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Nuclear Regulatory Commission
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Subject: Arkansas Nuclear One - Units 1 and 2
Docket Nos. 50-313 and 50-368
License Nos. DPR-51 and NPF-6
60 Day Response to NRC Bulletin 2002-01, Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity

References:

1. Entergy letter dated April 1, 2001, "15 Day Response to NRC Bulletin 2002-01, Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity," (0CAN040201)
2. Entergy letter dated May 27, 1988, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants (0CAN058813)
3. NRC letter to Entergy dated September 30, 1992, "NRC Inspection Report 50-313/92-23; 50-368/92-23"

Dear Sir or Madam:

By letter dated March 18, 2002, the NRC issued Bulletin 2002-01, "Reactor Pressure Vessel Head Degradation And Reactor Coolant Pressure Boundary Integrity", requiring licensees to provide 15 day and 60 day responses. The 15 day response was provided in Reference 1. Attachment 1 provides the Entergy Operations, Inc. (Entergy) response to the 60 day request for Arkansas Nuclear One (ANO), Units 1 and 2.

ANO has established procedural controls that ensure RCS walkdowns are conducted to identify potential leaks, boric acid evaluations are effectively performed, and systems, structures and components (SSCs) which have been affected by boric acid are properly restored. Personnel who perform boric acid walkdowns and evaluations are trained to identify boric acid leaks and to establish appropriate corrective actions. The ANO Boric Acid Corrosion Prevention Program has been evaluated by onsite organizations as well as the NRC during routine inspections. Therefore, Entergy believes that the Boric Acid Corrosion Prevention Program at ANO provides reasonable assurance for compliance with the applicable regulatory requirements discussed in Generic Letter 88-05 and Bulletin 2002-01.

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This letter is submitted pursuant to 10 CFR 50.54(f) and contains information responding to NRC Bulletin 2002-01 for ANO-1 and ANO-2. There are no new commitments being made in this response to Bulletin 2002-01.

If you have any questions or require additional information, please contact Steve Bennett at 479-858-4626.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 14, 2002.

Sincerely,

Sherrie R. Cotton

Sherrie R. Cotton
Director, Nuclear Safety Assurance

SRC/sab

Attachments

1. 60 Day Response to NRCB 2002-01, Reactor Pressure Vessel Head Degradation And Reactor Coolant Pressure Boundary Integrity

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60 Day Response to NRC Bulletin 2002-01, Reactor Pressure Vessel Head Degradation And Reactor Coolant Pressure Boundary Integrity

NRC Required Information

Bulletin 2002-01 requires all PWR addressees to provide within 60 days of the date of this bulletin the following information related to the remainder of the reactor coolant pressure boundary:

3.A The basis for concluding that your boric acid inspection program is providing reasonable assurance of compliance with the applicable regulatory requirements discussed in Generic Letter 88-05 and this bulletin. If a documented basis does not exist, provide your plans, if any, for a review of your programs.

Response:

Scope of Generic Letter 88-05

Generic Letter (GL) 88-05, *Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants*, required four areas to be considered for ensuring that licensees boric acid inspection processes were adequate to identify reactor coolant pressure boundary (RCPB) leakage that could degrade carbon steel piping and components. This includes the following actions:

(1) A determination of the principal locations where leaks can cause degradation of the primary pressure boundary by boric acid corrosion.

(2) Establishing procedures for locating coolant leaks.

(3) Establishing methods for conducting examinations and performing engineering evaluations to establish the impact on the RCPB when leakage is located, and

(4) Establishing corrective actions to prevent recurrences of boric acid corrosion.

As stated in Generic Letter 88-05, ANO-1 had experienced boric acid corrosion on a high pressure injection nozzle. As a result of this event and as committed in an LER associated with this event (LER 86-006-00 dated December 9, 1986), Entergy took actions to address boric acid corrosion of the RCS which met the guidance of the generic letter. The ANO response to GL 88-05 was provided in Reference 2.

The ANO boric acid program has been established under procedural control as the Boric Acid Corrosion Prevention Program (BACPP). The ANO BACPP was reviewed by the NRC in 1992 (Ref. 3) and was found to meet or exceed the requirements of GL 88-05. Entergy has continued to enhance the ANO boric acid program and remains in compliance with the guidance of GL 88-05 and the applicable requirements of the General Design Criteria of 10CFR50, Appendix A.

The following information provides the basis for the acceptability of the ANO boric acid program for meeting NRC guidance and regulations.

Procedural Controls and Locations of Potential Boric Acid Corrosion at ANO

ANO has several processes and procedures that control the BACPP. The program is administered within the ANO System Engineering Department. However, there are other onsite departments that provide implementation of the program in addition to System Engineering.

Procedure 5000.005, "*Boric Acid Corrosion Prevention Program Administration*", establishes the overall site controls for the program. This includes establishing the responsibilities of appropriate site organizations for observation, identification and evaluation of potential boric acid leakage. Specifically, System Engineering, as the administrator of the BACPP, is responsible to interface with all affected departments to maintain consistency and compliance with the ANO BACPP.

During a refueling outage plant cooldown, an RCS walkdown is performed to inspect for leaks that have the potential for boric acid corrosion which could cause carbon steel wastage. These inspections are required by ANO-1 Procedure 1102.010, "*Plant Shutdown and Cooldown*" and by ANO-2 Procedure 2102.010, "*Plant Cooldown*". During plant heatup another series of walkdowns are performed similar to that performed for cooldown. These walkdowns are controlled by ANO-1 Procedure 1102.001, "*Plant Preheatup and Precritical Checklist*" and ANO-2 Procedure 2102.001, "*Plant Pre-heatup and Pre-critical Checklist*". During a refueling outage, these walkdowns cover the inspection of such areas as:

- RCS hot and cold leg piping, valves and instrument taps, sample lines, etc.
- Steam generator manways and handholes,
- Pressurizer nozzles, penetrations and piping,
- Reactor vessel head closures,
- High and low pressure injection piping and valves,
- Shutdown cooling (decay heat) lines,
- Incore instrument tube closures (ANO-1),
- Reactor coolant pump seals,
- Charging and letdown lines (ANO-2),
- Various bolted connections and components.

During plant walkdowns, Operations personnel (as well as other organizations) perform an inspection of the RCS to document any leakage including signs of boric acid deposits. A list of boric acid leakage sites is compiled from the walk down and provided to System Engineering. System Engineering performs an evaluation of those locations, as discussed below per Procedure 1032.037, "*Inspection and Evaluation of Boric Acid Leaks*". Each leak path evaluation is assigned an evaluation number and tracked to resolution. Repairs are performed under the ANO Maintenance Action Item (MAI) process and condition reports are generated, as appropriate.

In addition, Entergy has established a new ANO Procedure 2311.009, "ANO Unit 1 and Unit 2 Alloy 600 Inspection", to facilitate inspections concerned with Alloy 600 primary water stress corrosion cracking (PWSCC). The procedure contains guidance for inspection of the specific small bore and pressurizer nozzles that are susceptible to PWSCC for both units. The ANO-1 incore instrument nozzles which are located on the bottom of the vessel are not covered by OP 2311.009, but are inspected during the post outage pressure test walkdowns. The procedure identifies specific RCS locations that are to be walked down and documented to detect potential leaks from Alloy 600 components. This procedure was also discussed in our 15 day response to Bulletin 2002-01 (Ref. 1).

Actions Taken upon Identification of Boric Acid Leakage

ANO Procedure 1032.037, "*Inspection and Evaluation of Boric Acid Leaks*", governs the process for investigating and evaluating boric acid leaks for both units. This procedure also establishes the Boric Acid Corrosion Coordinator within System Engineering. The Coordinator's responsibilities include performing preliminary investigations of the cause and severity of the leak, coordinating resolution the condition, determining the root cause of the leak, and ensuring reports documenting the problem are prepared in a timely manner. A form contained in this procedure is completed to document the evaluation.

The Boric Acid Evaluation form includes two sections which are completed by either System Engineering or a combination of System Engineering and the organization identifying the boric acid leak. The first section of the form is to include information about the location of the boric acid leak, the nature of the boric acid and any identified conditions such as wastage. Upon completion of this portion of the form, it is forwarded to System Engineering who performs an evaluation of the potential effects from the boric acid and whether the system, structure, or component is significantly affected by the presence of boric acid. MAIs are generated for boric acid leaks to ensure that the condition is promptly corrected to avoid any carbon steel degradation. Photographs are often taken to support the as-found condition of the leaking component as well as the equipment where the boric acid may have dripped. If there is a potential for significant impact or wastage, a condition report is written and action is taken to repair or replace the component, if required.

Documentation of boric acid evaluations are retained by the Boric Acid Coordinator within System Engineering. These evaluations serve to provide a history of ANO boric acid leaks and conditions. System Engineering is able to review these evaluations to determine whether recurring conditions exist and for support in determining the root cause of leakage conditions.

Boric acid corrosion prevention training has been provided to ANO System Engineering including those who perform boric acid evaluations. The training includes historical industry events, ANO specific events, corrosion degradation processes, wastage degradation, and recognition of boric acid leakage during equipment walkdowns. Operations personnel who perform boric acid walkdowns are also trained in the recognition of boric acid leakage and deposits. Post outage pressure tests performed in accordance with Procedures 5120.242 and 5120.243 are conducted by QC personnel who are qualified to perform visual inspections as a VT-2 inspector.

ASME Section XI Inservice Inspection

The ANO-1 and ANO-2 ASME Section XI Inservice Inspection programs (CEP-ISI-002 and CEP-ISI-004, respectively) include the examination of welds, rigid restraints and pressure boundaries of components and piping on Class 1, 2 and 3 systems. The weld and rigid restraint examinations are performed during the specified periods. The system pressure tests of piping are performed during regular intervals of every refueling outage for Class 1 piping and once a period for Class 2 and 3 piping systems. The ANO ISI programs identify the specific welds and rigid restraints that have been selected for examination during the 10-year interval. A list of the Class 1, 2 and 3 lines is also included, with notes exempting some from testing.

The system pressure test examination requirements are contained in the Entergy ASME XI System Pressure Testing Program (CEP-PT-001). The system pressure tests that are performed for the ASME Section XI program are performed to verify there is no throughwall pressure boundary leakage. CEP-PT-001 also contains the acceptance criteria and examination guidelines for performing VT-2 exams. Leakage is evident either through presence of liquid or boric acid deposits on nearby equipment, under piping, or at low points in insulation and piping.

ANO Quality Control procedures (5120.242 and 5120.243) are used for the Post Outage Pressure Test for Unit 1 and Unit 2, respectively for a VT-2 inspection of the RCS pressure boundary (remote visual examination may be substituted for direct examination). Detailed listings of the inspection locations are provided in the procedure. Relevant conditions are evaluated for corrective measures in accordance with CEP-PT-001. The Class 1 RCS system is pressure tested at the end of every refuel during Mode 3 with the system at normal operating pressure.

Bolted connections are also inspected during the periodic system pressure tests. For insulated connections, a four-hour hold time is required unless the insulation is removed. Specific bolting has been determined to be susceptible to boric acid corrosion, and these bolted connections require insulation removal. Bolted connections in systems borated for the purpose of controlling reactivity are screened for susceptibility for boric acid corrosion based on various chemistry factors of the carbon steel.

Obstructions To Visual Inspections

The primary obstructions to boric acid leakage detection are either the presence of insulation or isolated leakage location within the auxiliary or reactor building. Regarding the presence of insulation, most boric acid leaks are due to leaks from valve bonnet or pump casing joints, loose valve packing and various bolted connections. These connections are not normally insulated and the ability to observe boric acid is not typically hampered by insulation. RCS walkdowns usually have little difficulty in detecting open boric acid leaks in quantities as small as a few ounces of boric acid. If insulation is present, boric acid deposits may have to be more than just a few ounces for detection. However, boric acid leakage that would be expected to result in wastage would need to be present over a period of time and in sufficient quantity which would allow detection. These quantities would most likely be identified from boric acid deposits around the insulation.

With regards to visible obscurity of boric acid, some leaks may not be immediately identified upon coming down from an outage. Some boric acid leaks are also identified from other routine walkdowns and activities performed by system and design engineers, and maintenance personnel. From the initial reactor building walkdowns as well as other outage activities that identify boric acid deposits, it is unlikely that boric acid leakage would not be detected.

In cases where leakage paths may occur for Alloy 600 primary water stress corrosion cracking (PWSCC), ANO has established a separate program for performing these inspections as discussed in Procedure 2311.009. Specific susceptible locations have been identified and are inspected during each refueling outage.

Post outage pressure test walkdowns are conducted by Quality Control personnel at the same time as the Operations pre-critical walkdowns. The inspection includes the ASME Class 1 components to the boundaries specifically defined in the procedure. Special attention is given to inspection of bolted connections, components which have been opened in the outage and repaired or replaced components. Sources of leakage detected during the pressure test are required to be identified. The assistance of ANO Maintenance or Modifications groups may be required if insulation needs to be removed to determine the source of leakage. However, all of these components are to be observed prior to accepting the system integrity for startup.

Confirming Actions that Show Adequacy of Boric Acid Program

The ANO Boric Acid Corrosion Prevention Program has existed since the mid-1980s as a result of an ANO-1 high pressure injection seal leak which resulted in wastage of carbon steel on other portions of the RCS. The program has continued to evolve and mature as a result of lessons learned from other industry and site boric acid findings. When boric acid leaks occur that could impact systems, structures and components, ANO documents the conditions through our 10CFR50, Appendix B corrective action program. In addition, leaks that have resulted in pressure boundary degradation have been reported to the NRC under 10CFR50.73. A review of the condition reports and LERs has documented findings at ANO where our program has been effective in identifying and addressing boric acid conditions that could potentially impact systems, structures and components.

<u>Licensee Event Reports (LERs)</u> – Since the establishment of the ANO Boric Acid Program, Entergy has identified several boric acid related conditions which were reported under 10CFR50.73. The evaluations performed for the conditions associated with these LERs help to refine the BACPP and ensure they receive industry-wide acknowledgement. The LERs issued since 1989 at ANO include the boric acid corrosion of an ANO-1 Control Rod Drive Mechanism (CRDM) flange assembly in 1989, a leak in the area of an ANO-1 pressurizer upper level instrumentation nozzle in 1990, the leak on an ANO-1 RCS hot leg level instrument nozzle in 2000, a leak in the ANO-2 pressurizer heater sleeves and a RCS temperature nozzle in 2000, and the axial flaw identified in the ANO-1 CRDM nozzle in 2001. The evaluation results for these findings have been used to identify improvements for potential boric acid leak identification and repair methods.

<u>Condition Reports (CRs)</u> – Condition Reports were examined for the period of 1999 up to the latest ANO-2 outage to help determine the effectiveness of our boric acid program. Ten CRs (not already covered by LERs) were reviewed that were related to boric acid leakage conditions. The actions taken for these CRs addressed both the specific boric acid condition, and as appropriate, the broader concern for boric acid effects. Actions to address these CRs, as well as other CRs have also been important for enhancing the ANO BACPP and to evaluate possible recurring conditions. It was recently identified that pressure tests from underneath the Unit 2 reactor vessel had not been inspected. This condition was documented in a condition report and the inspection was performed during heatup from the recent 2R15 outage.

<u>Boric Acid Program Evaluations</u> - During the most recent Unit 2 refueling outage, more than 50 boric acid evaluations were performed and documented. Most of these were for packing and other minor boric acid leaks, however, these evaluations provide positive indication that there is a high level of attention to ensuring that boric acid degradation is effectively addressed. In the most recent Unit 2 refueling outage, initial walkdown inspections identified five Alloy 600 pressurizer heater nozzles that were leaking. Repairs were performed to return the nozzles to required pressure boundary integrity. In addition, during performance of RCS walkdowns for heatup from the 2R15 outage, an additional nozzle was identified to have signs of boric acid and the plant was cooled back down for nozzle repair prior to proceeding to criticality; thus showing the effectiveness of the ANO boric acid program and system integrity walkdowns.

<u>Recent QA Audits and Surveillances</u> ANO Quality Assurance has also performed audits and surveillances that included the Boric Acid Corrosion Prevention Program. Even though areas of improvement were identified, the results of the reviews determined that the ANO BACPP is effective.

- *Quality Assurance Surveillance Report QS-2001-ANO-091 Boric Acid Corrosion Prevention Program (BACPP) Turnover, August-September 2001* - This surveillance was performed to review the turnover of responsibilities for the BACPP from Engineering Programs and Components to System Engineering in 1999 and subsequent actions taken by System Engineering following issue of a Notice of Violation to ANO for failure to conduct trending of boric acid leakage following the turnover. The surveillance considered a review of GL 88-05 and the ANO response. Quality concluded that the turnover of the BACPP was performed in a reasonable manner and that even though problems occurred in the transfer, these problems would likely have been overcome. Quality concluded that the revised program meets the requirements of NRC Generic Letter 88-05.

- *Audit of ANO Engineering Programs (including Boric Acid Corrosion Prevention Program) August-October 1999:* Quality reviewed the BACPP against the requirements of Generic Letter 88-05 and Entergy's responses to the generic letter. The program was found to be satisfactory; however, a program deficiency was identified during review of the Unit 2 interface with the BACPP. Quality noted that when performing the plant cooldown walkdowns per OP-2102.010, ANO-2 Operations was only required to "identify any leakage and submit a job request (MAI) as needed". The concern was that the procedure did not invoke the BACPP to perform evaluations. This condition has been corrected to ensure that the initial portion of the Boric Acid Evaluations are completed and provided to System Engineering.

License Renewal Program Review - The ANO BACPP is credited for the long term management of aging effects for ANO-1 license renewal. Even though the license renewal was only for ANO-1, the program is applicable to both units and its administration is the same for both units. As noted in the ANO-1 license renewal application, the boric acid program will prevent significant degradation of carbon steel as a result of boric acid corrosion including loss of material (wastage). The ANO BACPP was also acknowledged in the NRC's Safety Evaluation for the ANO-1 license renewal dated April 2001 as a program for ensuring the long term acceptability of systems and components potentially affected by boric acid corrosion.

To determine the adequacy of the aging management programs to support ANO-1 license renewal, the NRC performed an inspection for ANO-1 which included evaluation of the ANO Boric Acid Corrosion Prevention Program. In review of our BACPP the NRC identified two areas where the program implementation was deficient. This included the misplacement of boric acid inspection records from the fall 1999 ANO-1 outage (1R15) and the lack of a complete boric acid database for use in trending. Condition reports were written on these findings. However, the conclusions of the inspection found that the boric acid program was acceptable and should be effective to manage aging effects caused by boric acid corrosion.

Conclusion

ANO has established procedural controls that ensure that walkdowns are effectively conducted, boric acid evaluations are performed, and systems, structures and components which have been affected by boric acid are properly restored. Personnel who perform boric acid walkdowns and evaluations are trained to ensure that boric acid leaks are identified and appropriately resolved. The BACPP has been evaluated by onsite organizations as well as the NRC during routine inspections. Therefore, Entergy believes that the Boric Acid Corrosion Prevention Program at ANO provides reasonable assurance for compliance with the applicable regulatory requirements discussed in Generic Letter 88-05 and Bulletin 2002-01.