APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report Nos. 50-313/91-29; 50-368/91-29

Operating License Nos. DPR-51; NPF-6

Licensee: Entergy Operations, Inc. (Entergy)
Route 3, Box 137G
Russellville, Arkansas 72801

Facility Name: Arkansas Nuclear One (ANO), Units 1 and 2

Inspection At: ANO site, Russellville, Arkansas

Inspection Conducted: October 15-18, 1991

Inspector: I. Barnes, Chief, Materials and Quality Programs Section, Division of Reactor Safety

Approved: Dwight D Chamberlain
D. Chamberlain, Deputy Director, Division of Reactor Safety

12-16-91
Date

Inspection Conducted October 15-18, 1991 (Report 50-313/91-29)

Areas Inspected: Routine, announced inspection pertaining to followup of seismic qualification deficiencies in Foxboro instrument modules, action on previous inspection findings, and followup of a licensee event report.

Results: Within the areas inspected, no violations or deviations were identified. Inspection identified that the licensee had performed an effective root cause analysis of the seismic qualification deficiencies in Foxboro instrument modules. Planned actions in response to the deficiencies were found to be comprehensive and appropriate for the identified root causes.

Inspection Conducted October 15-18, 1991 (Report 50-368/91-29)

Areas Inspected: Routine, announced inspection pertaining to followup of stem corrosion in the governor valve for the Unit 2 turbine driven emergency feedwater pump, and action on a previous inspection finding.

Results: Within the areas inspected, no violations or deviations were identified. Metallurgical analysis has identified that the valve stem degradation was caused by galvanic and pitting corrosion. The inspection did

not positively confirm the source of high concentrations of sulfur and chlorides that were present in corrosion products on the valve stem. The licensee has responded appropriately to the stem corrosion problem by replacement of the nitrided Type 410 stainless steel stem with a Type 410 stainless steel stem that has been plated with electroless Nickel and hard Chromium plate.

DETAILS

1. PERSONS CONTACTED

Entergy

*G. Ashley, Licensing Specialist
*S. Boncheff, Licensing Specialist
*T. Brown, Assistant to Unit 2 Plant Manager
*W. Butzlaff, Quality Assurance Supervisor
*B. Day, Unit 1 System Engineering Manager/Acting Plant Manager
*S. Garchow, Manager, Safety Assessment
*D. James, Licensing Supervisor
*D. McKenney, Unit 1, System Engineering Supervisor
*T. Mitchell, Unit 2 System Engineering Supervisor
D. Nilius, Unit 2 System Engineer
S. Paquette, Design Engineer
*C. Warren, Unit 2 Maintenance Manager
*M. Woodby, Unit 1 System Engineer
*A. Wrape, Manager, EIC Design
*J. Yelverton, General Manager, Operations

The inspector also contacted other licensee personnel during the course of the inspection.

*Indicated those persons who attended the exit interview that was conducted on October 18, 1991.

2. ACTION ON PREVIOUS INSPECTION FINDINGS (92701, 92702)

2.1 (Closed) Inspector Followup Item (313/9041-01): Followup on resolution of Condition Report CR-1-90-0398, pertaining to defective ASME III, Class 1 pipe which was discovered during prefabrication welding.

The inspector reviewed the status of the actions contained in Condition Report CR-1-90-0398 and verified that 24 out of the 25 planned actions had been satisfactorily completed. The remaining action, which pertained to revision of Engineering Specification M-89 to specify use of SA-376 piping in lieu of SA-312 piping for all Class 1 applications, had not been completed as of this inspection. Licensee personnel informed the inspector that the remaining action would be completed in accordance with the criteria specified in Condition Report CR-1-90-0398. This inspector followup item is considered closed.

2.2 (Closed) Violation (313/9106-01; 368/9106-01): Inadequate receipt inspection of safety-related pipe.

The inspector verified, by review of the status of the actions contained in Condition Report CR-2-91-0109, that the licensee had implemented its

commitments made with respect to: placing of Bechtel purchased stainless steel pipe, which contained surface defects, under a Quality Control (QC) hold; institution of a reinspection process for material that was transferred by Bechtel to the licensee; inspection of a sample of installed pipe from the heat of material identified to contain surface indentations; performance of engineering analysis to verify (for the worst case identified indication) that, if nonconforming pipe had been installed in the Units 1 and 2 service-water systems, it would continue to be acceptable; revision of the QC training module to incorporate lessons learned from the piping problems; and revision of the welder training program to ensure craft personnel are sensitized to detecting piping defects. This violation is considered closed.

3. FOLLOWUP ON A LICENSEE EVENT REPORT (LER) (92700)

(Closed) LER No. 313/90-012: Defects in ASME III, Class 1 stainless steel pipe discovered during prefabrication welding, which if installed could have resulted in failure of the high-pressure injection system during operation.

The inspector reviewed the corrective actions taken by the licensee for this LER during followup on Condition Report CR-1-90-0398, which is discussed in paragraph 2.1 above and pertained to the same subject. The inspector confirmed that the nonconforming pipe had been replaced with material from another manufacturer and that the vendor and its service supplier had been visited by ANO personnel to verify implementation of appropriate actions to preclude recurrence of this problem. This LER is considered closed.

4. FOLLOWUP OF SEISMIC QUALIFICATION DEFICIENCIES IN FOXBORO INSTRUMENT MODULES

4.1 Background

On August 28, 1991, ANO, Unit 1 entered Technical Specification 3.0.3 as a result of an engineering determination that certain instrument modules contained in the Foxboro Specification 200 instrument cabinets were not installed in a seismically qualified configuration. This determination resulted from the identification by licensee personnel that: (a) vibration dampening material had not been installed in several instrument modules, and (b) certain cabinet power supply brackets and instrument module card guide rails were missing. Additional information regarding resolution of these deficiencies is documented in NRC Inspection Report 50-313/91-28; 50-368/91-28. The purpose of this inspection was to review the engineering and procurement history for this equipment and to verify that the licensee had established appropriate actions to preclude recurrence of similar problems.

4.2 Engineering and Procurement History

The inspector reviewed Design Change Package (DCP) 83-1057, which pertained to installation of cabinets and Foxboro equipment in Unit 1. The DCP was noted to contain instructions to follow the vendor manual for installation and checkout of module cards, but did not specify the need for or provide guidance

on installation of bumpers (i.e., vibration dampening material), cabinet power supply brackets, and card guide rails. From review of Foxboro Manufacturer's Instructions (MIs), the inspector confirmed information provided by the licensee that the only Foxboro MI which contained instructions regarding installation of bumpers was MI 2AN-105, "N-2ANU Analog Nests." This document was not issued until May 1984 and, as discussed below, did not appear to have been received on site until November 1984. The majority of cabinet installations took place during Refueling Outage 1R6, which occurred between October 1984 and January 1985. The DCPs applicable to these installations were thus prepared prior to receipt of MI 2AN-105. The inspector additionally noted that the MIs were currently silent in regard to installation of card guide rails. The inspector confirmed that the Foxboro seismic qualification document (i.e., QOAAA01, "Program for Class IE Qualification of Spec 200 Instrumentation Equipment," Revision A), which had been reviewed and approved by design engineering, did make a reference to the modification to standard designs that were necessary for seismic qualification. These modifications were stated to include seismic mounting brackets, retention clips for cards, and rubber bumpers.

The inspector concluded from review of the engineering history that: (a) the vendor had not furnished appropriate instructions to ensure the licensee was cognizant of seismic qualification configuration requirements; and (b) the engineering review process used to determine the adequacy of QOAAA01, Revision A, did not identify the statements made in regard to required modifications for seismic qualification.

The inspector reviewed the procurement requirements for the Foxboro equipment contained in Purchase Order (PO) 12265 and Supplement 1 to PO12265 dated, respectively, June 12, 1984, and September 24, 1984. It was noted from this review that the procurement documents included the following requirements: (a) use of a quality assurance program (QA) program that met the requirements of 10 CFR Part 50, Appendix B and ANSI N45.2; (b) design, fabrication repair, examination and testing to be in accordance with IEEE 323-1974, IEEE 344-1975, and Foxboro Qualification Documents QOAAA and QOAAB; (c) the submittal of certificates of conformance to the PO; and (d) the submittal of instruction/service manuals and parts lists.

The inspector reviewed the receipt inspection reports for the items procured by PO12265 and PO12265, Supplement 1, and noted that they were generally not explicit in terms of identifying the specific documents that had been received with a particular shipment. The receipt inspection reports did identify, however, when vendor manuals had been received and which permitted the identification of MI 2AN-105 being received on site in November 1984. It could not be verified from the receipt inspection reports whether Foxboro had provided parts lists as required by the PO, thus precluding a clear determination of whether the vendor had identified the shipment of bumper, power supply brackets, and instrument module card guide rails. Examination of cartons containing spare cards did not reveal, however, a parts list, or any documentation indicating that the cartons also contained guide rails and a bumper. The available information, while not conclusive, suggested to the

inspector that parts lists were not supplied. Furnishing of such lists would have contributed to identification of the problem only if the hardware supplied for seismic qualification was specifically included in the lists.

4.3 Root Cause Analysis and Planned Actions

The inspector reviewed the root cause analysis and planned response actions for the identified seismic deficiencies, which were documented in Condition Report CR-1-91-0261. The root cause analysis was found to be comprehensive and well written. Two root causes for the problem were identified which consisted of: (a) the vendor information documenting the qualified configuration was inadequate and obscure; and (b) the plant modification process review of the Foxboro IE qualification test report was not detailed enough to identify the qualified seismic configuration, nor did the process require the detailed specification of the configuration. The inspector concurred with this root cause analysis, with the minor exception that the failure of the report review to identify the qualified configuration was considered to be a result of the process not requiring detailed specification of the qualified configuration, and not a root cause in itself.

Review of the planned licensee actions indicated the licensee was responding appropriately to the seismic deficiencies. Actions were noted to include: (a) inclusion of installation instructions for seismic qualification hardware in technical manuals containing Foxboro seismic qualified components; (b) sampling of other safety-related vendors that supply similar manuals for generic use components, to assure applicable manuals had been reviewed during the technical manual project; (c) clarification of design review requirements to ensure specific instructions are provided when constructing or modifying qualified component or system configurations; (d) training actions with respect to configuration management; and (e) incorporation of seismic inspection criteria into the planning documents for cabinet preventive maintenance.

5. FOLLOWUP OF STEM CORROSION IN THE GOVERNOR VALVE FOR THE UNIT 2 TURBINE-DRIVEN EMERGENCY FEEDWATER PUMP 2P7A

5.1 Background

During post-maintenance testing of Pump 2P7A on May 9, 1991, the emergency feedwater pump turbine tripped on overspeed. The cause of the overspeed trip was subsequently determined to be a buildup of foreign material or corrosion products in the packing area of the governor valve stem, which prevented the governor valve from closing as the turbine accelerated on startup. The valve stem and packing (alternating graphite rings and Type 410 stainless washers) had been replaced on March 26, 1991, during Refueling Outage 2R8. Additional information regarding this event is documented in NRC Inspection Report 50-313/91-17; 50-368/91-17. The governor valve stem was subsequently

removed on May 31, 1991, and sent to a contractor laboratory for metallurgical analysis. The purpose of this inspection was to review the results of the metallurgical analysis and the actions taken by the licensee to address the problem.

5.2 Review of Metallurgical Analysis

Review of the metallurgical report showed that the laboratory had concluded that degradation of the valve stem was a result of galvanic and pitting corrosion. The galvanic corrosion was attributed to the contact between the nitrided Type 410 stainless steel stem and the more electrochemically noble graphite rings in a corrosive electrolyte medium. The pitting corrosion was attributed to chlorides present in the steam environment. The inspector noted that, with the exception of the pits, the corrosion was confined to the nitrided layer at the surface of the valve stem. The inspector considered the nature of the corrosion to be illustrative of the reduction in corrosion resistance that is known to occur when martensitic stainless steels are nitrided.

Energy dispersive X-ray spectroscopy of corrosion deposits on the stem and in pits identified the presence of high sulfur and chloride concentrations. Licensee metallurgical staff have concluded that the high levels were most likely attributable to the impure steam environment and the tendency for these elements to concentrate in a labyrinth seam. An alternate possible source of the elements was indicated to be cleaning solvents or lubricants used during maintenance activities. The inspector reviewed both Job Order 782869, which installed the valve stem on March 26, 1991, and steam generator water chemistry records for the startup following 2R8. The inspector was unable from this review to positively confirm the responsible source of the chlorides and sulfur.

5.3 Actions Taken by the Licensee

The licensee, as a result of utility testing initiatives, procured replacement valve stems which had been plated with electroless Nickel followed by a hard Chromium plate. The plated stems had been demonstrated by testing to have adequate wear resistance and to be operable after extensive exposure to high chlorides, temperature, and humidity. The new stems had also been used successfully at two other nuclear plants with no reported problems. The inspector reviewed the test data and confirmed that superior corrosion resistance was exhibited by the plated specimens.

6. EXIT INTERVIEW

An exit interview was held on October 18, 1991, with those individuals denoted in paragraph 1, in which the inspection findings were summarized. The licensee did not identify as proprietary any of the information provided to, or reviewed by, the inspectors.