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Waterford 3

W3F1-2002-0051

May 16, 2002

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Waterford Steam Electric Station, Unit 3
Docket No. 50-382
60 Day Response to Bulletin 2002-01, "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity"

REFERENCES:
1. Louisiana Power & Light letter dated June 3, 1988, "Generic Letter 88-05" (W3P88-1207)
2. Entergy letter dated April 1, 2002, "15 Day Response to NRC Bulletin 2002-01, Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity" (W3F1-2002-0032)
3. Entergy letter dated April 16, 2002, "30 Day Response to NRC Bulletins 2001-01 and 2002-01 for Vessel Head Inspection Findings"
4. NRC letter to Entergy dated March 19, 1992, "NRC Inspection Report 50-382/92-06"
5. NRC letter to Entergy dated October 22, 1992, "NRC Inspection Report 50-382/92-24"

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 a 15 day, 30 day, and 60 day response. The 15 day and 30 day responses were provided in References 2 and 3 respectively. Attachment 1 provides the Entergy Operations, Inc. (Entergy) response to the 60 day request for Waterford Steam Electric Station, Unit 3 (Waterford 3).

Entergy has a number of programs in place at Waterford 3 to ensure boric acid leaks and any related wastage is detected, appropriately evaluated, and, when necessary, repaired. These programs include the Generic Letter 88-05 Boric Acid Corrosion Prevention Program, the Alloy 600 Program, the Inservice Inspection Program, and the Protective Coating Inspection Program. Entergy believes these programs provide reasonable assurance that applicable regulatory requirements are satisfied.

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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 Waterford 3. This letter does not include any commitments.

If you have any questions or require additional information, please contact D. Bryan Miller at 504-739-6692.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 16, 2002.

Sincerely,

Joe Venable
5/16/02

Joseph E. Venable
Vice President, Operations
Waterford Steam Electric Station, Unit 3

JEV/DBM/cbh

Attachment:
60 Day Response to Bulletin 2002-01, "Reactor Pressure Vessel Head Degradation and Reactor Coolant Pressure Boundary Integrity"

cc: E.W. Merschoff, NRC Region IV
N. Kalyanam, NRC-NRR
J. Smith
N.S. Reynolds
NRC Resident Inspectors Office
Louisiana DEQ/Surveillance Division
American Nuclear Insurers

Attachment 1

W3F1-2002-0051

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

60 Day Response to 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 [pressurized water reactor] Plants," required four areas to be considered for ensuring that licensees boric acid inspection processes are adequate to identify reactor coolant pressure boundary (RCPB) leakage that could degrade carbon steel piping and components. This involved the following:

- A determination of the principal locations where leaks can cause degradation of the primary pressure boundary by boric acid corrosion.
- Establishing procedures for locating coolant leaks.
- Establishing methods for conducting examinations and performing engineering evaluations to establish the impact on the RCPB when leakage is located, and
- Establishing corrective actions to prevent recurrences of boric acid corrosion.

In response to GL 88-05, Entergy Operations, Inc. (Entergy) established a boric acid corrosion prevention program at the Waterford Steam Electric Station, Unit 3 (Waterford 3) to inspect for boric acid leaks in the RCPB and to evaluate the impact of those leaks on carbon steel or low alloy steel components. Per this program, evidence of leaks including boric acid crystals or residue is inspected and evaluated regardless of whether the leak was discovered at power or during an outage. Based on the evaluation, appropriate corrective actions are initiated to prevent recurrence of the leak and to repair, if necessary, any degraded materials or components. The Waterford 3 boric acid corrosion prevention program complies with the considerations of GL 88-05 and the requirements of the general design criteria of 10CFR50, Appendix A as is described below

Boric Acid Corrosion Prevention Program

The boric acid corrosion prevention program specific to GL 88-05 is the responsibility of the Systems Engineering Department and is one in a number of programs at Waterford 3 used for monitoring and controlling boric acid leakage and corrosion. In addition to the GL 88-05 boric acid corrosion prevention program several other programs/inspections are in place that will also identify boric acid deposits and related degradation and insure appropriate and timely corrective actions are taken. These include the inspections on the hot legs, cold legs, reactor vessel head, pressurizer, and steam generators per the Alloy 600 Program Plan, the Inservice Inspection (ISI) Program, and the protective coating inspections. In addition to these inspection programs, reactor coolant system leakage detection systems are monitored and trended by Operations and Systems Engineering to insure leakage is maintained within Technical Specification limits and any unexpected increase in leakage is investigated.

Generic Letter 88-05 Boric Acid Corrosion Prevention Program

Procedure UNT-007-027, "Control of Boric Acid Corrosion on the Reactor Coolant System Pressure Boundary," controls the program required by GL 88-05. It ensures the integrity of that portion of the Reactor Coolant System (RCS) pressure boundary susceptible to boric acid corrosion. The areas within the scope of the inspection are:

- Reactor Coolant Pumps – pump casing, inside driver mounts and studs
- Steam Generators – primary side, manways, instrument nozzles
- Pressurizer – heaters, instrument nozzles, lower portion of vessel
- Reactor Coolant Piping –hot legs and cold legs
- Reactor Vessel – head

Walkdowns of the above areas are performed every refueling outage and during all cold shutdowns if the previous inspection has not taken place within the previous 60 days. The inspection is performed at normal RCS temperature and pressure prior to decontamination. These walkdowns inspect for boric acid leaks that have the potential to cause carbon steel wastage. Insulation is not removed nor is scaffolding installed for these walkdowns. For the purposes of these walkdowns boric acid leakage means the presence of boric acid where it is not expected; or in sufficiently larger quantities than expected in areas where a small amount of boric acid is normal, i.e., valve stems, pump shafts, etc. Installed maintenance platforms and ladders provide adequate vantage points for these walkdowns.

During the walkdowns, plant personnel, under the direction of an experienced System Engineer, perform an initial inspection of the RCS to document any leakage. A list of leakage sites is compiled and Engineering performs an evaluation of these locations. In accordance with UNT-007-027, these evaluations include an assessment of the corrosion damage that has already occurred, the corrosion damage expected to occur, and its affect on the integrity of the RCS pressure boundary. The Maintenance Action Item (MAI) system is used to track required repairs and follow-up actions. Condition Reports are generated should conditions warrant.

The scope of the program was developed based on an engineering evaluation completed in 1988. This evaluation looked at ASME Safety Class 1 systems and determined the RCS pressure boundary components that were susceptible to boric acid corrosion. Following an NRC inspection of the GL 88-05 program in 1992, Engineering reevaluated the scope of the program and confirmed the adequacy of the original program scope. This reevaluation was discussed with the NRC staff in a follow-up inspection, later in 1992, and found to be acceptable by the staff. In 1993, Entergy identified all valves inside containment within boric acid wetted systems, including systems beyond the scope of GL 88-05, that contained pressure-retaining parts that were susceptible to boric acid corrosion and documented this in PEIR TS-15A. Of 606 valves reviewed, 145 were found to contain pressure-retaining parts susceptible to boric acid corrosion. Entergy initiated a systematic replacement of susceptible parts in these valves at Waterford 3. Susceptible parts have been replaced in 135 of the 145 valves identified.

In response to Bulletin 2002-01, the GL 88-05 program scope was again evaluated for adequacy. This evaluation performed in March 2002, prior to refueling outage 11, expanded on PEIR TS-15A by including mechanical components other than valves. This review also extended the boundaries of the search to include components outside containment that are unisolable during normal plant operations. Over 1000 mechanical components in boric acid containing systems were systematically reviewed for susceptibility to boric acid corrosion. As part of this evaluation the 145 susceptible valves identified in PEIR TS-15A were reviewed to verify that the susceptible parts had been replaced. Documentation was located confirming that the susceptible parts had been replaced in 135 of the original 145 valves. Of the remaining 10 valves, two were excluded from further consideration because they were not safety related. A list of 48 susceptible components, including the 8 valves from the PEIR that had not been upgraded, was compiled as a result of the March 2002 evaluation. The 48 components were either addressed by previously scheduled refueling outage 11 (March/April 2002) inspection/work activities or were walked down by Engineering personnel during the refueling outage. No major problems were identified.

Alloy 600 Program

The Alloy 600 Program has evolved based on industry experience concerning Primary Water Stress Corrosion Cracking (PWSCC) of inconel 600 nozzles and is documented in the "W3 SES Alloy 600 Program Plan." The Alloy 600 Program Plan is the responsibility of the Design Engineering Department and provides inspection guidelines and general repair plans for inconel 600 nozzles that are found leaking. The program plan specifies specific group responsibilities and complies with Combustion Engineering Owners Group (CEOG) and Electric Power Research Institute (EPRI) Materials Reliability Program (MRP) guidance. This program plan specifies a detailed bare metal visual inspection and schedule for the nozzle to vessel/pipe interface for signs of boric acid leakage from reactor vessel head penetrations, pressurizer penetrations, RCS hot and cold leg penetrations, and steam generator penetrations where inconel 600 nozzles are utilized. (Nozzles repaired utilizing less susceptible inconel 690 are not required to be reinspected during subsequent outages.) Scaffolding is erected as necessary and insulation is removed to facilitate these visual inspections due to the small amount of leakage typical of Alloy 600 cracking.

Inspection of the reactor vessel head penetrations are controlled by procedure QAP-410, "Reactor Vessel Head VT Examination (Alloy 600)" and are performed by VT-2 certified examiners. Any boric acid leakage detected by these inspections is documented and the information is forwarded to Engineering for evaluation and corrective action. The Maintenance Action Item (MAI) system is used to track required repairs and follow-up actions. Condition Reports are generated and License Event Reports (LERs) are submitted to document RCS pressure boundary leakage. Reactor vessel head penetrations were inspected (bare metal effective visual in accordance with Bulletin 2001-01) during the recently completed refueling outage and no leakage was identified. Future reactor vessel head penetration inspection schedules and techniques will be determined based on industry experience and NRC/industry guidance.

Experienced Engineering personnel perform the visual inspections of the nozzles on the pressurizer, hot legs, cold legs, and steam generators. In accordance with the Alloy 600 Program Plan,

- the pressurizer and hot leg nozzles (inconel 600) are inspected each refueling outage.
- the cold leg and steam generator nozzles are inspected on a staggered basis with at least half being inspected during each refueling outage because they operate at a lower temperature and are therefore less susceptible to PWSCC. If leakage is identified the inspection is expanded to include all nozzles.

Any boric acid leakage detected by these inspections is documented and the information is forwarded to Engineering for evaluation and corrective action. The MAI system is used to track required repairs and follow-up actions. Condition Reports are generated and LERs are submitted to document RCS pressure boundary leakage. No leakage was identified during the recently completed refueling outage.

ASME Section XI Inservice Inspection

The Waterford 3 ASME Section XI Inservice Inspection program is the responsibility of Central Engineering Programs and is contained in CEP-ISI-001, "Waterford 3 Steam Electric Station Inservice Inspection Plan." The program is currently in the second period of the second 10-year interval. It includes the examination of welds, rigid restraints and pressure boundaries of components and piping on Class 1, 2 and 3 systems. CEP-ISI-001 contains the Class 1, 2 and 3 lines that require examination and the specific welds and rigid restraints that have been selected for examination during the 10-year interval. The weld and rigid restraint examinations are performed during the specified periods in CEP-ISI-001 in accordance with the applicable non-destructive examination procedures.

Class 1 piping (e.g. RCS piping) is pressure tested each refueling outage. The RCS pressure test examination requirements are contained in CEP-PT-001, ASME Section XI, Division 1 System Pressure Testing." The ASME Section XI system pressure testing is implemented at Waterford 3 through NOECP-253, "ASME Section XI Periodic System Pressure Testing" and NDE-10.02, "VT-2 Inspections." NOECP-253 contains required plant conditions and lineups to perform the system pressure tests on specific line numbers. The tests are separated by their frequency and method of performance (during existing surveillances, normal plant operations, specific requirements, during shutdowns or startups). Quality Assurance/NDE implements the tests specified in NOECP-253 and uses NDE-10.02 to perform the VT-2 examination.

The system pressure tests that are performed for the ASME Section XI program are done to verify there is no through wall pressure boundary leakage. NDE-10.02 contains the acceptance criteria and examination guidelines for performing VT-2 exams. For the RCS pressure test, leakage is evident either through the presence of liquid or boric acid deposits on nearby equipment, under the piping, or at low points in insulation and piping. Additionally, NDE-10.02 specifies the following:

- If boric acid residues are detected on components during a system pressure test, the leakage source and the areas of general corrosion must be located. Components (leaked on during the pressure test) with local areas of general corrosion that reduce the wall thickness by more than 10% must be evaluated by site Engineering to determine whether the component may be acceptable for continued service, or whether repair or replacement is required.

- Results of visual examination are recorded on the visual examination report or similar report as appropriate to the type of examination.
- The report is marked as unacceptable if any leakage is detected and the source, location and amount of any leakage detected is recorded and itemize on the VT-2 examination report.
- All unacceptable conditions reported by VT-2 examiner must be evaluated for corrective measures by Engineering.
- Unacceptable conditions evaluated as nonconforming by Engineering are documented on a Condition Report or other nonconformance document(s).
- Reports documenting unsatisfactory conditions are reviewed by the VT Level III to ensure items requiring actions or follow-up are identified and documented.

ASME Section XI requires insulation removal at bolted connections and a VT-2 examination at normal operating pressure. Entergy implements alternative requirements approved by the NRC allowing bolted connections in systems borated for the purpose of controlling reactivity be screened for susceptibility for boric acid corrosion based on the following criteria:

- <10% chromium
- 17-4PH or 410 SS studs or bolts aged at <1100 °F or with hardness above RC30, or
- A-286 SS studs or bolts with a pre-load >100ksi.

All bolted connections (susceptible and non susceptible) are inspected during the periodic system pressure tests in accordance with ASME Section XI, with insulation in-place, each refueling outage for Class 1 or once each period for Class 2 or 3 components along with the balance of the piping. Additionally, bolted connections determined to be susceptible have a VT-2 examination performed with the insulation removed once each refueling outage for Class 1 or once each period for Class 2 or 3 components with no hold time or pressure/temperature requirements.

As indicated above, the Class 1 RCS system is pressure tested at the end of eachrefuel outage during Mode 3 or 4 with the system at normal operating pressure and at least one charging pump inservice. The specific Class 1 bolted connections examined every refueling outage are the reactor head, pressurizer manway, steam generator #1 and #2 manways, and valves RC-317A(B), SI-304A(B), SI-401A(B), SI-404A(B), and SI-405A(B). Reactor vessel head weld and piping weld exams are spaced throughout the 10-year interval as specified in CEP-ISI-001.

Protective Coating Inspection Program

Procedure NOECP-451, "Conducting Engineering Inspection of Reactor Containment Building Protective Coatings," provides the controls for inspections of the protective coatings on the containment vessel liner plates, dome, and structural steel in containment. The Design Engineering – Civil Group, controls these inspections. Inspections of the protective coatings on the containment vessel liner plates, dome, and 10 percent of the structural steel in containment are performed every refuel outage. These inspections focus on finding protective coatings that has blistered or peeled or show indications of rust. However, while not explicitly performed to identify boric acid deposits, this program would document any boric acid deposits found on inspected components and initiate appropriate corrective actions via MAIs or condition reports thus providing additional assurance that boric acid leaks would be identified.

Reactor Coolant System Unidentified Leakage Monitoring

Technical Specification 3.4.5.2, "Operational Leakage," requires that unidentified RCS leakage be limited to one gallon per minute (GPM). Operations determines the unidentified RCS leak rate in accordance with Technical Specification surveillance requirements at least once per 72 hours while in Modes 1, 2, 3, and 4. This is done by performing an RCS inventory balance in accordance with OP-903-024, "Reactor Coolant System Water Inventory Balance." Operations and the RCS System Engineer trend unidentified leakage throughout the operating cycle, monitoring it for adverse trends or unexpected step changes. If either is noted, appropriate corrective actions are initiated thus providing additional assurance that boric acid leaks would be identified.

Confirming Actions that Show Adequacy of Boric Acid Program

The Waterford 3 Boric Acid Corrosion Prevention Program was implemented following the issuance of GL 88-05 and an Alloy 600 program was initiated when industry experience indicated the need for such a program. Both programs have matured as additional industry experience has been obtained to ensure that the programs continue to be effective. When boric acid leaks are identified Entergy documents and corrects the conditions through the 10CFR50, Appendix B corrective action program. In addition, leaks that result in pressure boundary degradation are reported to the NRC under 10CFR50.72/73 as applicable. Specifically, small RCS leaks, typical of Alloy 600 cracking, have been identified and corrected as reported to the NRC via LERs 1999-002-00 and 2000-011-00. Additionally, small leakage (one drop per two minutes) from a cracked weld in the charging system was reported to the NRC via LER 2000-003-00. These LERs demonstrate that very small boric acid leaks are effectively identified at Waterford 3. Seventeen condition reports initiated since 1999 document boric acid leaks at Waterford 3. Many of these condition reports were initiated as a result of the programs discussed above and are indicative of the effectiveness of the Waterford 3 Boric Acid Corrosion Prevention Program. Finally, there has not been a forced unit shutdown of Waterford 3 due to excessive unidentified leakage, resulting from boric acid corrosion, since 1992 (LERs 1992-002-00 & 1992-006-00) thus the current programs are effectively identifying and addressing boric acid conditions that impact systems, structures and components.

Conclusion

Entergy has a number of programs in place at Waterford 3 to ensure that boric acid leaks and any related wastage is detected, appropriately evaluated, and, when necessary, repaired. These programs include the Generic Letter 88-05 Boric Acid Corrosion Prevention Program, the Alloy 600 Program, the Inservice Inspection Program, and the Protective Coating Inspection Program. Entergy believes that these programs are effectively identifying boric acid leakage and associated corrosion at Waterford 3 and therefore provides reasonable assurance that applicable regulatory requirements are satisfied.