that these surveillance requirements were satisfied.

The inspectors reviewed Form 1015.016F, "Shift Turnover Checklist (Unit 2) Modes 5 & 6." This form was used to verify operability of the fuel handling area ventilation system every 12 hours while in Modes 5 or 6. The inspectors also reviewed Job Orders 00909151 and 00909728, which authorized the recent monthly and 18-month surveillances, respectively. Both of these surveillance activities were satisfactorily completed.

2.11.2 Conclusions

The licensee was properly ensuring the operability of the fuel handling area ventilation system every 12 hours and at monthly and 18-month intervals and while in Modes 5 or 6.

2.12 Fuel Handling Equipment Modifications and Maintenance

2.12.1 Discussion

The inspectors reviewed several procedures associated with maintenance and preventive maintenance (PM) activities on fuel handling equipment (identified in Attachment 2). The procedures reviewed appeared to be adequate for their intended purpose. The inspectors requested PM records for the following equipment:

- Fuel Pool Purification Pump 2P-66,
- Purification Filter 2F-3A, and
- Fuel Pool Pump 2P-40A/B.

Maintenance work requests reviewed by the inspectors indicated that PM activities for the above components were performed as required.

The inspectors reviewed corrective maintenance records for work performed before 2R8 on Refueling Machine 2H-1. All work appeared to have been appropriately performed and documented. Preventive Maintenance Engineering Evaluation (PMEE) No. 148, "Fuel Handling Cranes," Revision 2, established PM activities and schedules for fuel handling equipment using vendor recommendations. It also established general PM guidelines to be considered when manufacturers' recommendations were not available. Review of various refueling equipment checkout procedures indicated that some minor PM activities were performed during equipment checkouts.

From discussions with the licensee, the inspectors determined that Unit 2 had problems similar to those that had been previously identified during an inspection of Unit 1, in that refueling task job orders did not clearly indicate what PM activities were to be performed. NRC Inspection Report 50-313/93-26; 50-368/93-26, Section 2.16.1, discussed this weakness. The licensee had subsequently taken appropriate corrective actions from the lessons learned in Unit 1 and applied them to Unit 2. Current refueling task job orders for Unit 2 provide more detailed information on maintenance activities than they had previously.

The inspectors also requested PM records associated with the spent fuel pool gate seals (cask loading pit and fuel tilt pit). The inspectors were informed that sometime during October 1993, while preparing for the outage, the licensee identified a leak in the fuel tilt pit gate seal. Further investigation into this issue identified that PMs had not been performed according to vendor recommendations. The vendor recommended that the pneumatic seals be replaced every 5 years. However, the licensee identified that Unit 2 seals had never been replaced. The licensee has since developed PMs that will replace the seals every third refueling outage.

The inspectors requested information about any modifications to the fuel handling equipment for Unit 2 and was informed that no major modifications had been performed; however, four minor modifications had been implemented before 2R9. The inspectors review of the modifications listed below was limited to a brief review of the applicable documentation to determine completeness.

- Plant Change (PC) 92-8061 replaced joysticks for the refueling machine console,
- PC 90-8096 replaced 2H4 transfer system underwater limit switches,
- PC 90-8028 replaced the 80286 processor with an 80386 processor in the refueling machine central processing unit, and
- PC 91-8009 modified the mounting plate for 3 hp hoist motor for Fuel Handling Crane 2H1.

2.12.2 Conclusions

It was determined that fuel handling equipment PMs were performed as required. Subsequent to the Unit 1 FIRS inspection, which identified that refueling task job orders did not clearly indicate what PM activities were to be performed, the licensee applied a "lessons learned" approach and evaluated the Unit 2 program to determine if similar conditions existed. Upon determining that a similar condition existed, the licensee took appropriate corrective actions. The refueling task job orders for Unit 2 were upgraded to reflect greater detail than before.

2.13 Fuel Assembly Post-Irradiation Examination and Reconstitution

2.13.1 Discussion

The licensee does not presently conduct post-irradiation examinations of fuel assemblies. The licensee's safety analysis report committed to conducting this type of examination only after the first three fuel cycles. The inspectors verified that these examinations had been conducted according to the commitments and that all anomalies had been satisfactorily addressed.

With respect to reconstitution, the licensee has historically reconstituted fuel assemblies. A total of 23 fuel assemblies have been reconstituted, representing a total of 27 fuel rods that have been replaced with stainless steel rods.

Due to the absence of certain radionuclides in the reactor coolant, and since the licensee's fuel failure prediction software codes have not predicted any failed rods, the licensee did not anticipate having to reconstitute fuel assemblies during this outage. The licensee used both IODYNE and CHIRON as fuel failure prediction software. During 2R9, the IODYNE code predicted two to three failed fuel pins and the CHIRON code predicted four to five failed fuel pins. A total of three rods were identified as actually failed. Both codes predicted zero failed rods during this cycle.

To ensure the licensee had the proper procedures to conduct fuel reconstitution, the inspectors reviewed the results of the reconstitution activities conducted at the end of Cycles 7 and 9. No reconstitution was conducted at the end of Cycle 8.

Fuel assembly reconstitution was conducted by ABB-CE, using their quality control procedures that had been approved by the licensee. The fuel reconstitution activities were conducted in accordance with Procedure 2302.049, "ANO-2 Fuel Assembly Reconstitution," Revision 0. This procedure outlined the method by which reconstitution in the spent fuel pool was to be conducted. Included as an attachment to the procedure was a site traveler that delineated the requirements and methodology for assembly reconstitution.

After the end of Cycle 7, the Babcock & Wilcox (B&W) Fuel Company performed ultrasonic inspection that verified four failed assemblies. Their testing also revealed that three of the four failed assemblies were adjacent to the core periphery during Cycle 7. Because the failures were close together, B&W suggested that this potential trend may warrant additional investigation. When questioned by the inspectors, the licensee stated that the matter had not been given further consideration. Examinations of peripheral assemblies at the end of Cycle 9 did not yield similar results.

Three assemblies were identified for reconstitution by ABB-CE at the end of Cycle 9. Two of the assemblies had failed rods in the periphery of the assemblies. The licensee had procedures that allowed replacing peripheral rods under certain conditions. Since these assemblies did not meet the pre-established conditions, ABB-CE wrote Nonconformance Report (NCR) 2000512-001, dated October 5, 1992. In dispositioning the NCR, ABB-CE concluded that installation of the stainless steel rods in the periphery of the two assemblies was "acceptable, provided that these two bundles are not returned to the core in cycle [sic] 10." Apart from this described restriction, ABB-CE also required that an engineering and physics evaluation of the assemblies be conducted prior to their use. When questioned by the inspectors regarding what guidance the licensee had to ensure that the proper evaluations were conducted before reinstalling the assemblies, the licensee stated there were none. However, the licensee, by unrelated action, had discovered that it had overlooked the separate restriction. As a result of the inspectors' questions, the licensee initiated an update to their ANO, Unit 2 Cycle 12 Fuel Management Information and Ground Rules Document and the reload design review procedure to ensure that all NCRs written against reconstituted assemblies are properly evaluated prior to reinstallation of the assemblies into the core.

2.13.2 Conclusions

The licensee had a program requiring post irradiation examinations of spent fuel assemblies only for the first three cycles. Historically, fuel rod reconstitution has been performed; however, none was scheduled during 2R10, because no failed fuel rods had been identified. If reconstitution were to be performed, the licensee had procedures for such activities. As a result of the inspectors' questions, the licensee initiated an update to their ground rules document and reload design review procedure to ensure all NCRs written against reconstituted assemblies are thoroughly evaluated prior to use in a core.

2.14 <u>Loose Parts and Foreign Material Exclusion</u>

2.14.1 Discussion

Procedure 1000.018, "Housekeeping," Revision 20, governed the licensee's housekeeping and foreign material exclusion (FME) activities. Attachment 5 to the procedure established the spent fuel area and new fuel pit area as housekeeping Level 1 areas. The procedure required that Level 1 areas receive the highest order of cleanliness and that buffer zones be established around the areas. The procedure allowed establishing FME areas within Level 1 areas.

Clear plastic and other non-essential items were prohibited in a Level 1 area. All loose items and tools were required to be secured by a lanyard when in the area.

Procedure 1025.019, "System Cleanliness Controls During Modification and Maintenance," Revision 5, governed the conduct of maintenance activities and provided guidelines to prevent foreign material from entering the area during maintenance or modifications. If foreign material were dropped into the cavity or spent fuel pool and could not be retrieved, Procedure 1025.019 required that a condition report be written to document the incident and to assess the effect on the system and provide any corrective action prior to restart.

As a conservative measure, the licensee had also erected fences (with a gate) surrounding both Unit 1 and 2 spent fuel pools to restrict personnel and material access into the areas. The Unit 2 fenced area provided a buffer zone of up to approximately 10 feet between the fence and the beginning of the Level 1 area. Each gate was prominently posted with instructions regarding housekeeping rules and prohibitions. At the completion of the outage, the licensee will evaluate whether the fences will remain permanently around the pools or if they will be removed and re-installed before each outage. The installation of the fences clearly aided in increasing personnel sensitivity to and awareness of housekeeping/FME requirements. The inspectors toured the Unit 2 spent fuel pool area and the reactor cavity and found housekeeping was excellent in both areas. The reactor cavity area was also properly posted with housekeeping and FME area signs.

The inspectors reviewed an internal memorandum regarding FME and housekeeping controls during this outage. The memorandum reiterated that the requirements of Procedures 1000.018 and 1025.019 were expected to be followed during this outage. It also served to heighten sensitivity regarding Level 1 housekeeping requirements. The memorandum stated that additional personnel would be hired and trained in the requirements of these procedures and employed as Level 1/FME area watches. The memorandum further stated that these individuals would be dedicated solely to patrolling the Level 1 housekeeping area in the reactor building. During tours of the reactor building, the inspectors observed the hired individuals conducting FME watches in the reactor building.

2.14.2 Conclusions

Housekeeping was excellent in the spent fuel pool and reactor cavity areas. The establishment of an FME watch in the reactor building was a conservative measure. The inspectors considered the placement of a fence around both Unit 1 and 2 spent fuel pools to increase housekeeping/FME sensitivity to be commendable.

2.15 Verification of Spent Fuel Storage Locations

2.15.1 Discussion

The inspectors reviewed Technical Specification 3/4.9.12 and related procedures that addressed fuel storage restrictions in the spent fuel pool. Procedure 1022.012, "Storage, Control, and Accountability of Special Nuclear

Material (SNM)," Revision 16, described the administrative requirements established for the control, storage, and detection of any loss of SNM during shipment to, from, or while in storage at ANO. Procedure 2503.001, "Fresh Fuel Inspection and Storage," Revision 9, described the movement and storage of fresh fuel after receipt inspection. The inspectors also compared the nuclear fuel location records (Form 1022.12E) to the Unit 2 Spent Fuel Pool Inventory Map (Form 1022.012N) to verify fuel assembly location (i.e., correct position). The Nuclear Fuel Location Record provided a chronological history of the storage locations for all fuel assemblies. It showed the assembly's storage location in the spent fuel pool after initial receipt, the location of the assembly in the core, and all subsequent locations, either in the core or in the spent fuel pool. The inspectors reviewed a sample of spent fuel assemblies from Batches A through M fuel. No discrepancies were noted during the inspectors' comparisons of location records and inventory maps.

The Technical Specification specified that storage in the spent fuel pool was to be restricted to fuel assemblies having initial enrichment less than or equal to 4.1 percent weight uranium 235 (w/o U-235). The inspectors reviewed a sample of certified material test reports associated with fuel assemblies from Batches A through H fuel and verified that the initial enrichment of the fuel assemblies was less than 4.1 percent weight U-235.

For assemblies stored in the spent fuel pool, the inspectors reviewed the criterion for restricted verses non-restricted storage. The criterion was based on a plot of the initial assembly average enrichment and the assembly average burnup. Restricted assemblies were those that fell within the restricted region of the enrichment verses burnup plot, while non-restricted assemblies fell within the non-restricted region of the plot. The plot was shown in Procedure 1022.012.

Both restricted and non-restricted assemblies could be stored in Region One of the spent fuel pool in a normal loading pattern because the storage locations contain boraflex. In Region Two, non-restricted assemblies could be stored in the spent fuel pool in a normal loading pattern while restricted assemblies were required to be stored in a checkerboard loading pattern. This checkerboard pattern required that all adjacent storage locations be physically blocked. The inspectors verified that the assemblies reviewed were properly stored according to the Technical Specification requirements.

The inspectors became aware of Condition Report 2-94-0156, initiated on March 31, 1994, that identified a condition regarding the placement of three new Batch N fuel assemblies into incorrect locations in the spent fuel pool. This was identified at the time a licensee inspection was being conducted to verify that all fuel assemblies to be loaded into the Cycle 11 core were in their correct spent fuel pool locations, in accordance with Procedure 2502.001, "Refueling Shuffle." The discrepant condition was identified by visually comparing the fuel assembly identifications to the nuclear fuel location records and spent fuel pool inventory maps maintained by reactor engineering. It was specifically identified that Fuel Assemblies N006, N007, and N008 were stored in locations J-9, L-9, and K-9, rather than the expected Locations L-9, K-9, and J-9, respectively.

The licensee determined that these fuel assemblies had not been moved since initial storage in the spent fuel pool subsequent to receipt inspection. Therefore, it could reasonably be assumed that the assemblies were improperly placed at that time. The three assemblies were received on site in the first shipment of new Cycle 11 fuel on February 8, 1994, and placed in Region One of the spent fuel pool on February 9, 1994; thus, there was no violation of the storage location requirements specified in Technical Specification 3/4 9.12. The licensee further determined that relocation of the assemblies was neither required (from a shutdown margin perspective) nor recommended. However, the need to correct the nuclear fuel location records and spent fuel pool inventory maps was recognized, and this was accomplished on April 1, 1994. The fuel movement sequence for core reload also had to be revised to reflect the true locations of these assemblies to avoid misloading the Cycle 11 core. The inspectors noted that Section 10.3 in Procedure 2502.001 required a final verification of the core after reload. In response to the identified condition, the licensee counseled the spent fuel pool operator on the misplacement of the subject fuel assemblies. In addition, the licensee concluded that a procedural inadequacy existed, in that Procedure 2503.001 did not require independent verification of fuel assembly location at the time of placement in the spent fuel pool. The inspectors verified that all other fuel movement procedures required independent verification at the time of placement. The licensee promptly issued Procedure Change 1 to Revision 9 of Procedure 2503.001 on April 1, 1994, which clearly defined independent verification requirements at the time of placement of fuel assemblies into the spent fuel pool. In addition, the inspectors were informed that Unit 1 management (including reactor engineering) was informed of this incident to prevent the likelihood of a similar occurrence happening during a subsequent refueling operation.

This misplacement of fuel assemblies was a violation of Technical Specification 6.8.1, which required that written procedures be established, implemented, and maintained covering refueling operations. Procedure 2503.001, which was responsive to the Technical Specification requirements, was determined by the licensee to be inadequate in that it did not provide for independent verification of new fuel assembly storage in the spent fuel pool. The inspectors noted that a violation of Technical Specification 3/4 9.12 did not occur. Reactor engineering personnel could not recall any similar occurrences, and the inspectors were unable to identify any similar occurrences. This violation will not be subject to enforcement action because the licensee's efforts in identifying and correcting the violation met the criteria specified in Section VII.B.2 of the Enforcement Policy.

2.15.2 Conclusions

The inspectors considered the licensee's fuel storage program, except for the incident identified by the licensee, to be well defined, with excellent records to provide a chronological history of fuel movement and storage locations. Regarding the incorrect placement of three new fuel assemblies within the spent fuel pool, licensee management took prompt steps to identify the cause, determine necessary corrective actions, and establish preventive measures.

2.16 Observation of Fuel Movements

2.16.1 Discussion

During the week of March 28, 1994, the inspectors observed the offload of fuel from the reactor vessel. As stated previously, the inspectors found the fuel movement procedures and controls to be well established, and the fuel handlers were knowledgeable and well versed in the procedural requirements. Communications were well established among the control room staff, refueling machine operator, senior reactor operator, upender operators, and the spent fuel bridge operator. An audible neutron rate counter was installed in the refueling cavity area and operating. The inspectors observed the movement of eight fuel assemblies and noted that the fuel handlers performed in accordance with the procedure, which was located on the fuel handling bridge. In addition, the inspectors observed the spent fuel bridge operator placing offloaded fuel assemblies into the locations communicated to him by the control room. The spent fuel bridge operator performed his activities in accordance with the procedure, which was located on the spent fuel bridge.

The inspectors noted that the water clarity was very good in both the refueling cavity and the spent fuel pool. While a couple of underwater lights in the refueling cavity had burned out earlier and had not been replaced, there was adequate lighting for the refueling machine operators. In addition, lighting was available in the reactor vessel, and the licensee had installed a refueling mast-mounted television camera that provided excellent visibility and verification with respect to positive movement of the fuel assembly hoist and lowering operations.

2.16.2 Conclusions

Refueling water clarity was very good, and reactor cavity lighting was good. The use of a refueling mast-mounted television camera to aid the operators in assuring positive control of the fuel assembly during hoisting and lowering operations was considered a good practice.

3 INSERVICE INSPECTION (ISI) (73753)

The objective of this inspection was to determine whether the performance of ISI examinations and any repair and replacement of Class 1, 2, and 3 pressure retaining components was performed in accordance with the applicable ASME boiler and pressure vessel code, and whether the licensee had appropriately satisfied any requirements imposed by NRC and industry initiatives.

3.1 ISI Program

3.1.1 Discussion

The inspectors met with the licensee's ISI staff to discuss the ISI program and scheduled examinations. The inspectors reviewed the ISI plan and schedule for the current inspection period of the second 10-year interval for Unit 2. The inspectors reviewed ASME code cases that the licensee had utilized and adopted, and found that they had been endorsed by the NRC. In an NRC safety evaluation dated November 22, 1991, the NRC staff had concluded that the ANO, Unit 2 second 10-year interval ISI program plan, submitted on January 12, 1990, was unacceptable. The licensee submitted a revision to the second 10-year interval ISI program plan in a letter dated July 31, 1992. In this revision, a change was made to include volumetric examination of 7.5 percent of all Category C-F-1 piping welds greater than 4-inch nominal pipe size, regardless of the wall thickness. The NRC staff approved this revision in a safety evaluation, dated July 6, 1993. It appeared that all changes to the ISI program had been documented appropriately.

The inspectors selected for review ISI records of Class 1 components examined during the first 10-year interval to determine if the licensee had followed their ISI program. The inspectors' review of those records concluded that the licensee had followed their ISI Program during the first 10-year interval.

3.1.2 Conclusions

The ISI program was well defined and had been updated to incorporate approved changes. Changes to the examination plan were documented appropriately.

3.2 Observation of Nondestructive Examinations (NDE)

3.2.1 Discussion

The inspectors observed several different methods of NDE used to detect flaw indications (surface and subsurface) Some of the methods observed were manual ultrasonic examination (UT), magnetic particle (MT), liquid penetrant (PT), and visual examination during hydrostatic testing (VT-2). The inspectors observed NDE performed on code class components such as steam generator head to nozzle welds, field welds in the safety injection system made during code replacement activities, circumferential welds in the feedwater system, and VT-2 examination during hydrostatic testing of portions of the high pressure safety injection system. The inspectors verified that approved procedures were available and being followed. Equipment was calibrated as required, and data taken by the NDE examiners was properly recorded.

Before NDE volumetric examinations began, the inspectors observed the calibration of equipment. Calibrations of the UT were satisfactorily performed according to applicable procedures. UT instruments were found to be calibrated for screen height linearity, amplitude control linearity, and linear sweep using appropriate reference blocks. The inspectors observed the preparation and use of proper UT distance amplitude correction curves. The inspectors observed NDE personnel verifying that proper surface preparation and metal surface temperatures were satisfactory prior to the performance of the particular examination. The inspectors verified the size, frequency, and angles of the search units (transducers) used, as well as the scanning techniques, scanning sensitivity, direction, rate of search unit movement, overlap, and coverage, which were in accordance with the applicable NDE procedure. The inspectors verified that a system calibration check was performed before the examination to verify the instrument sensitivity and sweep range calibration. The inspectors also observed that MT and PT examinations were properly performed.

The inspectors observed the hydrostatic testing of portions of the high pressure safety injection system (HPSI). This test was performed to inspect the welds made on the system because of valve replacement. Observations by the inspectors indicated that the test was performed according to pressure test instructions. Proper equipment and calibrated test gauges were used. The pressure was slowly raised to the required test pressure, and licensee personnel continuously monitored both test gauges and equipment. Once the required pressure was reached and stabilized, it was maintained for the minimum test interval of 10 minutes. During that time, the VT-2 examiner performed a walkdown of those portions of the HPSI system being tested, and specifically inspected for leaks. No leaks were identified, and the test was declared successful. The authorized nuclear inservice inspector (ANII) was present during hydrostatic testing of the HPSI system.

The inspectors noted during review of Procedure 1415-012, "Magnetic Particle Examination, ASME Section XI," Revision 2, that it neither required the use of a magnetic particle field indicator (pie gauge) nor specified where the pie gauge should be used. Section V of the ASME Code required the use of a pie gauge when necessary. Since the procedure did not address the use of a pie gauge, the inspectors discussed this apparent omission with the NDE Level III examiner. The Level III examiner subsequently informed the inspectors that Procedure 1415.012 would be changed to define the appropriate circumstances for use of the pie gauge.

The examinations observed during the inspection are listed in Table 2.

TABLE 2

Examinations Observed

ISI EXAM	Description	Component	ASME Code Item	Exam Method
62-002	circumferential weld	Feedwater Loop 1	C5.51	UT, MT
22-019	valve to elbow circumferential weld	Safety Injection Loop 1B	B.9.11	UT
24-047	elbow to pipe circumferential weld	Safety Injection Loop 2B	B.9.11	PT
04-034	head to nozzle	Steam Generator "B"	C.2.21	MT
Feedwater-100	feedwater pipe to reducer	HPSI	code repair and replacement	UT
Feedwater-101	feedwater pipe to reducer	HPSI	code repair and replacement	UT

3.2.2 Conclusions

The inspectors determined that the examinations observed were performed in accordance with approved procedures by qualified NDE personnel. Calibration checks were conducted as required. The ISI Program was being effectively implemented.

3.3 <u>Personnel Qualifications and Certifications</u>

3.3.1 Discussion

The inspectors reviewed the certifications of the NDE Level II personnel performing the inspections. These personnel were contractor employees from Societe Generale de Surveillance (SGS). During the NDE observations, the inspectors checked the identity of the personnel calibrating the ultrasonic equipment and performing various NDE examinations, and compared this information to the personnel certifications. The reviewed documentation indicated that the NDE personnel were certified to perform the intended work. NDE personnel were found to be knowledgeable of procedural requirements, examination techniques, and test equipment. The inspectors also verified that the qualification and certification records included the annual, near distance visual acuity and color vision examination. The inspectors also reviewed the qualifications and certifications of the licensee's two Level III examiners. The inspectors determined that all of the NDE personnel were properly certified according to industry standard ASNT SNT-TC-1A.

3.3.2 Conclusions

NDE personnel were properly certified to perform the intended work.

3.4 <u>ISI Procedures and Records Review</u>

3.4.1 Discussion

The inspectors reviewed NDE procedures (identified in Attachment 2) associated with the ISI examinations being performed to verify that the procedures were consistent with the requirements of the ASME Code. The procedures were observed to contain sufficient details and instructions to perform the intended examinations. NDE reports were properly completed and submitted to the NDE Level III examiner for review and evaluation.

The ASME Code, Section V, required that examinations be performed in accordance with written procedures and that these procedures must be demonstrated to the satisfaction of the ANII. Discussions with the ANII and review of the ANII's records revealed that NDE procedures developed during the ANII's assignment to ANO were demonstrated to his satisfaction. The inspector also discussed repair and replacement activities with the ANII, and observed his required inspection efforts in those activities and other NDE examinations. The ANII had observed his inspection responsibilities during the performance of hydrostatic testing of the HPSI.

3.4.2 Conclusions

ISI procedures contained sufficient details and instructions to perform the examinations observed. The ANII was routinely involved in the observation of ISI NDE activities.

4 INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI) PAD (92701)

4.1 Discussion

The inspectors held discussions with licensee representatives and contractor personnel responsible for construction of the ISFSI pad. The licensee's representatives stated that the function of the storage pad is to provide a relatively flat surface for storage of casks for the high level waste storage project. The concrete storage pad will not require any active operating mode for the safety of the stored fuel. The inspectors were also informed by the licensee representatives that failure of the pad will not affect any plant operations. These discussions and review of documentation indicated that the ISFSI pad will be a nonsafety-related structure. The inspectors reviewed the proposed plans and geotechnical investigation report proposed for the ISFSI pad.

Excavation and back-filling for the pad were complete. However, the specifications indicated that concrete should be placed as soon as possible after excavation and forming have been completed. The inspectors were concerned because excavation had been completed for weeks and no concrete had been placed. The licensee representatives informed the inspectors that compaction tests will be performed before concrete placement occurs to determine if additional excavation is necessary.

4.2 Conclusions

The licensee and its contractors had developed sufficient construction plans and specifications to construct the ISFSI pad.

5 FOLLOWUP ON CORRECTIVE ACTIONS FOR A VIOLATION (92702)

(Closed) Violation 313/9326-01; 368/9326-01: Numerous Examples of Failure to Maintain Level 1 Housekeeping Controls Were Identified in Both of the Spent Fuel Pool Areas

The licensee responded to this violation by aggressively increasing personnel sensitivity to and awareness of the need for compliance with FME and housekeeping controls, including the erection of fenced areas around both spent fuel pools.

Refer to Section 2.14 above for further details.

6 FOLLOWUP (92701)

(Open) Inspection Followup Item 313/9326-02: Problems Encountered with the Main Hoist of the Polar Crane during 1R11

On September 17, 1993, the reactor vessel head was raised high enough to clear the alignment pins and trolleyed away from the reactor vessel to the reactor cavity location where a subsequent vertical lift was to occur. Upon initiating the lift movement, the head started to slip downward. Eight additional attempts were made to lift the reactor vessel head, but each time, slippage occurred. The magnitude of each slippage was estimated to range from 1-6 inches.

The licensee initially postulated that the slippage was most likely caused by a lower than normal bus voltage. The licensee believed that the crane's induction motor could not generate enough starting torque without initial slipping occurring. Following this determination, the vessel head was successfully lifted and placed on the head stand.

During the week of October 4, 1993, the reactor vessel head was lifted from its stand. This time the crane was powered with higher voltage. Again, however, the licensee noticed that the head slipped during movement. The head was then placed back on the reactor vessel. The licensee's representative indicated that the crane's problems were now thought to be due to the crane's logic circuitry.

The inspectors reviewed the status of the licensee's corrective actions for this event. The inspectors noted that not all the actions detailed in the licensee's corrective action response have been completed. The inspectors also noted that the information contained in the root cause evaluation section of the licensee's response was in the process of being changed to reflect additional information. Because the licensee was updating their root cause evaluation to reflect the latest, most accurate information, and because all correction actions have not been completed, this item will remain open.

ATTACHMENT 1

1 PERSONS CONTACTED

1.1 Entergy Personnel

*C. Anderson, Unit 2 Operations Manager
*S. Bennett, Acting Supervisor, Licensing
*M. Bourgeois, Project Manager, Outages
*B. Converse, Engineering Programs Supervisor
*M. Cooper, Licensing Specialist
*R. Edington, Unit 2 Plant Manager
D. Fowler, Quality Assurance Specialist, Operations
B. James, Unit 2 Assistant Outage Manager
*M. Harris, Unit 2 Maintenance Manager
*J. Kowalewski, Unit 1 Maintenance Coordinator
*M. Ledezma, Maintenance Specialist
*D. Lomax, Engineering Programs Manager
*J. McWilliams, Modifications Manager
*D. Mims, Licensing Director
*T. Mitchell, System Engineering Supervisor
*F. Philpott, Unit 2 Reactor Engineering Superintendent
*S. Pyle, Licensing Specialist
*J. Ray, Nondestructive Examinations Superintendent
C. Reed, Quality Assurance Specialist, Operations
*T. Reichert, Unit 1 Reactor Engineering Superintendent
D. Wagner, Quality Assurance Superintendent
*T. Weir, Materials Manager

1.2 NRC Personnel

*D. Powers, Chief, Maintenance Branch

In addition to the personnel listed above, the inspectors contacted other personnel during this inspection period.

2 EXIT MEETING

An exit meeting was conducted on April 1, 1994, during which the inspectors summarized the scope and findings of this inspection. The licensee did not express a position on the inspection findings documented in this inspection report. The inspectors acknowledged that, during the inspection, the licensee had provided certain information that was considered proprietary. The proprietary information was returned to the licensee at the conclusion of this inspection.

ATTACHMENT 2

DOCUMENTS REVIEWED

FIRS DOCUMENTATION

PROCEDURES

2502.001, "Refueling Shuffle," Revision 24

2302.049, "ANO-2 Fuel Assembly Reconstitution," Revision 0

1000.018, "Housekeeping," Revision 20

1025.019, "System Cleanliness Controls During Modification and Maintenance," Revision 5

2503.003, "Operation of Fuel Handling Equipment," Revision 13

1022.013, "Preparation and Conduct of Refueling Activities," Revision 5

AA52001-026, "Fuel Handling Equipment," Revision 6

2502.003, "Preparation For Refueling," Revision 12, Attachments J, D, and A, and Revision 13

1010.008, "Industry Events Analysis Program," Revision 6

5510.203, "Vendor Technical Manual Review and Update," Revision 1

1412.067, "Small AC Motor Lubrication and Inspection," Revision 2

2411.005, "Unit 2 Fuel Pool Pump Lubrication and Inspection," Revision 1

PMEE No. 148, "Fuel Handling Cranes," Revision 2

1025.026, "Preparation, Review and Approval of Preventive Maintenance Engineering Evaluations," Revision 1

1000.024, "Control of Maintenance," Revision 41

2402.156, "Unit 2 Replacement of Contaminated Filters," Revision 1

2104.006, "Fuel Pool Systems," Revision 12

2504.009, "Unit 2 Canal Seal Plate Installation," Revision 2

2504.010, "Unit 2 Canal Seal Plate Removal and Storage," Revision 5

2503.001, "Fresh Fuel Inspection and Storage," Revision 9

QAP 18.04, "Performance of Fuel Vendor Audits," Revision 0

QAO-9. "Internal QA Surveillance," Revision 8

QUALITY ASSURANCE SURVEILLANCE REPORTS

F94-1, performed January 18-21, 1994, at Hematite, MO
F94-2, performed January 18-21, 1994, at Windsor, CT
F93-15, performed December 14-17, 1993, at Hematite, MO
F93-14, performed December 7-10, 1993, at Windsor, CT
F93-13, performed November 16-19, 1993, at Hematite, MO
F93-12, performed October 26-29, 1993, at Windsor, CT

PLANT CHANGES

90-8096
92-8028
91-8009
92-8061

MAINTENANCE JOB ORDERS

898592
852824
906713
834389
879647
852818
907652
852823
898602
893142
907574
856168
906437
852817
908515
832228
893141
893144
909869
907656
907108
909151
909728

INFORMATION NOTICES

IN 88-65
IN 93-70
IN 92-21
IN 91-26

IN 89-01
IN 87-19
IN 85-12

DRAWINGS/P&IDs

M-2236, Revision 69
2HCC-63-1, Revision 3
M-2235, Revision 57
2HCC-60-1, Revision 9
2HCC-59-2, Revision 5
2HCC-59-3, Revision 6
2HCC-53-1, Revision 16
D-18492, Revision 6

FORMS

1015.016F, "Shift Turnover Checklist (Unit 2) Modes 5 & 6"

ISI DOCUMENTATION

2R10 Outage ISI Examination Scope

PROCEDURES

1415.012, "Magnetic Particle Examination - ASME Section XI," Revision 2

1415.004, "Liquid Penetrant Examination - ASME Section XI," Revision 2

1415.025, "Ultrasonic Examination Of Austenitic Piping Welds," Revision 2

1415.007, "Manual Ultrasonic Weld/Wall Thickness Profile," Revision 1

1415.023, "Ultrasonic Thickness Measurement - A Scan," Revision 2

1415.001, "Ultrasonic Thickness Measurement (Digital Or Meter Display)," Revision 2

1415.027, "Fluorescent Liquid Penetrant Examination," Revision 1

1415.015, "Ultrasonic Instrument Linearity Calibration Procedure," Revision 3

1415.017, "Manual Ultrasonic Examination of Ferritic Piping Welds," Revision 6

1025.043, "Repair and Replacement Request Completion and Control," Revision 1

MES - 09, "Inservice Inspection Program," Revision 0

1415.022, "Ultrasonic Examination Of Dissimilar Metal Welds," Revision 4

JOB ORDER

910575 - Hydrostatic Test

ISI NDE REPORT NO./CALIBRATION SHEETS

ISI-MT-015-2
ISI-UT-036-2
ISI-CAL-028-2
ISI-MT-014-2
ISI-UT-045-2
ISI-CAL-043-2
UT-94-014-2
ISI-PT-046-2

ISFSI PAD DOCUMENTATION

"Geotechnical Investigation Proposed ISFSI PAD," Grubbs, Garner & Hoskyn, Inc., dated October 1992

Calculation No. 92-D-2001-02, Revision 0, by Sierra Nuclear Corporation

Field Density Tests of East Site, by Grubbs, Garner & Hoskyn, Inc., Consulting Engineers

DRAWINGS

C-2017, Sheets 1 through 14, Revision N
C-2017, Sheet 1A, Revision N-1
C-2017, Sheet 7A, Revision N

DESIGN CHANGE PACKAGE

92-2001, High Level Waste Storage Project