This policy also states "that Davis-Besse will be a learning organization. We must learn from events, conditions, evaluations, and trends. The learning should then be used to improve processes and programs. Experience and results should be publicized to other parts of the organization so that they, too, can learn. Learning from oneself and learning from others is necessary for a competitive, continually learning organization."

Similar provisions are contained in the FENOC Quality Assurance Program Manual (QAPM), Revision 2, dated 1/3/02, which includes the following statements:

- The requirements and commitments contained in the QAPM are mandatory and must be implemented, enforced, and adhered to by all individuals and organizations.
- Management at all levels encourages the identification of conditions that are adverse to quality.
- A corrective action program is established and implemented that includes prompt identification, documentation, significance evaluation, and correction of conditions adverse to quality.
- Reports of conditions that are adverse to quality are analyzed to identify trends in quality performance. Significant conditions adverse to quality and significant trends are reported to the appropriate level of management.

In addition to these policies on the corrective action process as a whole, Davis-Besse has also had a policy on root cause analysis. The policy statement entitled *Root Cause Analysis* dated 10/98 provides the following guidance for conducting root cause investigations, analyses, and determinations:

- The policy endorses the use of INPO Good Practice 90-004, Root Cause Analysis, as the methodology for conducting root cause analysis at Davis-Besse.
- "When conducting root cause analysis of complex and significant events, it is expected that the investigation be conducted by personnel who have no direct involvement in the event. Further, for such events, the investigation leader should be a senior, experienced member of management to ensure necessary resources are made available and the necessary effort is put forth into the investigation."
- "Personnel anticipated to perform analysis of complex events on a request basis should be trained in Management Oversight Risk Tree Analysis (MORT) or Human Performance Enhancement System (HPES) analysis."
- "Management of the area in which the event occurred should take the responsibility to initiate root cause analysis. Timely initiation of root cause analysis report should be predicated on thorough completion of analysis of the data."

In summary, the Team concludes that adequate policies had been established for finding and fixing problems.

In addition, the Team reviewed the current guidelines for the corrective action program and the corrective action procedure that was issued in 2000. The Team used a Change Analysis to compare the guidelines and procedures against the elements of a model corrective action program. The Team concluded that, although the program contained marginal elements, it was adequate for a base corrective action program in prescribing instructions for corrective action activities.

However, as discussed below, even though policy, procedures, and guidelines had been established and were adequate for finding and fixing problems, personnel at all levels of the organization did not effectively implement the corrective action process. This resulted in missed opportunities to identify the nuclear safety impact of the boric acid corrosion to the RPV head from 1996 to 2002. The Team concludes that if the Corrective Action Program had been stronger and reflected the state-of-the art, it might have avoided or compensated for some of the problems with the ineffective implementation. (Contributing Cause 6.2.2)

Identification and Categorization of Adverse Conditions

The Team evaluated corrective action documentation from 1996 to 2002 to determine whether Davis-Besse had identified and documented the nonconforming conditions involving the boric acid on the RPV head and other boric acid related issues. Based upon the following facts, the Team concludes that in general these conditions were adequately identified:

- Boric acid accumulation on the RPV head was identified during each refueling outage from 10RFO to 13RFO and was documented on PCAQR 96-0551, PCQAR 98-0767, CR 00-0782, CR 00-1037, CR 02-0685, and CR 02-0846.
- Boric acid accumulation in the CACs was repeatedly identified from 1999 to 2001 and was documented on various corrective action documents, such as PCAQR 98-1980.
- Boric acid clogging of the radiation monitor filters was repeatedly identified from 1999 to 2001 and documented on various corrective action documents, including CR 99-0882, CR 99-0928, and CR 99-1300.
- Boric acid corrosion and other problems with the RC-2 Pressurizer Spray Valve were documented on at least 14 corrective action documents, including PCAQR 98-0915, PCAQR 98-1885, and CR 99-0738. Furthermore, CR 98-0020 was initiated to report a lack of comprehensive actions relative to resolving the management issues associated with this work.

Although adverse conditions involving boric acid were in general identified and documented, the categorization of the adverse conditions, and the selection of the level of evaluation for those conditions, allowed the use of superficial cause analysis techniques. (Root Cause 6.1.2.b) For example:

- Boric acid accumulation on the RPV head was designated for an apparent cause evaluation on PCAQR 96-0551, PCQAR 98-0767, CR 00-0782, CR 00-1037, CR 02-0685, and CR 02-0846. PCAQR 96-0551 was initially designated for a root cause analysis. However, more than two years later on 11/2/98, the Plant Engineering Manager approved a downgrading of PCAQR 96-0551 to an apparent cause evaluation noting "an apparent cause analysis will more than support efforts to prevent recurrence." This downgrading occurred despite the fact that recurrence of boric acid deposition on the RPV head had already been documented on PCAQR 98-0767 on 4/25/98. Similarly, PCAQR 98-0767, CR 00-782, CR 00-1047, CR 02-0685, and CR 02-0846 were all considered to be routine and designated for an apparent cause evaluation without corrective action to prevent recurrence (CATPR), even though the conditions represented repeat events and should have been classified as more significant under the Corrective Action Program.

- PCAQR 1998-0649 designated boric acid leakage from the CRDM flanges for an apparent cause evaluation without CATPR, even though this was the second occasion in which the replacement gaskets for the flanges had experienced leakage.
- Boric acid clogging of the radiation monitor filters was designated for an apparent cause evaluation without CATPR on CR 99-0882 and CR 99-0928 and was not classified as an apparent cause evaluation with CATPR until issuance of CR 99-1300.
- PCAQR 1998-1885 on the RC-2 valve was assigned a Category 1 classification, requiring a root cause analysis. However, this occurred only after six PCAQRs had been issued during the previous five months on this same component before this categorization.

Additionally, during interviews, several of the managers acknowledged that adverse conditions are categorized and dispositioned as relatively low.

As discussed below, this low level of evaluation contributed to leaving boric acid on the RPV head and an improper diagnosis of the containment atmospheric conditions.

<u>*Determination of Causes for Adverse Conditions*</u>

The Team evaluated the determination of causes for the adverse conditions associated with the RPV head and other boric acid issues.

The response to PCAQR 96-0551, which documented boric acid left on the RPV head in 10RFO in April of 1996, exemplifies the ineffective cause determinations related to the boric acid on the RPV head.

- The RCS design engineer who performed the inspection of the RPV head and initiated the PCAQR stated that "the condition of the area from which boron could not be removed is not known." He stated that "since the boric acid deposits are not cleaned it is difficult to distinguish whether the deposits occurred because of the leaking flanges or the leaking CRDM [nozzles]." He also noted in evaluating the potential for damage to the RPV head from leaking CRDM flanges that "this type of leakage damage is extremely difficult to measure because area of interest can not easily be inspected." Despite these statements, the RPV head was not completely cleaned and inspected for damage or leakage from the CRDM nozzles.
- The station relied upon an engineering justification, which concluded that the boric acid would result in negligible corrosion rates because the temperature of the RPV head was greater than 550 °F. This evaluation of the potential for damage was inaccurate, as discussed in the Technical Root Cause Analysis Report.
- Finally, although this PCAQR was designated for a root cause analysis, the PCAQR was downgraded and closed more than two years later without an approved root cause analysis, without determining whether the CRDM nozzles were leaking or the RPV head was corroding, and without any corrective action or action to prevent recurrence.

With respect to the clogging of the radiation monitor filters, the station made several attempts to identify the source of the clogging. In particular, CR 99-1300 was issued for recurring radiation monitor filter clogging, and was assigned apparent cause with corrective actions to prevent recurrence. Evaluations of the iron oxide on the filters were performed by contractors, but the contractor's conclusions were not utilized by the station. Additionally, the station used thermography and listening devices, which were not able to locate the source of the leak. In the end, none of the actions taken by the station were effective in identifying the source of the leak.

Additionally, although the initial CR on RC-2 valve leakage was issued on 5/20/98, a root cause for the problems with the RC-2 packing was not initiated until PCAQR 98-1885 was issued on 10/16/98. Packing issues were re-identified on RC-2 valve in 12RFO. CR 2000-1001 was written on the RC-2 valve to identify the cause of the packing issues. This resulted in the third root cause analysis for the RC-2 valve, which indicates the ineffectiveness of previous root cause evaluations and preventive actions.

Similarly, Davis-Besse initiated several efforts to identify the cause of the increase in the unidentified RCS leakage, all which were not effective. Finally, the station was not effective in identifying the source of boric acid leakage that lead to the accumulation of boric acid in the CACs.

These failures appear to be symptomatic of a larger problem with cause determinations. For example:

- Quality Assessment issued SR-98-MAINT-07 on 1/19/99 documenting weaknesses in recognition and oversight of collective significance issues and a need for guidance to emphasize management's responsibility for properly recognizing, documenting, and escalating issues and assuring timely corrective actions.
- NQA issued audit AR-01-REGAF-01 on 12/26/01 and stated that "collective significance CRs are not apparently categorized consistently either by category or by evaluation method." It also noted that only three of 32 collective significance reviews received some type of formal documented analysis, and that plant personnel have not been trained in any approach to the evaluation of collective significance problems. This report also identifies that the evaluation for basic and root causes were marginal and appeared to represent poor ownership. NQA recommended use and documentation of formal analytical method for all root and basic cause evaluations.

The Team concludes that the cause determinations for identified problems associated with the degradation of the RPV head and other boric acid issues were less than adequate dating back to at least 1996. This hampered the organization's ability to evaluate the potential for damage to the RPV head. (Root Causes 6.1.2.a and 6.1.2.c) Furthermore, condition reports associated with this review tended to stay unresolved until significant degradation occurred. (Observation 6.3.5)

Corrective Actions

The Team evaluated the adequacy of corrective actions for issues related to boric acid. As a result of this review, the Team identified a number of problems related to the adequacy of corrective actions.

The Team found that on a number of occasions, the plant was restarted without taking corrective action for identified boric acid problems. For example, the plant was restarted in 10RFO, 11RFO, and 12RFO without fully removing the boric acid from the RPV head. Additionally, the plant was restarted from 11RFO with known RC-2 leakage (PCAQR 98-1130) and known CRDM flange leakage (PCAQR 98-0649).

In other cases, corrective action was not taken for identified adverse conditions including boric acid. For example, Engineering and ISEG personnel issued seven extension requests for PCAQR 96-0551. The PCAQR remained open for 2 years and 9 months, and was closed without taking the designated corrective action (e.g., installing access ports in the service structure for the RPV head). Additionally, CR 99-0738 was issued to identify the need to change out RCS valve yokes after RC38 yoke was identified with boric acid corrosion. As documented in CR 02-01449, plans to address these valves in 12RFO and 13RFO were not properly executed. In still another case, CR 00-4138 documented an increase frequency of cleaning of deposits of boric acid in the Containment Air Cooler (CAC) to an interval of once every 8 weeks. The CR assumed that the source of the boric acid deposits was a RCS leak, but stated that "we cannot stop the source of the deposits at this time." Therefore, the corrective actions were aimed at reducing the radiation dose from the cleanings rather than fixing the leak and eliminating the need to clean the CACs. Similarly, CR 01-0039 was issued for a step drop in CAC plenum pressure due to an increase in boric acid in the containment atmosphere. This CR speculated that the cause was a boron ball that had fallen from a component "instead of building up on the component." This CR was closed without taking action to identify the component or eliminate the buildup of boric acid.

The Team identified other cases in which corrective action documents were closed by means of reference to actions specified in other documents that were still open, but the referenced action was never taken. For example, PCAQR 98-0767, which identified boric acid on the RPV head during 11RFO, was closed by reference to the still open PCAQR 96-0551 which identified boric acid on the RPV head during 10RFO. However, PCAQR 96-0551 was later closed without taking corrective action to remove all of the boric acid from the RPV head. Additionally, a mode 4 restraint was tied to CR 00-1037, which documented boric acid on the RPV head during 12RFO. This mode restraint was closed to an open work order to remove the boric acid from the head, but the cleaning work defined in the work order was not completed in full in that boric acid was left on the RPV head.

In other cases, the corrective action was not effective in correcting the boric acid problems. For example, in 10RFO, 11RFO, and 12RFO, the station attempted to clean boric acid from the RPV head, but not all of the boric acid was removed. CR 00-1037 states that during 12RFO the "accumulated boron deposited between the reactor head and the thermal insulation was removed during the cleaning process" and that "no boric acid induced damage to the head surface was noted during the subsequent inspection." In fact, the cleaning was not fully successful, some boric acid was left on the head, and those areas of the head could not be inspected for damage. During interviews, some management personnel at Davis-Besse indicated that at the time they were not aware that boric acid had been left on the RPV head, and an evaluation was not performed to determine the acceptability of leaving boric acid on the head.

There were other problems with the effectiveness of corrective action. For example, PCAQR 98-0915 on 5/5/98 documented corrosion of the RC-2 Pressurizer Spray Valve yoke, and PCAQR 98-1130 was issued on 5/20/98 to initiate an evaluation of the RC-2 packing leak by plant engineering per the boric acid corrosion program. PCAQR 98-1885 was issued to correct this condition, but the corrective actions were not effective. Additionally, CR 98-0020 provided for a root cause evaluation of management issues on the RC-2 event, and actions were taken to prevent recurrence. However, the preventive actions for the RC-2 event were not effective in resolving the condition with the boric acid on the RPV head during 12RFO, and many of the causes identified in the root cause evaluation for the RC-2 event were similar to those identified by an NQA *Examination of Five Closed Nonconformances Related to the Reactor Pressure Vessel Head* on June 13, 2002, and this Report (indicating that the preventive actions for the RC-2 event were not effective in eliminating the root causes of the event).

These problems with the adequacy of the designation and implementation of corrective action were also reflected in other material considered by the Team. For example, the following excerpts from interviews were indicative of the perceptions of station personnel with respect to corrective action:

- All condition reports are emergent, but no one has staff to address them, the attitude is 'just get rid of them.'
- Tell engineers to justify operability and accept deficiencies.
- What we have is a lot of long standing issues.
- Site culture was apathetic. The same people do the same stuff wrong over and over.
- The culture was to analyze everything away.
- We do not do a good job following issues to completion. The hot issues get the attention and others end up getting dropped.

Similarly, other evaluations have identified problems with corrective actions. For example, QA audit AR-99-CORAC-01 in 1999 noted that management was not ensuring corrective actions were implemented in a timely manner and that due dates were being extended with minimal evaluation of the negative ramifications. Similarly, the Condition Report Process owner issued CR 01-2028 on 8/8/01 noting a recurrence of CRs documenting late CR evaluations and corrective actions. Additionally, the January 1998 WANO Peer Review noted: "Minor materiel condition deficiencies are being overlooked because an environment has been established to accept these type of deficiencies."

Based upon the above, the Team concludes that corrective actions assigned and implemented from 1996 to 2002 failed to find and fix the leaks that caused extensive damage to the RPV head and other components. (Root Cause 6.1.2.d)

Recurring Problems and Trending

The Team first evaluated the adequacy of Davis-Besse's policies and procedures on trending of equipment problems. The Team found that Davis-Besse's corrective action policies contained adequate provisions for trending of problems. For example, the *Corrective Action* policy statement, dated 10/98, states that Davis-Besse will effectively analyze identified problems, including determination of trends and use of objective, accurate, and complete trend data so that sound decisions can be made. This policy also states "that Davis-Besse will be a learning organization" and must learn from trends to improve processes and programs. Similarly, the FENOC QA Program Manual, Revision 2, 1/3/02 states that reports of conditions that are adverse to quality are analyzed to identify trends in quality performance. In contrast, the Team determined that the procedural provisions of trending were not adequate. For example, NQA audit report AR-00-CORAC-01 notes that Davis-Besse's trending procedure did not describe a comprehensive vision for trending and analysis, and that expected outputs were not defined and basic requirements and expectations for reporting of trending data were not provided. It also noted that the process was not set up to detect long-term generic problems using historical data, CR coding data, and cause analysis input.

The Team also evaluated the adequacy of actions to identify and correct adverse trends with respect to problems associated with boric acid. The Team found that recurring problems with respect to boric acid issues either were not documented as an adverse trend and/or that the causes of the recurring problems were not identified and corrected. For example:

- As noted in CR 00-0782, CRDM flange leakage was an on-going deficiency since 1980. In particular, in every refueling outage from 7RFO through 12RFO, CRDM flange leakage was identified. Although Davis-Besse replaced the original gaskets for the flanges over a period of years, some of the replacement gaskets also leaked. It was not until 13RFO that no leaking flanges existed.
- As mentioned above, boric acid was left on the RPV head in 10RFO, 11RFO, and 12RFO, but these conditions were not identified as an adverse trend and the collective impact of these conditions was not evaluated.
- CR 00-1547 identified an adverse trend involving a drop in plenum pressure for the Containment Air Coolers due to boric acid coating the cooling coils. The CR was designated as "routine" and the apparent cause was identified as probably being boric acid residue from 12RFO. The remedial action for the CR was cleaning of the coils, without any action to prevent recurrence. Similarly, CR 02-2943 identified 13 previous CRs relative to boric acid on the CACs after the head degradation was found. No previous high level CR was identified or processed for the adverse trend involving the CAC cleaning.
- As discussed above, unidentified RCS leakage continued to increase from 1999 through 2001, and there was frequent clogging of the radiation monitor filters during this same period. Davis-Besse did not identify and correct the cause of these problems.
- There were repeat events with Reactor Coolant Pump (RCP) flange and gasket leakage from 1996 through 2002 (e.g., PCAQR 96-0650, DB-OP-06900, CR 2000-0699, CR 2000-0869).
- PCAQR 98-1885 Root Cause Report states that RC-2 Pressurizer Spray Valve packing leakage resulted in 20 work orders in 22 years. Packing errors recurred in 2000 on RC-2.

Additionally, during this same time period, other groups identified generic concerns with respect to the trending program and evaluation of the collective significance of problems at Davis-Besse. For example:

- Quality Assessment issued SR-98-MAINT-07 on 1/19/99 documenting weaknesses in recognition and oversight of collective significance issues.
- CR 99-1765 documented that the Corrective Action Tracking System (CATS) database was not useful for equipment reliability trending.
- CR 99-2249 documented the absence of a working trending program, stating that "only the most obvious trends are discussed."
- NQA audit report AR-99-CORAC-01 documented that quality trending was not being completed and that a quality trend summary had not been completed in nearly two years. This report also noted that about 80% condition reports reviewed in the audit contained coding errors.
- Similar findings were made the next year in NQA audit report AR-00-CORAC-01. This report states that the area of trending was marginal, with no adverse quality trends identified

in the previous two years. This report also notes that about 80% of the 200 condition reports reviewed in the audit contained coding errors.

- In interviews, the Condition Report Process owner noted that trending capabilities between outages does not exist. Therefore trending of issues that only arise during outages is not provided.
- The Team evaluated over 30 collective significance reviews conducted at Davis-Besse since the beginning of 2001. Of these, only one was related to equipment issues.
- NQA audit report AR-01-REGAF-01, issued on 12/26/01, noted that only three of 32 collective significance reviews received some type of formal documented analysis. It also noted that plant personnel have not been trained in any approach to the evaluation of collective significance problems.
- The root cause for CR 01-1934 identified that Davis-Besse did not have effective equipment trending and contained a corrective action stating that the plant should develop an equipment trending process. In response, the Condition Report Process owner noted than an enhanced equipment trend capability was not necessary for the CR database (CREST) due to the current trending capabilities of the program.

In summary, the Team concludes that equipment and materiel trending failed to identify and correct recurring failures, equipment degradation, and performance issues. (Root Cause 6.1.2.e)

Operation's Involvement

Throughout this investigation, the Team expected to encounter information that would indicate the level of influence that Plant Operators had in attempting to resolve the plant conditions that were linked to the RPV head damage. Instead, except for the pursuit of the RCS unidentified leak rate by the Plant Manager, the Team found that they were largely not visible. (Observation 6.3.9)

The Team examined the Control Room's assessment of conditions identified in CRs and PCAQRs, along with information from several interviews. From these, the Team observed that Operations did not take an active role in advocating actions to improve the condition of the plant. The Team's review of Condition Reports clearly demonstrated a tendency by Operations, to underestimate the impact of reported problems on equipment health and operability. Their collective treatment of the issues suggests that the resolution of the problems was viewed as purely an engineering responsibility.

The Team did not undertake the task of specifically determining why this lack of involvement occurred. However, interviews with several Operations personnel reflect a perspective found in many interviews of the staff. This is that personnel identified or stated concerns in varying degrees, but would nonetheless perform their duties under the assumption that someone else was responsible to see that issues were resolved.

5.3.3.3.2 Independent Oversight Organizations

The Team initially intended to perform a MORT analysis of the independent oversight activities performed by Quality Assurance (QA) and Company Nuclear Review Board (CNRB) related to PWSCC of the CRDM nozzles and boric acid corrosion. However, as the investigation proceeded, the Team determined that there is a relatively small number of relevant facts that pertain to QA and the CNRB. Given the relative paucity of facts in this area, the Team determined that a MORT analysis of this area would not be meaningful. As a result, the Team is only providing observations regarding the activities of these groups. However, the Team also notes that FENOC has already initiated assessments of QA and the CNRB.

Quality Assurance

The Team identified surveillances and audits performed by QA related to boric acid control.

- On 1/19/99, the QA Manager issued Surveillance Report SR-98-MAINT-07. The QA surveillance included a review of the investigation and resolutions of issues identified during the work on the RC-2 valve. The surveillance concluded the initial response, corrective actions, and management attention to RC-2 issues were inadequate. QA found that when adequate resolutions were not obtained, no other organization(s) stepped up to provide additional assistance and appeared to take a hands-off approach. Furthermore, QA found that when senior management directives were given as assignments, there was confusion among organizations as to what responsibilities they had incurred. However, QA did conclude that the Boric Acid Corrosion Control Procedure NG-EN-00324, met the intent of Generic Letter 88-05. The Team concludes that this surveillance was intrusive and reflected an appropriate evaluation by QA.

- Quality Assessment Audit Report (AR-00-OUTAG-01) was issued on 7-7-00. This audit was performed to assess the effectiveness of various program activities during 12RFO. Engineering was rated as having satisfactory performance and was noted to have several positive attributes, including aggressive cleaning of boric acid accumulation from the reactor head. Additionally, QA determined that Engineering displayed noteworthy persistence in ensuring that the boric acid accumulation was thoroughly cleaned from the reactor head. Given the fact that not all of the boric acid was cleaned from the RPV head during 12RFO and that corrosion of the head was occurring during this time frame, the Team concludes that QA's findings were inconsistent with the facts.

Overall, the Team observes that there was little evidence of QA's involvement in this area, and the documented findings by QA were of mixed quality. (Observation 6.3.6) There are signs that the organization was not effective in identifying problems. However, the Team decided not to pursue the issue further because the identification of problems in this area is not likely to be connected with the root cause of the event, and the Vice President of the FENOC Oversight and Process Improvement Department has initiated an independent root cause investigation that addresses "Failure in QA Oversight to Prevent Significant Degradation of Reactor Pressure Vessel Head (CR 02-02578)".

Company Nuclear Review Board

The Team examined the minutes from the CNRB meetings related to boric acid control.

- On 10/16/96, CNRB Meeting #257 Minutes from 5/22/96 were issued. There was only one area that discussed boric acid, and that discussion pertained to the "significant" amounts of boron located on several casing studs of the Reactor Coolant Pump (RCP) 1-1. It was mentioned that these studs were removed and inspected for degradation, several had to be replaced, and the other three RCPs were inspected and some minor leakage was noted on the RCP 1-2 pump. There was no discussion of the boric acid program.

- The minutes from the 1/7/99 CNRB (Main Committee) Meeting included a discussion by the Engineering & Licensing Subcommittee regarding RC-2 issues, including the sequence of events, major corrective actions, and planned actions. The meeting minutes captured limited discussion on the RC-2 issues and no discussion of the Boric Acid Corrosion Control Program. Additionally, there was some discussion of the frequent cleaning efforts of the CACs. The minutes state that boric acid was plating out on the CACs, which decreased their efficiency and that containment entries were required about every ten days to clean the coolers.

- The meeting minutes from the 7/22/99 CNRB Main Committee Meeting indicate that the committee chairman reviewed two industry situations where management failed to recognize the need for a safety evaluation and let schedule or goal pressures force poor decisions to proceed with work. He cautioned management to be leery of situations that might cause decisions to be driven by goals or schedules and to be knowledgeable of the requirements for doing safety evaluations. Additionally, discussions were held about RCS leakage and problems encountered with the radiation monitors that required filter changes every 36 to 48 hours, and it was stated that an investigation was proceeding on this issue. It also stated that that iron was found on the filters and that Southwest Research has been contacted to investigate this matter. The CNRB committee members questioned if thermography had been used to identify the source of the RCS leakage, and the response indicated that thermography had been used as well as "listening devices." The subcommittee was also updated on continuing plant problems in the areas of RCS leakage, radiation monitors, and Containment Air Coolers/containment temperatures.

The Team concluded that there was not enough factual information gathered during this phase of the analysis to develop a conclusion addressing CNRB. However, the Team observes that no documented information was found that would indicate that the CNRB had been effective in raising the station's awareness regarding degrading plant conditions. The Team determined that further analysis in this area was not warranted as part of this root cause analysis, because CNRB does not typically perform independent inspections to identify problems but instead acts to review problems identified by others. Therefore, insight from CNRB may have helped elevate boric acid leakage as a greater concern, but is unlikely to have identified or prevented the corrosion. Additionally, FENOC has initiated a review of the adequacy of the CNRB.

5.3.3.4 Task Performance Errors

In a typical MORT analysis, task performance errors are analyzed from the perspective of individual errors. In the case of the degradation to the RPV head at Davis-Besse, this approach was modified, in that the errors of importance were the failure to recognize the significance of key plant symptoms, and the organization thereby missed the opportunity to identify the corrosion over time. Initially four errors were considered for evaluation, but during the investigation a fifth was added (related to RCS Unidentified Lead Rate). The five organizational-level errors examined were:

- the failure to recognize the significance of the boron accumulating and left on the RPV head
- the failure to recognize the significance of the boron and iron oxide plugging of containment radiation monitor filter elements
- the failure to recognize the significance of the increasing frequency of Containment Air Cooler fouling with boric acid
- the failure to effectively determine and correct the source(s) of leakage from the RCS
- the ineffectiveness of the corrective actions taken in response to the RC-2 event in 1998, as they related to identifying the importance of brown boric acid deposits

As the Team began to utilize the specific areas of the Task Performance Error Section of MORT, it soon became clear that a slightly different approach would be more effective. A clear pattern of similar organizational response to the plant conditions described above became apparent. The Team then decided to examine the RC-2 event from the perspective of how the organization responded to its problems, prior to it becoming an event.

As the work continued, the Team found that the information needed to answer the questions under Task Performance Errors was already being collected throughout other sections of MORT. For example, a great deal of data had been collected under the program and process reviews. Therefore, other existing sections of MORT were fortified with additional facts from these topics. A separate investigation using the specific Task Performance Sections of MORT became unwarranted, in that it would simply re-apply the same knowledge.

The revised approach analyzed the task performance errors within the Management Risk Assessment Section, by drawing from the conclusions of other sections, and adding specific additional data. Section 5.3.3.6 provides the full description of the approach and its conclusions.

The common features of the organizational errors included:

- The conditions were identified on Condition Reports on numerous occasions, but not necessarily every time the condition appeared.
- The assessments of operability and importance of the conditions to safety tended to be underestimated. (Root Cause 6.1.3)
- The categories assigned to the Condition Reports were relatively low, and root cause analyses were not performed. (Root Cause 6.1.2.b)
- The cause analyses were shallow, and focused on managing the symptoms rather than the causes of the identified problems. (Root Causes 6.1.2.a and 6.1.2.c)
- The station tended to defer or re-assign resolution of the problem. (Root Cause 6.1.2.d)
- The collective significance of the errors was not evaluated.
- Senior management oversight of resolution of conditions (except for the RCS Unidentified Leak Rate) was not visible. (Root Cause 6.1.2.e)

5.3.3.5 Corporate/Management Goals

This portion of the MORT analysis examines Management Policy. The Team examined the treatment of safety (industrial and nuclear) in Davis-Besse policy documents. It also considered management incentives and management presence and involvement in the field. The Team concludes that neither safety policy or compensation incentives were causal factors in the damage to the RPV head. However, they are important considerations for the future, in that they need to be consistent with the philosophy that nuclear safety is of primary importance.

Davis-Besse Policy Statements on Safety

Davis-Besse has few policy-level documents. In particular, there is no overarching document dedicated to the subject of safety. The Team concludes that the written policies that do exist have been inconsistent and incomplete in their treatment of employee and nuclear safety. As a result, they do not support a safety focus. (Observation 6.3.8)

The following describes the content of the existing policy statements. It should be noted that many of these policies were examined back to the mid-1980s, and they have not changed appreciably over the years.

- The DBNPS Philosophy document provides two pages of philosophy emphasizing value to customers of electricity, employees, management style, communication and corporate citizenship. It makes a basic statement "We are committed to a safe work environment, and the safety of co-workers is the responsibility of each of us." There is no mention of nuclear safety.

- Nuclear Operations Policy, Tech – 12, effective 10/1/98, describes the parameters within which the Davis-Besse Nuclear Power Station is operated. There is no mention of nuclear safety.

- Introduction to the Policy Manual for the Nuclear Power Station, dated 8/14/00, describes nuclear safety as being of "paramount importance" which "imposes rigorous requirements".

- Charter DBOMTO, Davis-Besse Outage Management Team Organization, (12/17/99, rev 00), states that safety has three distinct elements:
  - Personnel safety – "Work to achieve a safety culture where employees accept ownership and personal responsibility for working safely"
  - Nuclear safety – ...a conservative operating philosophy where safe operation of the plant is our foremost priority. This is accomplished by maintaining a constant awareness of shutdown risk issues and protected train philosophy in dealing with any changes to scheduled activities..."
  - ALARA – Maintain ALARA "by ensuring that individuals follow expected radiological practices, and the assumptions used to develop work practices and the schedule are maintained."

While there are additional minor examples that were examined, the conclusion of the Team is that the concept of safety has not been given sufficient prominence or focus in the written policy area.

However, the value of separately written policies in the context of today's operation of Davis-Besse is questionable. In recent years, with the formation of FENOC, policy, in effect, is described and implemented via the published Business Plan, which states that the four areas of importance for the organization, in order, are Safety, People, Reliability, and Cost. Therefore, the continuing existence of older policy formats may not be warranted.

Management Incentives

The Team examined the monetary incentives for Davis-Besse personnel to determine whether the incentives prompt safety. With respect to the management incentives, the Team concludes that the FENOC monetary incentive program rewards production more than safety at senior levels of the organization. This supports misalignment of the organizational priorities, and inhibits the transition of the organization to a safety-first philosophy. (Observation 6.3.7)

For example:

- The Nuclear Vice-Presidents' incentive compensation formula includes a contribution for net income of FirstEnergy Solutions. FirstEnergy Solutions includes all nuclear and fossil generation. Therefore, there is a financial incentive to allow investments to be allocated to plants that will generate the best financial return. This can put fossil and nuclear in competition for funds on a basis that does not necessarily consider the possible impact to nuclear safety at the nuclear plants.

- The Nuclear Incentive Compensation for 2002 provides for incentive compensation for various factors related to safety and production. The percentage attributed to safety decreases as the level in the organization rises. At the plant director level and above, incentive compensation is mostly based on production, but the incentive compensation at lower levels is mostly based on safety.

The percentage value assigned to various goals has changed over time, and the historical value of safety as an incentive was more consistent throughout the organizational levels in the past. For example, in 1997, the Davis-Besse Incentive compensation percentage attributed to safety, although not a majority, was fairly constant from the Vice President down and was about equally based on production and safety.

In the 1996 Davis-Besse Incentive compensation, safety was the highest contributor at all levels of management.

Thus, since at least 1997, the monetary incentive program has rewarded production more than safety at senior levels of the organization.

Management Presence and Involvement

A prevailing opinion in many interviews was that management's physical presence in the field has been minimal. Supporting this belief are the actual logs of containment entries by managers and senior managers which identify relatively few entries into containment by management during 11RFO, with some improvement in 12RFO. When questioned on expectation for management presence in the field, the management interviewees stated that there was a field observation program, but that there were no specific expectations for containment. (Observation 6.3.10)

In interviews with recent top site management, there was no pattern in how they believe important matters should be communicated up and down, and they indicated that problems tend to be solved within silos, and that free and open discussion of potential problems is rare.

The Team could not determine if more involved management would have prevented the damage to the RPV head. However, over the years, some individuals in management made assumptions and drew conclusions regarding the conditions on the RPV head with limited or no direct examination of the head.

5.3.3.6 Risk Assessment System Conclusions

This branch of MORT evaluates the aspects necessary for management to be knowledgeable of risks and to assess risks as part of decision-making. As such, it includes the evaluation of the programs designed to provide management with the information to properly assess risk.

The technical root cause investigation conducted in March and April of 2002 concluded that the Davis-Besse organization failed to identify the corrosion of the reactor head base metal until its discovery during maintenance activities. Since the corrosion of the head was not a known condition, the MORT sections that would evaluate management's acceptance of a known risk were not useful to this investigation. Therefore, the applicable sections of the MORT system were those that evaluate why management did not recognize the development of the conditions and the risk associated with them.

The feeders into the conclusions of this MORT section are the results of other major sections of MORT. The sections on Corporate/Management Goals, Technical Information Systems, Hazards Analysis Process, and Corrective Action Program were combined with important elements of the Task Performance Error Section. Together these sections evaluated the following issues:

- evaluation of the failure to recognize the significance of boric acid on the RPV head
- evaluation of the failure to recognize the significance of the increasing frequency of cleaning of the Containment Air Coolers
- evaluation of the failure to recognize the significance of the plugging of the radiation monitor filters with boric acid and iron oxide
- evaluation of the failure to identify and correct the source of increased RCS leakage as anything other than CRDM flange leakage
- comparison of the organization's performance in identifying and resolving the issues with the RC-2 Pressurizer Spray Valve prior to it becoming an event in 1998

The Team compiled extensive MORT section analyses and supporting factual data to answer two questions:

- Why did management not implement effective programs to have prevented the corrosion to the RPV head?

- Why did management not recognize the significance of the degraded conditions in the containment and address them as potentially significant safety concerns?

The Team concludes that the answer to these two questions, and the overall root cause for why the damage to the RPV went undetected by the organization, is as follows:

Less than Adequate Nuclear Safety Focus - Production focus, established by management, combined with taking minimum actions to meet regulatory requirements, resulted in acceptance of degraded conditions. (Root Cause 6.1.1)

Supporting conclusions are:

- The elements of the programs designed to maintain a conservative safety philosophy degraded at the same time as the effects of the RCS leakage worsened. (Contributing Cause 6.2.1)
- Even though management had sufficient involvement in the industry and knowledge of plant conditions, they failed to recognize the significant nuclear safety concerns being manifested in containment. (Root Cause 6.1.3)
- Management pursued symptoms rather than the identification of the causes. (Root Cause 6.1.2.a)

The facts that support these conclusions come from all of the MORT analyses, along with additional evidence, all of which are summarized below.

- The MORT-Corporate/Management Goals section of this report describes how company policies are inconsistent in their treatment of safety. It also shows that the financial incentives for senior-level positions are heavily influenced by production. (Observations 6.3.8 and 6.3.9)

- The Technical Information Systems section concludes that the structure existed for management to have received the correct information to understand the risks of boric acid. However, key industry and site knowledge was not adequately integrated into programs, nor applied by the organization. (Root Cause 6.1.3)

- Similarly, the Hazards Analysis Process section concludes that the program elements necessary to analyze nuclear safety risks were adequate throughout the timeline of events. Over time, though, the processes/programs that prompt entry into these analyses became less restrictive. (Contributing Cause 6.2.1) This reduced the frequency with which the process was applied, and caused some conditions to go unanalyzed for nuclear safety.

- The pattern of an adequate program but flawed implementation was also exhibited in the conclusions of the evaluation of the Corrective Action Program. Once again, the Team judged the policy and process to be sufficient to have successfully identified the corrosion of the RPV head much earlier. However, all levels of the organization failed to implement the Program effectively. Low categorization, superficial cause analyses, ineffective corrective actions, and inadequate equipment trending all contributed to the outcome. (Root Causes 6.1.2.a, 6.1.2.b, 6.1.2.c, 6.1.2.d, 6.1.2.e, and 6.1.3)

The Team concluded that these failures were fundamentally attributable to a less than adequate nuclear safety focus by management. Numerous interviews indicate that production became a source of pride for the station in the years that overall performance of the station improved (late 1980s into early 1990s). Production is a natural goal of the enterprise, and would not necessarily conflict with safety performance. In fact, the Team concluded that safety was treated with adequate rigor in those years when production improvement was clearly evident. Later in the 1990s, safety focus eroded. Further discussion on this appears later in this section of the report.

Dozens of additional facts were compiled by the Team to support the overall conclusion of this section. Listed below are samplings of the important facts that demonstrate a less than adequate nuclear safety focus.

Focus on Production

- In response to a question if leaks found during walkdowns were left un-repaired, a manager noted: "Yes. Some were justified; we determined we could get them next time. We would be subjected to production pressure."

Only Taking Minimum Actions Needed for Regulatory Compliance

- In the early 1990s, Davis-Besse thought that CRDM cracks and leaks were a European problem and that Davis-Besse did not have them. This issue was never discussed as a compliance issue. If it were a compliance issue, it would have went straight to the top of the pack. (interview with a former Director).
- In responding to PCAQR 94-0295, the Supervisor of System Engineer did not believe performance of nozzle inspection was necessary since a formal regulatory commitment had not been made.
- "There was nothing (in the procedure) requiring boric acid off the head." (interview with a former Director).
- Temporary Modification (TM) 01-0019 was processed in November 2001 to remove the iodine filter cartridge for RE 4597AA Containment Atmosphere Normal Range. It was noted in the associated 50.59 evaluation that the increase of iodine levels in the containment was induced by an increase in RCS leak rate from the recent downpower as well as the effect of known fuel leaks. It also notes the purpose of the radiation monitors is to provide positive indication in the control room of RCS leakage. It was noted that removing the iodine channel would not force the station to enter Technical Specifications and was acceptable.
- The RCS unidentified leak rate had been rising throughout the last operating cycle, but did not lead to decisions to shut down the plant in 2001/2002 because the rate was within technical specification limits. Inspection for possible leak sources was conducted only when the opportunity arose in the brief downpower. As stated in an interview with a site manager: "We weren't at the tech spec limit (for RCS unidentified leakage) and we had taken actions to look for leaks and there were plans to look closer during the next outage. Management was monitoring the status daily and we would have taken any necessary actions prior to reaching tech spec limits. We also had the mindset that CRDM flanges were leaking."

Acceptance of Degraded Conditions

- The iodine cartridges on containment leak detection monitors were plugging so much that they were physically by-passed.

- CR 1999-1300 notes that Temporary Modification 99-0022 installed four portable HEPA filtration units in containment to reduce the particulate concentration (iron oxide/boric acid). This action was taken rather than finding and fixing the source of the RCS leaks.
- The Plant Engineering Manager stated in PCAQR 96-0551 that cleaning of boric acid from the RPV head "as best as we can" was adequate.
- "And I can only speak through 98 timeframe...we locked in on dry boron being okay, therefore I can run under that phenomenon. But I don't know why we were never worried about the nozzle cracking, or if we were worried, it was about circumferential cracking, not wastage..." (interview with former VP).
- In 1998/99, the plant ran for approximately 9 months as the RCS leak rate increased. Shut down did not occur until leak rate achieved 0.8 gpm, and after the Containment Air Coolers had been cleaned 17 times.
- Radiation Protection issued CR 00-4138 on 12/21/00 to document an increased frequency of cleaning boron from the CACs. The CR states: "Since we cannot stop the source of deposits at this time, these corrective actions are aimed at reducing the station dose associated with cleaning the CACs to maintain their function." The CACs were cleaned repeatedly without an operability determination. Then in 13RFO, the CACs were declared inoperable. (CR 02-2943)
- Davis-Besse Cycle 13 Operating History, as provided in the DBNPS Business Plan Monthly Performance Report for April 2002 reports that Secondary Plant Chemistry entered the yellow indicator for performance in June, 2001, and entered the red indicator in September, 2001. By the end of the year the Chemistry Performance Indicator (CPI) was greater than 1.5 (1.00 is desired).

Restarting the Plant with Degraded Conditions

- The plant was restarted in 10RFO, 11RFO, and 12RFO without fully removing the boric acid from the RPV head.
- The plant was restarted from 11RFO with known CRDM flange leakage (PCAQR 98-0649).
- Management decided to start the plant at the end of 11RFO, with unresolved leakage from the RC-2 valve. The plant was later shut down for tornado and restarted, without repair to the valve.
- After the tornado, there was debris in the ditches. Despite the existence of the debris, an operator was told to start Circulation Water. He objected stating that the canal had to be drained first due to the debris. The Shift Supervisor responded to him, stating that "if the VP says we start-up then we start-up." The Circulation Water was started and in less than 10 minutes, a shutdown of the system was needed. Operation had wrecked the screens and damaged an impeller. The plant also had to pull all the water boxes and clean them. (Interview with reactor operator)

The following senior and middle management interviews, from the period of 1996 until just prior to the present, were conducted to gain an understanding of their collective management style. The time period was selected because that was when the head damage occurred and when the associated plant conditions were in evidence. These interviews show a pattern of production focus and managing to minimum regulatory requirements.

Former Site Vice President

- His concept of VP at that time was that a strong plant manager ran the plant and the VP provided support and money and would take care of the corporate side of the operations. He would let the plant manager and the rest of the team run the technical show.
- He stated that the responsibility for consistency in programs and identification of issues starts at the lowest levels of the organization and percolates up – they must continue until they get a legitimate answer.

Former Site Vice President

- In response to how the plant got here, he said that standards were no where near his expectations coming into an INPO 1 plant. He said that there was denial of problems all across the board. Over time, the site developed comfort with its status, and an overall feeling that things were fine.

Former Director

- "There was a discussion at least in the PRC for a modification to cut the holes (in the service structure). It was over ½ million bucks for that MOD. We wanted to do it but it was a cost benefit thing."

Former Plant Manager

- He described the reason why the support structure modification was first proposed as an enhancement. Davis-Besse was an outlier, and needed to be ready, in case the NRC invoked the head inspection requirement. As to why it wasn't approved for 11RFO(1998), he stated it was because of lack of cost benefit. The System Engineer did not present it as a regulatory requirement. It would have passed if it had been.
- He stated that all containment was covered with Boric Acid. It was in places in 1996 and 1997 and after the RC-2 event. He stated that it was not acceptable, but was nothing new to see this boric acid.

Former Manager

- In response to a question whether the plant ever had leaks found during walk-down that weren't repaired, he said "Yes. There was a culture that we used engineering to justify why it was ok to proceed. Basically tell engineers to justify operability and accept deficiencies."
- He stated there is a lot of pressure to operate. He felt relieved once as operations manager that we tripped after a long run- - pressure was relieved by tripping. The trip was good, the pressure was off.

Former Manager

- Standards, over time, had unnoticeably slipped. The plant lived with a .15gpm leakage, yet in the Navy the standard was zero.

Internal and external review organizations also provided insight of declining performance in areas that support a nuclear safety focus.

- On 1/1/98, the WANO Peer Review noted: "Minor materiel condition deficiencies are being overlooked because an environment has been established to accept these type of deficiencies.
- The INPO 1999 Evaluation states: "Management has been focused on completing corrective actions rather than on determining the effectiveness of those actions to change the behaviors of management and the workforce."
- INPO 2001 Evaluation of Davis-Besse stated:
  - There are some indications that the organization may not be sufficiently self-critical or challenging when issues are identified. In these instances, the organization tends to focus on the positive aspects of an issue and not fully consider the potential challenge created or its significance.
  - "The shift manager seldom challenges engineering on the initial condition report response in regard to equipment operability. In addition, although the data provided by engineering may not provide a complete picture of the equipment condition, few engineering evaluations are requested to obtain further details."
  - "Some members of the engineering staff have an approach to equipment deficiencies that sets out to prove existing conditions are acceptable instead of probing worst-case scenarios and questioning why equipment remains capable of meeting its design function."
  - "Some station evaluations suggest that equipment operability is based solely on successful completion of previous surveillance requirements."
  - "Most system engineering activities are short-term focused, contributing to the lack of long-term attention to equipment performance."
- RHR International report from 1999 (Phase 2 Organization Study Results) drew the following conclusions:

  Organization Purpose and Direction:

  - The site had a pure operating orientation until the 1990s
  - Reliability and cost have become Critical Success Areas

  Organizational Structure and Systems:

  - There is a strong desire to cut out the nonessential; No one seems sure how
  - A gulf exists between Directors and other levels
  - Management levels rarely mix
  - Many Managers avoid raising bad news

  Management team effectiveness

  - There is little aggressive questioning
  - Managers avoid rocking each others' boats

  Organizational Processes:

  - Directors are seen as cautious and conflict averse

In contrast to the focus that appeared in the mid-1990s, the Team's investigation determined that nuclear safety was effectively integrated into practices and programs in the late 1980s and early 1990s. The following is presented to show how plant conditions were previously evaluated:

- A 1987 ISEG review of boric acid issues noted "experience has shown that even relatively hot metal can be sufficiently cooled on the surface by the flow of the leakage so that the surface stays wetter and boric acid corrosion is promoted." ISEG additionally noted: "The event at Turkey Point 4 demonstrates that boric acid will rapidly corrode ferritic (carbon) steel components and also that if a small leakage occurs near hot surfaces and/or surrounding then the boric acid solution will boil and concentrate becoming more acidic and thus more corrosive." This review demonstrates a proper understanding of the potential for boric acid corrosion.
- In 1990, when boric acid accumulation was identified on the pressure vessel head, corrective actions included: cleaning off the boric acid and inspection of the areas under the boric acid for surface irregularities. Additionally, a root cause determination was initiated as the CRDM flange leakage area was determined to be repetitive.
- In 1992, an extensive engineering review relative to CAC fouling was conducted to analyze the limits of operation. No such review was performed for similar component issues in the late 1990s.
- In the early 1990s the VP, when made aware of any boric acid, gave direction to clean it off, including washing the vessel head.

The transition from adequate to inadequate work practices occurred subtly, but was reflected in the direction management gave to site personnel after the early 1990s. A number of interviews provided insight into the changes in management style and site philosophy were changing.

- An Engineering manager stated in the 1990s Davis-Besse migrated away from justifying why it was okay to stay on line to justifying why it was necessary to come off line.

- In response to how the plant arrived to the present day situation, a Vice President noted that top quality people had left the station in the mid-1990s and that Davis-Besse became disassociated with the industry and was not benchmarking. He believed that the station was in a survival mode from the transition in ownership from Centerior to FirstEnergy in 1997.

- A Plant Manager noted that in the early 1990s that ALARA was strengthened, and that there were few people allowed to look at the RPV head and other high dose areas.

- A Design Basis Engineer Manager noted, our standards, over time, had unnoticeably slipped. The organization's standard was "how we have always done it."

Summarizing this transition, the nuclear safety focus of the late 1980s was evident in the site's program adherence and implementation. In this environment, technical information was utilized, corrective actions were based on supporting analysis, and safety concerns were recognized and properly assessed by management. As the focus shifted, implementation and level of rigor moved to support the perceived goals (survival, cost, schedule, status quo). The results were programs that were weakened in their ability to identify and address potential safety concerns. Corrective actions tended to be simplistic and superficial, and lacked rigorous analysis to support conclusions. The use of technical information tended to be selective, utilizing whatever information supported the perceived site goals. Key vendor specialty support was not evident. Procedures, polices and practices were altered and allowed more liberty in meeting requirements.

While the ability of various station programs to properly recognize and resolve problems was diminishing, increased risk with the possibility of reactor vessel nozzle cracking was occurring. One issue for nozzle cracking was simply the age of the plant. Therefore as time passed, risk increased. Despite beliefs that boric acid on the head was from CRDM flanges, there was also acknowledgment that until the boric acid was removed and the head was inspected there was a degree of uncertainty concerning the head's condition. The longer it stayed there, the higher the relative risk if it were being wetted. Industry gained further insight and experience with nozzle cracking both axial and circumferential, and the knowledge of a growing industry issue clearly advertised an increasing risk with the passage of time. However, as risk to Davis-Besse increased, the ability of personnel and programs to identify that risk was diminishing. The point where the station no longer appeared to take aggressive actions for boric acid issues appears to be in 1996, as represented on PCAQR 96-0551. This document presents the last evidence that the threat to the head from boric acid was viewed as important. However, management discounted this evidence. In later outages, there appears to have been little if any consideration given to the results of leaving boric acid on the RPV head.

6.0 Root Cause Determination

Based upon the analysis provided in Section 5.0, the Root Cause Analysis Team identified a number of root causes and contributing causes for the failure to identify boric acid corrosion of the RPV head. The Team also has a number of observations. These causes and observations are discussed in the following sections.

6.1 Root Causes

1. Less than Adequate Nuclear Safety Focus – A production focus established by management, combined with taking minimum actions to meet regulatory requirements, resulted in acceptance of degraded conditions on the RPV head and other components affected by boric acid. (Sections 5.3.1 and 5.3.3.6)

2. Less than Adequate Implementation of the Corrective Action Program - Implementation of the Corrective Action Program was less than adequate (Section 5.3.1), as indicated by the following:

   a. Addressing Symptoms Rather Than Causes - Management pursued symptoms rather than the identification of the causes with respect to the corrosion of the RPV base metal and other boric acid issues. (Sections 5.3.2, 5.3.3.4, and 5.3.3.3.1)

   b. Low Categorization of Conditions - The condition reports and evaluation methods on the RPV head and other boric acid issues were categorized as relatively low, resulting in the use of superficial cause analysis techniques. (Sections 5.3.2, 5.3.3.4, and 5.3.3.3.1)

   c. Less than Adequate Cause Determinations - Cause determinations for identified problems associated with the eventual degradation of RPV head and other boric acid issues lacked rigor and were less than adequate dating back to at least 1996. (Sections 5.3.2, 5.3.3.4, and 5.3.3.3.1)

   d. Less than Adequate Corrective Actions - Corrective actions assigned and implemented from 1996 to 2002 were not effective and failed to find and fix the leaks that caused extensive damage to the RPV head. (Sections 5.3.2, 5.3.3.4, and 5.3.3.3.1)

   e. Less than Adequate Trending - Equipment and materiel trending failed to identify recurring failures, equipment degradation, and performance issues associated with the boric acid on the RPV head and other boric acid issues. (Sections 5.3.3.4 and 5.3.3.3.1)

3. Less than Adequate Analyses of Safety Implications - Failure to integrate and apply key industry information and site knowledge/experience, effectively use vendor expertise, and

compare new information to baseline knowledge led to less than adequate analyses and decision-making with regard to the nuclear safety implications of boric acid on the reactor vessel head and in the containment. (Sections 5.3.2, 5.3.3.2, and 5.3.3.4)

4. Less than Adequate Compliance with Boric Acid Corrosion Control (BACC) Procedure and Inservice Test Program - Contrary to these programs, boric acid was not completely removed from the RPV head. The affected areas were not inspected for corrosion and leakage from nozzles and the sources of the leakage were not determined. (Section 5.3.2)

6.2 Contributing Causes

1. Lack of Hazard Analyses - Evaluations and decisions were made without hazards analyses that may have led to the identification of the nozzle leakage. (Sections 5.3.1, 5.3.3.2, and 5.3.3.6)

2. Corrective Action Procedure – The Corrective Action Procedure has provisions that do not reflect state-of-the-art practice in the industry, which may have allowed less than adequate corrective actions. (Section 5.3.3.3.1)

6.3 Related Observations

1. Design – The design failed to prevent leaks of boric acid. The Alloy 600 material used in the original design of the CRDM nozzles was susceptible to cracking and leakage, and the original gaskets in the CRDM flanges were susceptible to leakage. (Section 5.3.2)

2. Training – Training was not provided to the ISI VT-2 inspector on boric acid corrosion, and training on inspections was not provided to the engineers who conducted the inspections of the RPV head for boric acid in 10RFO and 11RFO. The training provided following the RC-2 event was less than adequate. (Section 5.3.2)

3. Coordination of Boric Acid Control Activities – The RPV head inspection activities and resolution of the corrective action documents on the head were not coordinated through the BACC Coordinator. (Section 5.3.2)

4. BACC Procedure – The BACC Procedure does not specifically reference the CRDM nozzles as one of the probable locations of leakage. (Section 5.3.2)

5. Untimely Corrective Action - Condition reports associated with the boric acid issues tended to stay unresolved until significant degradation occurred. (Section 5.3.3.3.1)

6. Quality Assurance - There was little evidence of QA's involvement in this area, and the documented findings by QA were of mixed quality. (Section 5.3.3.3.2)

7. Incentive Program - The FENOC monetary incentive program rewards production more than safety at senior levels of the organization. (Section 5.3.3.5)

8. Policies on Safety - The written policies have been inconsistent and incomplete in their treatment of employee and nuclear safety and do not support a strong safety focus. (Section 5.3.3.5)

9. Operations Involvement – Operations had minimal involvement in resolution of boric acid issues. (Section 5.3.3.3.1)

10. Management Observations – Management had minimal entries into containment and observation of conditions in the containment. (Section 5.3.3.5)

7.0 Extent of Condition

Section 6.1 of the Technical Root Cause Analysis Report discusses the activities to determine whether other components have been affected by PWSCC or boric acid corrosion. Based upon the information considered by the Root Cause Analysis Team, the Team believes that other activities may be adversely affected by the same causes identified in Section 6. Therefore, the Team recommends that Davis-Besse conduct reviews to determine whether other hardware, functions, and programs have been impacted by these causes.

Currently, the Davis-Besse Building Block Plans include reviews to assess the adequacy of systems, organizations, and programs to support safe and reliable operation. Specifically:

- The System Health Assurance Plan provides for a series of reviews of systems. These reviews include the following checks: reviews of CRs initiated since 1995 affecting the risk significant functions to verify the adequacy of corrective actions; reviews of Corrective Work Orders initiated since 1995 affecting risk significant functions to verify that degrading trends are not developing; reviews of modifications initiated since 1990 to address deficiencies of the system to support risk significant functions to ensure identified problems were properly resolved; reviews of industry operating experience identified after 1995 on risk significant functions to verify incorporation of lessons learned; elicitation of concerns by operators and maintenance personnel related to how the systems and system components are performing; and system walkdowns to assess the materiel condition of the system.

- The Management and Human Performance Excellence Plan includes a series of reviews of functional areas (organizations). These reviews include checks of: whether there are clear lines of authority and responsibly within the organization; whether staffing levels and resources are sufficient to handle assigned responsibilities; whether individuals have a clear description of their assigned responsibilities; whether individuals satisfy regulatory requirements and commitments for certification, qualification, and experience; whether the training of individuals is current; whether programs within the responsibility of the organization have an individual who is assigned as the owner; whether there are effective methods for communicating safety information within the organization; whether interfaces with other organizations are clearly defined; whether corrective actions and improvements for assessment related to the organization findings within the last two years have been effective; whether the organization has appropriate performance indicators or other goals and objectives; and whether the organization satisfies any other applicable regulatory requirements and commitments.

- The Program Compliance Plan provides for a series of reviews of programs, including: the interfaces with other programs or work groups are controlled; the program appropriately implements operating experience; the program has an appropriate level of management involvement; the program has an owner who is properly qualified; and the roles and responsibilities for program implementation are clearly defined and appropriately implemented.

The owners of the Building Block Plans should review their activities to ensure that the Plans account for the findings and conclusions in this Report.

8.0 Corrective Actions

This section repeats each of the root causes, contributing factors, and related observations in Section 6, and then identifies applicable corrective actions.

8.1 Corrective Actions for Root Causes

1. Less than Adequate Nuclear Safety Focus – A production focus established by management, combined with taking minimum actions to meet regulatory requirements, resulted in acceptance of degraded conditions on the RPV head and other components affected by boric acid. (Root Cause 6.1.1)

   Corrective Actions:

   a. The Management and Human Performance Excellence Plan also has the following relevant actions:

      - Extensive changes have been made in the officers, directors, and managers responsible for Davis-Besse, including establishment and appointment of a new Chief Operating Officer Executive Vice President, and Vice President of Oversight; changes in the site Vice President; and changes in each of the directors. These new individuals bring outside experience and high safety standards.
      - An effective management field presence/involvement plan will be developed to improve management oversight.
      - Management will ensure standards of excellence are communicated, and monitoring will ensure these standards are upheld at all levels. This entails management behaviors, first line supervisor behaviors, and individual worker behaviors. These standards will not only focus on behaviors, but also on the expectations for manager involvement in station activities.
      - A Management Monitoring Process will be used to monitor and trend the performance of specific management oversight activities taken on an individual basis. These will demonstrate the level of involvement of individual managers.
      - Case Study training will be given, which will consist of a review of the timeline of the event with site personnel to ensure all personnel understand how the event happened, what barriers broke down, and what needs to be different in the future.

   b. Assess the Safety Conscious Work Environment of Davis-Besse based on criteria and attributes derived from NRC policy and guidance, and develop an action plan to address any adverse conditions identified by the assessment.

2. Less than Adequate Implementation of the Corrective Action Program – Implementation of the Corrective Action Program was less than adequate. (Root Cause 6.1.2)

Corrective Actions:

a. The Program Compliance Plan includes a detailed review of the Corrective Action Program by outside consultants.

b. The Senior Management Team shall review and endorse all root causes in this report.

a. Addressing Symptoms Rather Than Causes - Management pursued symptoms rather than the identification of the causes with respect to the corrosion of the RPV base metal and other boric acid issues. (Root Cause 6.1.2.a)

Corrective Actions:

a. Ensure that the case study of this and other events (Corrective Action 8.1.1.b) includes emphasis on the need to find and address the causes of adverse conditions and the potential consequences of failures to do so.

b. The Management and Human Performance Excellence Plan also has the following relevant action:

- The Corrective Action Review Board (CARB), which reviews select corrective action document evaluations, will be used to enforce higher standards for cause evaluations and effective corrective action. This board will also be chaired by the Plant Manager or another director level individual.

b. Low Categorization of Conditions - The condition reports and evaluation methods on the RPV head and other boric acid issues were categorized as relatively low, resulting in the use of superficial cause analysis techniques. (Root Cause 6.1.2.b)

Corrective Actions:

a. Ensure that criteria for categorization of the significance of repeat equipment failures are appropriate and utilized by station personal. These criteria should be sufficient to elevate repeat Condition Adverse to Quality (CAQ) failure CRs to a Significant Condition Adverse to Quality (SCAQ) categorization, which requires utilizing of a higher evaluation method.

b. Review existing long-standing issues for possible SCAQ categorization and use of root cause evaluation techniques to obtain resolution of the issues.

c. Less than Adequate Cause Determinations - Cause determinations for identified problems associated with the eventual degradation of RPV head and other boric acid issues lacked rigor and were less than adequate dating back to at least 1996. (Root Cause 6.1.2.c)

Corrective Actions:

a. Require the use of formal cause determination techniques for root and basic cause evaluations to ensure analytical rigor is applied to the analysis. A tiered approach to the number and type of techniques applied should be considered.

b. Define and implement the training requirements necessary for cause evaluations, especially for equipment analysis.

c. Provide periodic independent reviews and self assessments of apparent cause evaluations to provide assurance of quality of these evaluations.

d. Less than Adequate Corrective Actions - Corrective actions assigned and implemented from 1996 to 2002 were not effective and failed to find and fix the leaks that caused extensive damage to the RPV head. (Root Cause 6.1.2.d)

Corrective Actions:

a. Improve the guidance on reviews of the effectiveness of corrective actions with focus on verifying that causes have been fixed, and provide training on the revised guidance.

b. Require the use of safety precedence sequence (step 6 of Root Cause Analyses Reference Guide) for root cause and basic cause analyses.

e. Less than Adequate Trending - Equipment and materiel trending failed to identify recurring failures, equipment degradation, and performance issues associated with the boric acid on the RPV head and other boric acid issues. (Contributing Cause 6.2.1.e)

Corrective Actions:

a. Implement an effective site wide equipment trending program. This program should define what is to be trended periodically (e.g. vendor, failure mode, failure mechanism, environmental, material issues).

b. Perform trending of issues that occur only during outages.

3. Less than Adequate Analyses of Safety Implications - Failure to integrate and apply key industry information and site knowledge/experience, effectively use vendor expertise, and compare new information to baseline knowledge led to less than adequate analyses and decision-making with regard to the nuclear safety implications of boric acid on the reactor vessel head and in the containment. (Root Cause 6.1.3)

Corrective Actions:

a. Establish the FENOC Hierarchy of Documents for Davis-Besse to ensure consistent policies and standards at all FENOC plants, including standards for analyses of safety issues.

4. Less than Adequate Compliance with Boric Acid Corrosion Control (BACC) Procedure and Inservice Test Program - Contrary to these programs, boric acid was not completely removed from the RPV head. The affected areas were not inspected for corrosion and leakage from nozzles and the sources of the leakage were not determined. (Root Cause 6.1.4)

Corrective Actions:

a. Provide training to applicable personnel and managers on the need to remove boric acid from components, to inspect for signs of corrosion, and to perform inspections for signs of boric acid in component internals.

b. Reinforce standards and expectations for procedure compliance and the need for work practice rigor.

8.2 Corrective Actions for Contributing Factors

1. Lack of Hazard Analyses - Evaluations and decisions were made without adequate hazards analyses that may have led to the identification of nozzle leakage. (Contributing Cause 6.2.1)

Corrective Actions:

a. Establish the FENOC decision-making process at Davis-Besse including hazard analyses.

2. Corrective Action Procedure – The Corrective Action Procedure has provisions that do not reflect state-of-the-art practice in the industry, which may have allowed less than adequate corrective actions. (Contributing Cause 6.2.2)

Corrective Actions:

a. Review and benchmark the Corrective Action Procedure against industry standards.

b. The Program Compliance Plan includes a detailed review of the Corrective Action Program by outside consultants.

8.3 Other Relevant Corrective Actions and Improvements

1. Design – The design failed to prevent leaks of boric acid. The Alloy 600 material used in the original design of the CRDM nozzles was susceptible to cracking and leakage, and the original gaskets in the CRDM flanges were susceptible to leakage. (Observation 6.3.1)

   Corrective Actions:

   a. The Reactor Head Resolution Plan provides for replacement of the corroded RPV head with a new head from the Midland Plant that uses Alloy 600 for the CRDM nozzles.

   b. Manufacture and install a new RPV head that does not use Alloy 600 for the CRDM nozzles.

2. Training – Training was not provided to the ISI VT-2 inspector on boric acid corrosion, and training on inspections was not provided to the engineers who conducted the inspections of the RPV head for boric acid in 10RFO and 11RFO. The training provided following the RC-2 event was less than adequate. (Observation 6.3.2)

   Corrective Actions:

   a. Provide training to personnel who perform ISI and BACC inspections on the BACC Procedure and ASME Code IAW-5250, Item b requirements, with emphasis on the need to inspect areas that are or have been covered with boric acid.

3. Coordination of Boric Acid Control Activities - The RPV head inspection activities and resolution of the corrective action documents on the head were not coordinated through the BACC Coordinator. (Observation 6.3.3)

   Corrective Actions:

   a. Provide training to the BACC Coordinator to ensure that he is aware of his responsibilities.

4. BACC Procedure – The BACC Procedure does not specifically reference the CRDM nozzles as one of the probable locations of leakage. (Observation 6.3.4)

   Corrective Actions:

   a. Establish a Boric Acid Nuclear Operating Procedure for FENOC PWRs. The BACC Program Manual lists the CRDM nozzles as one of the probable locations of leakage.

   b. The Program Compliance Plan includes a detailed review of the BACC and ISI Program by outside consultants.

5. Untimely Corrective Action - Condition reports associated with the boric acid issues tended to stay unresolved until significant degradation occurred. (Observation 6.3.5)

Corrective Actions:

a. Review the Corrective Action Program to identify whether it contains appropriate provisions for ensuring the timely resolution of conditions, and revise the Program as appropriate.

6. Quality Assurance - There was little evidence of QA's involvement in this area, and the documented findings by QA were of mixed quality. (Observation 6.3.6)

Corrective Actions:

a. The Nuclear Quality Assurance organization is performing an assessment to determine the adequacy of its audits and surveillances, and it should revise its activities as appropriate.

b. The Management and Human Performance Excellence Plan also states that a review will be performed of the effectiveness of and make changes to the CNRB to improve the safety focus.

7. Incentive Program Focuses on Production - The FENOC monetary incentive program rewards production more than safety at senior levels of the organization. (Observation 6.3.7)

Corrective Actions:

a. Management incentives should be realigned to place more reward for safety and safe operation of the station when the management positions reside at the station (e.g. Site VP and below). The distribution should be consistent among all site positions.

8. Policies Do Not Support Safety - The written policies have been inconsistent and incomplete in their treatment of employee and nuclear safety and do not support a strong safety focus. (Observation 6.3.8)

Corrective Actions:

a. Establish a FENOC-level policy emphasizing the station industrial and nuclear safety philosophy. The policy should be incorporated into procedures, guidelines, job descriptions and performance evaluations, as appropriate. Policies and procedures should include both management and worker responsibility in providing a safe work environment, personal protective equipment, training and working safely. [Note: The recommendation of the Team does not advocate a particular form that the policy may take, and in fact, the old 'policy book' could be eliminated in favor of an approach that is better connected with the Business Plan.]

9. Operations Involvement – Operations had minimal involvement in resolution of boric acid issues. (Observation 6.3.9)

Corrective Actions:

a. Integrate Operations into problem solving and promote Operations ownership of problem resolution.

10. Management Observations – Management had minimal entries into containment and observation of conditions in the containment. (Observation 6.3.10)

Corrective Actions:

a. Develop a plan for increased presence of management in the field during outages and normal operation.

9.0 Experience Review

Section 7 of the Root Cause Analysis Reference Guide and Attachment 11 of the Programmatic Guideline for the Davis-Besse Condition Report Process state that a review of similar experiences at the plant and the nuclear industry should be conducted to determine:

- whether past occurrences of similar problems indicate a generic or broader scope issue,
- why prior corrective actions for similar problems were not effective, and
- whether the currently proposed preventive actions are different so as to be more effective.

The Technical Root Cause Analysis Report evaluated whether there was previous experience with boric acid corrosion at Davis-Besse and the nuclear industry. As documented in that Report, previous events involving boric acid corrosion had occurred at both Davis-Besse and the nuclear industry. The Report also concluded that this previous experience was not effectively used to prevent the corrosion of the RPV head.

Section 5 above evaluates why the preventive actions for the RC-2 event at Davis-Besse were not effective and why previous industry experience on boric acid corrosion was not effectively used at Davis-Besse.

This section evaluates why the currently proposed preventive actions are different from those taken in response to the RC-2 event and previous industry experience, and why the proposed actions should be more effective.

9.1 Preventive Actions for Previous Events

Davis-Besse's preventive actions for industry experience included the following:

- Development of the Boric Acid Corrosion Control Program
- Evaluations that justified leaving boric acid on the RPV head based on industry experience which indicated that boric acid is not corrosive at temperatures above 550°F.

The preventive actions for the RC-2 event at Davis-Besse included the following (Licensee Event Report 1998-0009, Rev. 1):

- Revising the Boric Acid Corrosion Control Program, including benchmarking against industry standards and practices, to reflect higher standards for monitoring, evaluating, documenting and controlling boric acid leakage.
- Providing additional training to management and the technical staff to address the technical issues of boric acid control, and the Boric Acid Corrosion Control Program, the RC-2 event, and industry experience.
- Reinforcing the philosophy of conservative decision-making.
- Improving oversight.
- Counseling of the Maintenance Manager, Mechanical Services Superintendent, and Mechanical Services Supervisor on expectations of accountability.
- Providing training to Maintenance personnel on NG-DB-00225, "Procedure Use and Adherence".

9.2 Differences between Previous and Proposed Actions

There are a number of differences between the previous corrective actions for the RC-2 event and the corrective actions discussed in Section 8 above. Specifically, the actions in Section 8 have the following elements that were not present in the actions for the RC-2 event:

- New Management – Since December of 2001, the entire top tiers of management at Davis-Besse have changed. In particular, a new position of Chief Operating Officer has been created and filled, a new plant manager from outside of Davis-Besse has been appointed, every Director has been newly appointed (several from outside of Davis-Besse), and most of the managers have been replaced. Additionally, a new Vice President of Oversight position has been created and filled, and this individual will be in charge of oversight activities at all FENOC facilities. Finally, an Executive Vice President position was created and filled with an experienced INPO manager, to further strengthen engineering management oversight at Davis-Besse.

- Safety Focus – To ensure that nuclear safety is the primary responsibility of every employee, FENOC will take several actions. The Management and Human Performance Excellence Plan implements several relevant actions. For example, an effective management field presence/involvement plan will be developed to improve management oversight. Management will ensure standards of excellence are communicated, and monitoring will ensure these standards are upheld at all levels. These standards will not only focus on behaviors, but also on the expectations for manager involvement in station activities.

  Another corrective action is the implementation of a Management Monitoring Process to monitor and trend the performance of specific management oversight activities taken on an individual basis. These will demonstrate the level of involvement of individual managers.

  Lastly, Case Study training will be given, which will consist of a review of the timeline of the event with site personnel to ensure all personnel understand how the event happened, what barriers broke down, and what needs to be different in the future. This training is substantively different than that given to management after the RC-2 event because that training dealt specifically with the issues of boric acid control and related industry experience, while the Case Study focuses specifically on the broader root causes identified in this Report.

- Corrective Actions – FENOC will take numerous actions to address inadequate implementation of the Corrective Action Plan. For instance, with regard to addressing symptoms rather than causes, FENOC will ensure that the Case Study of this and other events includes emphasis on the need to find and address the causes of adverse conditions and the potential consequences of failures to do so.

  In addition, several of the Building Block Plans will implement actions to address this issue. For example, a detailed review of the Corrective Action Program will be performed by outside consultants as part of the Program Compliance Plan. In addition, the Management and Human Performance Excellence Plan requires that the Corrective Action Review Board

(CARB), which reviews select corrective action document evaluations, will be chaired by the Plant Manager or another director-level individual.

FENOC will also implement several corrective actions to address the low categorization of conditions. First, FENOC will ensure the criteria for categorization of the significance of repeat equipment failures are appropriate and utilized by station personnel. These criteria should be sufficient to elevate repeat Condition Adverse to Quality (CAQ) failure CRs to a Significant Condition Adverse to Quality (SCAQ) categorization, which requires utilizing of a higher evaluation method. Long-standing issues will be reviewed for possible SCAQ categorization and use of root cause evaluation techniques to obtain resolution of those issues.

To address the deficiencies in implementing corrective actions, FENOC will improve the guidance on reviews of the effectiveness of corrective actions with focus on verifying that causes have been fixed and provide training on the revised guidance.

With regard to deficiencies in trending, FENOC will implement an effective site-wide equipment trending program. In addition, FENOC will perform trending of issues arising during outages.

- Procedure Compliance – FENOC will be performing Case Study training, which will include emphasis on the need to adhere to procedures and the potential consequences or a failure to do so. Additionally, FENOC will reinforce standards and expectations for procedure compliance and the need for work practices rigor. These actions are substantially broader and more comprehensive than the corrective actions taken for the RC-2 event. Davis-Besse should perform reviews to ensure that these corrective actions are effective.

These actions are substantially broader and more comprehensive than the corrective actions taken from the RC-2 event. Davis-Besse should perform reviews to ensure that the corrective actions specified in this report are effective.

10.0 References

The following is a list of references reviewed in preparation of the Technical Root Cause Analysis Report and this Report.

10.1 Davis-Besse References

Procedures

- AD 1844.01, Preventive Maintenance
- AD 1845.01, 50.59 Procedure Safety Evaluations & Review Preparation
- DB-DP-00022, Station Review Board
- DB-MM-09011, Pressurizer Manway Cover Removel and Reinstallation
- DB-MM-09019, OTSG Primary Handhole Maintenance
- DB-MM-09020, OTSG Manway Maintenance
- DB-MM-09117, Reactor Coolant Pump Maintenance
- DB-MM-11053, CRDM Leaking Gasket Replacement (M-515-59),
- DB-OP-00002, Operations Section Event/Incident Notifications and Actions
- DB-OP-00018, Inoperable Equipment Tracking Log
- DB-OP-00022, Station Review Board
- DB-OP-01200, Reactor Coolant System Leakage Management
- DB-OP-02522, Small RCS Leaks
- DB-OP-02529, Fire Procedure
- DB-OP-06412, Process and Area Radiation Monitor System Operating Procedure, EXCERPT
- DB-OP-06900, Plant Heatup
- DB-OP-06901, Plant Startup
- DB-OP-06903, Plant Shutdown and Cooldown
- DB-PF-00204, ASME XI Pressure Testing
- DB-PF-03010, RCS Leakage and RCS Hydrostatic Test
- DB-PF-03065, Pressure and Augmented Leakage Test
- DB-SP-03357, RCS Water Inventory Balance
- EN-DP-00070, Procurement
- EN-DP-01090, Design Verification Procedure
- EN-DP-01142, Core Drill/Cut Out and Barrier Penetrations
- EN-DP-01200, Processing Plant Modifications
- MP 1401.41, Routine CRDM Maintenance
- MP 1700.83, Reactor Coolant Pump Disassembly, Inspection, Repair and Reassembly
- NA-QC-00358, Review of Documents, Systems, Processes and Activities Related to Nuclear Safety
- NG-DB-00018, Operability Determinations
- NG-DB-00116, Outage Nuclear Safety Control
- NG-DB-00202, Test Control
- NG-DB-00302, Davis-Besse Nuclear Power Station Fire Protection

- NG-EN-00301, Plant Modification
- NG-EN-00304, Safety Review and Evaluation
- NG-EN-00304, 50.59 Safety Evaluation
- NG-EN-00324, Boric Acid Corrosion Control
- NG-EN-00313, Control of Temporary Modifications
- NG-IM-00114, Preparation and Control of Administrative Guidelines
- NG-IM-00115, Preparation and Control of Nuclear Group Department and Section/Unit Procedures
- NG-NA-00115, Control of Procedures
- NG-NA-00701, Audits and Surveillance
- NG-NA-00702, Potential Condition Adverse to Reporting
- NG-NA-00711, Quality Trending
- NG-NE-0304, Safety Review and Evaluation
- NG-NP-00400, Materials Management
- NG-NS-00801, Operating License Amendments
- NG-NS-00804, NRC Communications
- NG-NS-0806, Preparation and Control of USAR Changes
- NG-NS-00807, Regulatory Reports
- NG-NT-00600, Training and Qualification
- NG-QA-00707, FENOC Quality Assurance Program Manual
- NOP-ER-1001, Continuous Equipment Performance Improvement
- NOP-ER-2001, Boric Acid Corrosion Control Program
- NOP-LP-2001, Condition Report Process
- NOP-LP-3001, Safety and Health Program
- NOP-LP-4003, 50.59 Safety Evaluation
- NOP-SS-3005, Independent Qualified Reviewer Program
- NT-ST-07044, Nuclear Training Procedure
- PP 1102.10, Surveillance Test Procedure for Plant Shutdown and Cooldown
- ST 5042.02, RCS Water Inventory Balance Procedure Surveillance Test
- ST 5066.00, ASME Section XI Inservice Pressure Tests
- VP-IE-00001, Independent Safety Engineering Organization
- VP-IE-00008, Review of Documents, Systems, Processes, and Activities Related to Nuclear Safety

Potential Condition Adverse to Quality Reports

- 1987-0032, Error in Drilling Control Rod Drive Flange 2-2
- 1988 0345,
- 1989-0058, Boric Acid Corrosion Concerns
- 1990-0120, Boron Leakage and CRDM Stator Cooling
- 1990-0221, CRDM Flange F-2 Slight Erosion of Outer Gasket Groove
- 1990-0433, Torque Values Not Provided to NSR/ASME Code Fasteners
- 1991-0353, Boron on Reactor Vessel Head from Leaking CRDM Flanges
- 1991-0496, Loose Disk Not Cotter Pin from MS735
- 1992-0072, CAC Cooler Degraded Below Acceptable Performance
- 1992-0248, Boron Found in Filter RE4597AA

- 1992-0346, Unusual Amount of Liquid Found in RE 4597AA
- 1993-0098, Reactor Head Vent Flange Leakage
- 1993-0132, Reactor Coolant Found Leaking from CRD Flanges
- 1993-0175, Service Water Piping to CAC's Have Accumulated Boric Acid
- 1993-0221, Undocumented Mech Temp MOD on MS735
- 1993-0287, MS734 and MS735 Closure
- 1993-456, RC-2 Has a Body to Bonnet Leak
- 1994-0295, TERMS A16892 Requires Visual Exam of Reactor Vessel Head each Outage
- 1994-0912, Documents CRDM Leakage
- 1994-0955, MS734 Disk Degradation
- 1994-0974, Documents Scratches and Gouges on Seating Surface Location G-5
- 1994-0975, Document ½ Moon Gouge CRDM Flange M-3
- 1994-1044, MS735 Leakrate Failure
- 1994-1191, RC-2 Packing Leak, SRTP CRD-NRR-07
- 1994-1295, MS734 and MS735 Impacting
- 1994-1338, Westinghouse CRDM part 21
- 1995-0100, Inadequate 10CFR50.59 Review
- 1995-0245, Administrative Procedure Compliance
- 1996-0330, Inadequate Change Reviews
- 1996-0448, MS734 and MS735 Valve Wear
- 1996-0551, Boric Acid on RX Vessel Head, Management Issues
- 1996-0650, VT-2 Exam of RCP Stud Shows Evidence of Boric Acid Leakage
- 1996-1018, Info Notice 96-032 Received Concerning Augmented Inspection of Rx Vessel
- 1997-1597, Operating Experience Assessment Program (OEAP) Review Inadequacies
- 1998-0020, RC-2 with Root Cause Analysis Report
- 1998-0046, Insulation for RC-2 Removed for Inspection and Not Reinstalled
- 1998-0649, Inspection Results of Reactor Vessel Head
- 1998-0650, Video Inspection Results CRDM Nozzle/Head Interface
- 1998-0767, Reactor Vessel Head Inspection Results
- 1998-0824, CAC's 2 and 3 Have Accumulated Boric Acid
- 1998-0915, Yoke on RC-2 is Corroded
- 1998-1130, RC-2 Packing Leak
- 1998-1164, Water Collecting in Sample Line for RE4597AA
- 1998-1642, Apparent Missing Nut
- 1998-1681, Missing Body to Bonnet Stud Nut
- 1998-1716, Functional Evaluation of RC-2 for Past Operability
- 1998-1799, RC-2 MWO Package Discrepancies
- 1998-1885, RC-2 Carbon Steel Nuts
- 1998-1887, Nut in Containment
- 1998-1895, Containment Normal Sump Leakage > 1GPM
- 1998-1904, 1998 Collective Significance Review
- 1998-1924, Functionality of RC-2 as A RCS Pressure Boundary
- 1998-1980, Containment Cooler Plenum Pressure Decreasing

- 1998-1981, HP-0057 Body to Bonnet Bolting
- 1998-1988, RC-2
- 1998-1895, CTMT Normal Sump Leakage in Excess of 1 gpm
- 1998-2011, LER Not Submitted to NRC Within 30 Days.
- 1998-2013, Timeliness Identification RC-2
- 1998-2069, Failure to Take Comprehensive Action for the Resolution of RC-2 Problems
- 1998-2082, Interim Bolting Configuration During RC-2 Bonnet Nut Replacement Under MWO 1-98-1158-00

Condition Reports

- 1998-0020, Multiple Problems with RC-2
- 1999-0372, Containment Rad RE4597AA/AB High
- 1999-0510, RE4597AA OOS Low Flow
- 1999-0738, RC-38 Material Wastage
- 1999-0845, Boric Acid Clumps Room 181
- 1999-0861, RE4597AA Sample Line Full of Water
- 1999-0928, Document Increased RE Filter Change Frequency
- 1999-1098, Issues with DB-OP-01200 RCS Leakage Management
- 1999-1300, RE Filter Analysis Results from Southwest Research Institute and Follow Up Actions
- 1999-1614, LER 1998-009
- 1999-1765, QA Surveillance Report SR-99-ENGRG-08 Identified CATS is Not Useful for Equipment Reliability Trending
- 1999-2249, Non-Compliance With USAR Requirements and Commitments Made to the NRC
- 2000-0781, Boric Acid on RV Studs
- 2000-0782, RV Flange Boric Acid from Weep Holes
- 2000-0903, Two CRDM Flange Fasteners Fail Preservice Exam
- 2000-0994, CRDM Flange F-10 Pitted
- 2000-0995, CRDM Flange D-10 Pitted
- 2000-1001, RC-2 Spray Valve Problems
- 2000-1037, Reactor Head Inspection Indicates Boric Acid Accumulation
- 2000-1210, CRDM D-10 Out of Plum
- 2000-1547, Containment Cooler Plenum Pressure Dropped
- 2000-4138, Increased Frequency of Containment Air Cooler Cleaning
- 2001-0039, Step Drop in Containment Air Cooler Plenum Pressure
- 2001-0487, Higher Containment Temperatures
- 2001-0642, Collective Significance Review of Post-Maintenance Testing Issues
- 2001-0670, Collective Significance of FPRs Generated in 2000
- 2001-0677, Technical Evaluation Documentation Adequacy Collective Significance
- 2001-0890, RCS Leakage Calculation Data Scatter
- 2001-1026, Collective Significance Torque Wrenches Out of Calibration
- 2001-1027, Collective Significance – Dial Calipers and Depth Gauges Out of Calibration

- 2001-1110, RE4597BA Filter Change Occurring More Frequently
- 2001-1191, CRDM Nozzle J-Weld Cracking Due to Inconel 600 Stress Corrosion
- 2001-1335, CAC Air Side Fouling Criteria
- 2001-1696, Safety Tagging Collective Significance Review
- 2001-1746, Weaknesses in the Tracking and Closeout of CARB Comments
- 2001-1747, CARB Charter Compliance
- 2001-1748, Corrective Action Review Board Recommendations
- 2001-1822, Increasing Frequency of RE4597BA Filter Changeout
- 2001-1857, RCS Leakage Anomalies
- 2001-1858, Collective Significance Review of Process Security, Activity Access Control
- 2001-1859, Collective Significance Review of Activity Records Capture CRs
- 2001-1871, Collective Significance Review of Work Management Process
- 2001-1896, Collective Significance Review of CRs Identified by External Oversight
- 2001-1983, Collective Condition Report on Temporary Intake Chlorination System
- 2001-2012, Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles
- 2001-2028, Collective Significance Review of Late CR Evaluations or Corrective Actions
- 2001-2236, Collective Significance Review of Simulator Panel Power Supply Failures
- 2001-2253, Collective Significance Review of Corrective Action Incomplete and Closed
- 2001-2521, Collective Significance Review of Lost Work Orders
- 2001-2706, Collective Significance Review for Operability Determinations
- 2001-2739, Collective Significance Review of CRs Resulting From Troubleshooting
- 2001-2749, Collective Significance Review of CRs on Changes to Computerized Processes
- 2001-2769, Containment Wide Range Radiation Element (RE2387) Spiking
- 2001-2795, RE4597BA Alarm
- 2001-2862, Potential Adverse Trend in Unidentified RCS Leakage
- 2001-2865, Collective Significance Review Enhancement - Guidance
- 2001-2936, Unable to Perform RE4597BA/BB Functional by the Technical Specification
- 2001-2967, CR Program Implementation Deficiencies in Evaluation Documentation
- 2001-3025, RCS Leakage
- 2001-3131, Collective Significance Review – Process Computer Systems Activity ACC. Con.
- 2001-3145, Collective Significance Evaluation of Procedures Not Updated During LAR PR
- 2001-3195, Collective Significance Investigation of Fuel Vendor-Related CRs
- 2001-3223, Collective Significance Review EMPAC Common Process Software Implementation
- 2001-3411, Equipment Failure on Detector Saturation During RE4597BA Testing
- 2002-00233, Collective Significance for SAC #2 Modification
- 2002-00685, Boron Build Up on Reactor Vessel Head

- 2002-00784, Collective Review Nuclear Fuel Related CRs for Common Causes
- 2002-00846, More Boron on Head Than Expected
- 2002-00891, Control Rod Drive Nozzle Crack Indication
- 2002-00932, CRDM Nozzle Crack Indications
- 2002-01051, Collective Significance Review of 13RFO Access Control Process Condition
- 2002-01053, Unexpected Tool Movement
- 2002-01103, Perform A Collective Significance Investigation For 13RFO Spaces Grid Issues
- 2002-01128, Reactor Head Material Finding
- 2002-01449, RCS Valve Repacks Not Performed
- 2002-01527, Collective Significance Review For Fire Protection Related Condition Report
- 2002-01649, Collectively Evaluate Weaknesses in Preparation for 13RFO
- 2002-01850, Compromised Standards
- 2002-02408, Collective Significance – Plant Modification Program Concerns
- 2002-02582, Collective Review of Extent of Condition Inspection CRs for Containment Sump
- 2002-02584, Implementation of Corrective Action Program By Site Personnel
- 2002-02585, Management and Supervisory Oversight and Ownership of Plant Activities
- 2002-02943, Containment Air Cooler Boric Acid Corrosion
- 2002-02974, Past Operability and Reportability Reviews
- 2002-03032, Collective Significance of Drawing Discrepancy Condition Report
- 2002-03266, Painting Occurring in Containment Without An Approved Engineering Work Request
- 2002-03280, Failed Plant System Cleanliness on the Refueling Canal
- 2002-03282, Untimely Resolution of Issues Related to Head Degradation

Audits

- Quality Assessment Corrective Actions Audit AR-99-CORAC-02
- Quality Assessment Corrective Actions Audit AR-00-CORAC-01
- Quality Assessment Corrective Actions Audit AR-93-CORAC-01
- Quality Assessment Corrective Actions Audit AR-94-CORAC-02
- Quality Assessment Corrective Actions Audit AR-96-CORAC-01
- Quality Assessment Corrective Actions Audit AR-96-CORAC-02
- Quality Assessment Corrective Actions Audit AR-00-CORAC-01
- Quality Assessment Corrective Actions Audit AR-98-CORAC-01
- Quality Assessment Corrective Actions Audit AR-99-CORAC-01
- Quality Assessment Corrective Actions Audit AR-97-CORAC-01
- Audit Report AR-00-OUTAG-01
- NAQ Audit AR-01-REGAF-01
- Quality Assessment Audit Report AR-02-OUTAG-01

Memos and Letters

- Memo – LCTS Item 3539 – IN 86-108
- Memo – High Particulate Concentration in Containment
- Memo – Control Rod Drive Nozzle Cracking, PCAQ 96-00551
- Memo – Reactor Vessel Head (RVH) Nozzle Cracking
- Memo – Cycle 12 Periodic Assessment for SUS 079-01, Radiation Monitoring System
- Initial Response to NRC GL 97-01, Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations Serial 2439a
- Response to GL 97-01 Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations Serial2472
- Request for Additional Information Regarding the Response to GL 97-01 Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations, Serial 2569 and Serial 2581
- Responses to Requests for Additional Information Concerning NRC Bulletin 2001-01, Circumferential Cracking of Reactor Pressure Vessel Head Penetrations Nozzles, Serial 2741
- Supplemental Information in Response to NRC Bulletin 2001-01
- Response to NRC Bulletin 2001-01 DRAFTs (4) and FINAL Serial 2731
- Memo – RCP Cover to Case Stud Inspection Req. M80-1188 and NN.1.1.44
- Memo from D. Huffman for Closure of IN90-10, PSWCC
- Memo - RCP Cover to Case Stud Inspection Request
- Memo – Closeout of IN 94-63
- Memo – Closeout of SER 2091
- Memo – Response to IE IN 82-06 A82-1651C
- Letter to J. Keppler – USNRC Region III, IE Bulletin 82-02, Docket #50-346
- Memo LCTS 3817 Closeout
- Response to Inspection Report # 50-346/98021, Serial No. 1-1188
- Response to GL 88-05, Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants
- Memo – Use of the Word "Should" in Procedures
- Announcement for Engineering Assessment Board
- FENOC Engineering Principles and Expectations - DRAFT
- Control Rod Drive Workscope Recommendations
- Monthly Quality Program Report
- Memo - EWR 01-0378-00
- Memo – Justification for the Performance of RFM 87-1275
- Letter to NRC, Serial 1-1077, Information Request Regarding Tapping of Check Valves MS734 and MS735
- Classification of MS734 and MS735
- Memo – Training Programs for Technical Staff
- Memo – Critical Duties List as Requested by 7/10/86 Memo
- Memo – Results of Meeting on Incorporating Industry Experience into Technical Staff Training
- Letter to NRC, Serial 1-1268, 4/8/02, Safety Significant Assessment of the Davis-Besse Nuclear Power Station, Unit 1 Reactor Pressure Vessel Head Degradation

- Letter to NRC, Serial 1-1275, Transmittal of Davis-Besse Nuclear Power Station, Unit 1 Return to Service Plan
- Serial No. 2761, Reactor Pressure Vessel Head Penetration Examination Plans for Davis-Besse Nuclear Power Station
- Serial No. 1-885, Revised Response to Generic Letter 88-05, Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in Pressurized Water Reactor Plants
- Response to Nuclear Regulatory Commission Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles".
- Serial No. 1-885, Revised Response to Generic Letter 88-05, Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in Pressurized Water Reactor Plants
- Memo – MOD 87-1193, Integrated Chemical Sampling Instrumentation Selection – Alkalinity Analyzers
- Letter – Contract Engineering, Reactor Closure Head Access Openings Modification, 3/21/90
- Closeout of IN 86-108, Supplement 3 (TERMS A17920)
- Letter to NRC, Serial No. 2149, License Amendment Application to Revise Technical Specification (TS) 3/4.9.13, Refueling Operations – Spent Fuel Pool Assembly Storage, and TS 5.6, Design Features – Fuel Storage
- Letter Copy of Independent Safety Engineering Charter and Organization Chart sent to Consolidated Edison, Indian Point 2 Station
- Letter to NRC, Serial No. 2745, Transmittal of Davis-Besse Nuclear Power Station Risk Assessment of Control Rod Drive Mechanism Nozzle Cracks
- Letter to NRC, Serial No. 2747, Supplemental Information is Response to the November 28, 2001 Meeting Regarding the Davis-Besse Nuclear Power Station Response to NRC Bulleting 2001-01

Request For Assistance and Work Orders

- Request For Assistance 87-0402-00
- Request For Assistance 87-0864-00
- Request For Assistance 90-0510
- Request For Assistance 90-0828
- Request For Assistance 91-0482
- Request For Assistance 92-0598, MS734 and MS735
- Request For Assistance 97-0029, MS734 and MS735
- Request For Assistance 98-0035 MS734 and MS735
- Request For Assistance 98-0141 RC-2 Packing Leak Injection Pressure Question
- Request For Assistance 00-0076 RC-2 Repack
- Request For Assistance 00-0145 RC-2 Packing Gland Studs
- Work Order 00-001846-000
- Work Order 00-001846-001
- Work Order 00-001861-000, 13R RV Head Work
- Work Order 98-00373-005
- Work Order 2-82-0018-01 RC-2 Packing Change to "Live Loading"

- Work Order 82-2255 Packing Leak
- Work Order 1-87-3699-04 CRD Motors, Cables and Vent Piping Fans
- Work Order 1-88-2457-02 Packing Adjusted
- Work Order 1-98-0558-00
- Work Order 99-003352-000
- Work Order 99-003352-001

7. Meeting Minutes

- Davis-Besse Project Review Group Meeting Minutes
- Davis-Besse PRC Meeting History – Project No MOD 94-0025
- PRG Meeting Minutes, DBB-97-00012
- PRG Meeting Minutes, DBB-97-00048
- Joint PRG and Work Scope Committee Meeting Minutes
- PRG Meeting Minutes MMS-95-00125
- Meeting Minutes Engineering/Licensing Subcommittee 99-001 and 99-002
- Meeting Minutes 97-001, Audit/Quality Assurance/Security Subcommittee
- Meeting Minutes Company Nuclear Review Board Rev 01 5/22/96
- Meeting Minutes Company Nuclear Review Board 9/3/98
- Meeting Minutes Company Nuclear Review Board 1/7/99
- Meeting Minutes Company Nuclear Review Board 4/27/99
- Meeting Minutes Company Nuclear Review Board 5/11/99
- Meeting Minutes Company Nuclear Review Board 7/11/99
- Meeting Minutes Company Nuclear Review Board 9/2/99
- Meeting Minutes Company Nuclear Review Board 1/13/00
- Meeting Minutes - Kalsi Engineering Study for MOD 87-1275, Check Valves MS734 and MS735
- Meeting Minutes – Modification 91-0044, MS734 and MS735 Replacement
- Meeting Minutes – K-T Analysis for MS734 and MS735
- Meeting Minutes – Training Review Board, November 1986
- Meeting Minutes – Training Review Board, June 1989

8. Guidelines/Policies/Manuals/Charters

- FENOC Quality Assurance Program Manual Revision 1
- Administration of the FENOC Quality Assurance Program Manual
- Safety Evaluation Guideline Rev 0
- PSA Level 2 Quantification Guidelines
- DB-PSA Level 1 Quantification Guidelines
- DB-PSA Sys Modeling Guidelines
- DB-PSA Program Guidelines
- DB-PSA Data Collection & Analysis Guides
- Policy Priority Management Tech-29
- Policy Implementing Guideline Priority Management Policy Rev 3
- Policy – Change Management Tech-27 Rev 0

- Guideline – Change Management
- Corrective Action Program Reference Guide Rev 5
- 50.59 Safety Evaluation Guideline Rev 0
- Operations Tech-12 Rev 16
- Nuclear Operations Admin-1 Rev 17
- Delegation of Authority Admin-9 Rev 20
- Corrective Action Tech-3 Rev 18
- Root Cause Analysis Tech-26 Rev 1
- Engineering Evaluations ES-11 Rev 1
- Responses to Regulatory Agency Requests M&C-6 Rev 16
- Babcock & Wilcox Owners Group M&C-11 Rev 17
- Personnel Qualifications Pers.-55 Rev 4
- Davis-Besse Nuclear Power Station Philosophy Phil Rev 2
- Falsification of Records Pers.-38 Rev 17
- Dissemination of Information Within the Company M&C-23 Rev 0
- Dissemination of Information Outside the Company M&C-1 Rev 18
- Policy Manual for the Davis-Besse Nuclear Power Station Intro Rev 20
- Condition Report Process – Programmatic Guideline
- Corrective Action Review Board
- Nuclear Group Policy and Organization, Index Pages, Rev 52
- Charter - Davis-Besse Project Review Committee
- Davis-Besse Project Review Group Charter Rev 3 and Rev 4
- Guideline – Davis-Besse Standard Communication Process Guide fosr Leaders and Team Members Rev 00
- Training Policy – Operating Experience Review Process Rev 1
- Charter – Teamwork Ownership and Pride (TOP) Team Charter Rev 0
- Business Practice 2.1 – FirstEnergy Strategic Vision
- Business Practice 2.2 – FirstEnergy Mission Statement
- Business Practice 2.3 – FirstEnergy Core Values
- Davis-Besse Leadership Development Steering Committee Charter Rev 0
- Developing Nuclear Management Personnel Pers.-58 Rev 3
- Davis-Besse Site Safety Committee Charter Rev 3
- Davis-Besse Outage Management Team Organization Charter Rev 00
- Company Nuclear Review Board Policies and Practices, (Rev 2, and Rev 9-12)
- Davis-Besse Work Scope Committee Charter (Rev 0 thru Rev 4)
- Potential Condition Adverse to Quality Review Board Charter Rev 0, Rev 4 Rev 6-9 and Rev 11)
- FENOC – Root Cause Analysis Reference Guide Rev 3
- Davis-Besse Policy/Charter/Guideline Manual Document Processing
- Davis-Besse Committees, M&C-13 Rev 23
- Station Review Board Charter
- Toledo Edison Philosophy
- Davis-Besse Nuclear Power Station Philosophy
- Policy and Organization of the Davis-Besse Nuclear Power Station Rev 2, Rev 13 and Rev 15 thru Rev 17

- Policy Manual for the Davis-Besse Nuclear Power Station, Rev 19
- Nuclear Group Policy Rev 15
- Nuclear Operations Policy Rev 2, and Rev 15 thru 17
- FENOC Quality Assurance Program Manual Rev 0
- USAR 17.2 Rev 21
- Corrective Action Policy, Tech.-3 Rev 0 and Rev 15 thru Rev17
- PCAQ Review Board Charter Rev 2
- Davis-Besse Nuclear Power Station 10CFR50.59 Manual Rev 0, Rev 1 and Rev 3
- Nuclear Mission Policy and Organization, Rev 12
- Policy – Responses to Regulatory Requests, M&C-6 (Rev 0, Rev 15 and 16)
- Policy – Babcock and Wilcox Owners Group (B&WOG), M&C-12 (Rev 0, Rev 13, Rev 15 and Rev 17)
- Davis-Besse Nuclear Power Station Policy/Charter/Guideline Manual Table of Contents, Rev 116
- Charter – Independent Safety Engineering Charter (Rev 01)

9. Job Descriptions and Open Positions

- Plant Manager Davis-Besse Plant Operations
- Manager - Operations Davis-Besse Plant Operations
- Manager – Maintenance Davis-Besse Plant Operations
- Manager – Plant Engineering Davis-Besse Plant Operations
- Manager – Design Basis Engineering Davis-Besse Engineering and Services
- Manager – Quality Assessment Davis-Besse Nuclear Assurance
- Manager – Radiation Protection Davis-Besse Plant Operations
- Director – Engineering and Services Davis-Besse Engineering and Services
- Open Position Announcement – Manager, Nuclear Outage
- Open Position Announcement – Manager, Nuclear Environmental and Chemistry

10. Other Station Documents

- Davis-Besse 13RFO CRDM Nozzle Examination Report, Revision 1, Framatome ANP UT Report, March 11, 2002.
- Davis-Besse System Health Report, 4th Quarter 2001
- Request For Modification 94-0025 Install Service Structure Inspection Opening
- Inservice Inspection Plan (ISI Plan) Volume II Third Ten-Year Interval Pressure Test Program
- Inservice Inspection Plan (ISI Plan) Volume II Second Ten-Year Interval Pressure Test Program
- Relief Request RR-A3 Insulated ASME Class 1 and 2 Pressure Retaining Bolted Connections
- Relief Request RR-A10 ASME Class 1 and 2 Pressure Retaining Bolted Connections
- System Description:
    - SD-022B Containment Air Cooling System and Recirculation System
    - SD-39A Reactor Coolant System

- Technical Specifications:
  - 3/4.4.6.1 Reactor Coolant Leakage Detection Systems
  - 3/4.4.6.2 Reactor Coolant System Operational Leakage
  - 3/4.4.10 Structural Integrity ASME Code Class 1, 2, and 3 Components
  - Updated Safety Analysis Report Sections.

- Reactor Coolant System Summary Description
  - 5.2 Integrity of Reactor Coolant Pressure Boundary (RCPB)
  - 11.4.4.4.5 Containment Vessel Monitor
  - Fig. 5.1-2 Functional Drawing Reactor Coolant System
  - Fig. 5.1-3 Reactor Coolant System and Supporting Structures - Plan
  - Fig. 5.1-4 Reactor Coolant System and Supporting Structures – Plan
- RWP 2000-5132 Clean Boric Acid from Rx Head
- 11 RFO Log
- 12 RFO Log
- Test Cover Sheet DB-PF-03065, Pressure & Augmented Leakage Test – V-2 Examination Test
- Boric Acid Corrosion Control Inspection Checklist – Reactor Head Flange
- 12 RFO Notes Day 2, April 2, 2002 by Andrew Siemaszko
- LCTS Closeout Form – No. 3664 – NRC IN 86-108 Supplement 1
- Commitment A16892, Complete Actions Regarding CRDM Nozzle Cracking to B&W Plants
- Tour Report, Summary of Presentation at B&W Owners Group Materials Committee Meeting with NRC Staff
- Commitment Entry Record
- MOD 90-0012/Voided
- MOD 94-0025, Install Service Structure Inspection Openings
- Organization Charts
- QAD-99-70050. ISE Review of Implementation Date for MOD 94-0025
- Managers Plant Issues
- Effectiveness Review for CR 1998-0020
- Telecon Prep Meeting Planned Conference Call Participants Bulletin 2001-01 Response
- Pre-Maintenance Approval Form for Work Order 99-003733
- List of Managers/Directors and Their Time In Current Positions
- Engineering Evaluation/Response Sheet to PM Program Supervisor. Initiation of a PM to Inspect the CRD to Reactor Head Each Refueling Outage, Beginning with the Sixth Refueling Outage
- TERMS Item A16892
- LER 1998-009 Rev 1, Reactor Coolant System Pressurizer Spray Valve Not Functional With Two of Eight Body to Bonnet Nuts Missing
- PM 1629 Monitor for CRDM Leakage
- Commitment No. 08406 Inspection of Threaded Fasteners in RC Pressure Boundary

- Figure A-3 Commitment Evaluation Summary CES 96-002
- Maintenance Work Order 1-93-1165-00
- Qualification Card for Andrew Siesmaszko
- Qualification Card for Glenn McIntyre
- Qualification Card for Prasoon Goyal
- General RC-2 Records Search for Packing Leak 1988
- Plant Engineering Job Familiarization Guideline TSM-001 Rev 5
- Lesson Plan TSM-IDE-I1994 for ESP (Boric Acid)
- Glenn McIntyre EST Cycle 99-04 Exam Class #TSM-IDE-1994 Quiz A
- Andrew Siemaszko EST Cycle 99-04 Class #TSM-IDE-1994 Quiz A
- Prasoon Goyal EST Cycle 99-04 Class #TSM-IDE-1994 Quiz A
- Andrew Siemaszko, General Orientation, Job Familiarization Guidelines, TSM-000 R00
- Lesson Plan TSM-BAS-I005 Materials Fundamentals
- Lesson Plan TSM-BAS-I006 Chemistry Control Fundamentals
- Engineering Assessment Board Role/Policy In Support of the Return to Service Plan Rev 0 and Memo
- NFEP-012, 50.59 Written Safety Evaluations, Rev 4
- Engineering Assessment Board Role/Policy In Support of the Return to Service Plan Rev 0
- Davis-Besse Committees
- 2001 Nuclear Incentive Goals
- 2002 Nuclear Incentive Goals
- Engineering Principles and Expectations – DRAFT and FINAL
- 3.0 Programmatic Elements
- Davis-Besse Nuclear Power Station Outages Since 1986
- Commitment 008405, Serial 1527 – GL 88-55
- New Head Arrival Picnic – Summary of Remarks by Tony Alexander
- FENOC Quality Trend Summary First Quarter 2002 Condition Reports
- ISE 87-10049, ISE Inspection of Pressurizer for Possible Boric Acid Corrosion
- Surveillance Package SR-98-Maint-07 Closure Review
- Performance Engineering Department Instruction, Operating Experience Assessment Program – Review Operating Exp. Rev 01
- Condition Report Indicators for MRM
- Boric Acid Corrosion Control Inspection Checklist – Reactor Vessel Head Closure
- Framatome ANP Engineering Record 51-5018965-00 Davis-Besse Head Deposit Sample Characterization (Second Batch, Nozzle #2 Removal) DRAFT
- Davis-Besse Nuclear Power Station NRC Inspection Report No. 50-346/01-05 (DRP)
- Davis-Besse Engineering Work Request 01-0378-00 Request for Larger Access Holes on Bottom of Reactor Head Service Structure Flange
- Davis-Besse Activity Tracking System Document Detail EWR-01-378-00 Control Rod Drive Nozzles
- Boric Acid Corrosion Equation – Answer to Sargent and Lundy Report Question on Significance of Ferris Hydroxide
- Report Requirements Form NP-33-78-49, AFP 1-2 Inoperable – Isolated for Maintenance to Repair MS735

- Test Cover Sheet DB-PF-04162, AFPT Steam Supply Check Valve Reverse Flow Test
- Field Problem Resolution 91-0049-901
- Calculation Sheet C-NSA-083.01-004, Allowable Leakage for MS734 and MS735
- Request For Modification 93-0047, Modify Shafts on MS734 and MS735
- Request For Modification 91-0044, Replace MS734 and MS735
- Calculation Sheet C-ME083.01-234, MS to AFPT Heat Recovering Line 1/23/92
- Calculation Sheet C-ME083.01-234, MS to AFPT Heat Recovering Line 1/19/96
- Equivalent Replacement Resolution ERR 32-2828-001, Replace MS735 Due to Degraded Seat
- Purchase Order 7022415, Framatome Technologies
- Index of Aux Feed Long Standing Issues for MS734 and MS735
- Root Cause Analysis Report Safety Tagging Program Provides Inconsistent Protection
- Nuclear Quality Assessment Self-Assessment Critique Log
- Root Cause Analysis Report Significant Degradation of the Reactor Pressure Vessel Head, CR 2002-0891 (Technical Root Cause Analyses Report)
- Management Containment Entries 11RFO and 12RFO
- USAR Search for Boric Acid Control
- Employee Concerns/Ombudsman Program Annual Report 2000
- Employee Concerns/Ombudsman Program Annual Report 2001
- Framatome Proposal to FirstEnergy for Inspection and Repair Services at Davis-Besse and Task Authorization for Purchase Order 7076448
- Training Attendance Summary TSM-IDE Oral Quiz
- Technical Staff and Managers Training Plan
- FirstEnergy Performance Report First Quarter 2002
- H. Peter Burg's Annual Shareholders Meeting Presentation Slides and Text
- Davis-Besse 2002 Operational Business Plan
- Inservice Test Program Third 10 Year ISI Program Vol. II, Rev 0
- Nuclear Engineering Procedures Manual, Safety Review and Evaluations NEP-012 Rev 0
- E-Mail – Research of Training Records for NG-EN-00324 Rev 0, Boric Acid Control Program
- Engineering Department Instruction Change EN-DP-01200.5 Modification Design Reports Rev 0 Change No. 3
- Results of Search in Process and Area Radiation Monitor for RCS Leakage
- Davis-Besse 2002 Safety Conscious Work Environment Survey Results Summary
- LCTS Closeout – NCR 84-0179 Referenced in SRTP-CRD-NRR-06, Transferred to PCAQ 87-0032
- E-Mail – Sequence of Events For Alarms Received on RE4597 AA/BA
- E-Mail – Index Information in CURATOR Regarding Log 3166
- Davis-Besse Presentation to INPO, July 1999
- 2000 Incentives
- Davis-Besse Nuclear Power Station 1999 Incentive Compensation Performance Measures, Rev 3
- Davis-Besse Short Term 1998 Nuclear Incentive Goals Final
- Davis-Besse 1997 Incentive Compensation Program Performance
- Davis-Besse Local Objectives 1996 Performance Measures May Projected Results
- Centerior Power Generation Group 1996 Strategic Objective Measures

- Group Performance Measures 1995 Incentive Compensation Local Goals
- Synopsis of Phone Call Regarding Company Incentives
- Reactor Coolant Pump Issues List – Excerpts
- Nuclear Group Procedures Table of Contents Rev 11, Rev 12 and Rev 38
- Company Nuclear Review Board Procedures Table of Contents Rev 7
- Davis-Besse Nuclear Power Station Business Plan Monthly Performance Report, April 2002
- Safety Review TM99-0022, Supply Non-Essential 480 VAC Power to Portable Filtration Units in Containment
- 10CFR50.59 Evaluation TM01-0019, Remove Iodine Filter Cartridge for RE 4597AA Containment Atmosphere Normal Range
- Davis-Besse Milestone Chart 1985 to 2003
- Limiting Condition for Operation
- Davis-Besse Nuclear Power Station Business Plan Monthly Performance Report – December 2000
- Davis-Besse Nuclear Power Station Business Plan Monthly Performance Report – December 1999
- Davis-Besse Nuclear Power Station Business Plan Monthly Performance Report – December 1998
- Davis-Besse Nuclear Power Station Business Plan Monthly Performance Report – December 1997
- Davis-Besse Nuclear Power Station Business Plan Monthly Performance Report – December 1996
- Davis-Besse Operational Business Plan 2002
- Trainee Tracking Successful Completions
- Davis-Besse Management Timeline
- Independent Safety Engineering Semiannual Report No. 2, September 1986 – January 1987

10.2 Vendor References

1. BWOG Integrated Response to NRC Generic Letter 97-01 Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations, BAW-2301, Framatome ANP Report, July 1997
2. Framatome ANP Report 51-5001951-01, Alloy 600 PWSCC Susceptibility Model, December 9, 1998 (Proprietary)
3. Oconee 1 RPV Head Nozzle Leaks presented by Dave Whitaker at EPRI Alloy ITG meeting January 19, 2001
4. Dominion Engineering, Inc. Calculation No. C-5509-00-6 Davis Besse CRDM Leak Rates using ANSYS Crack Opening Area (non-safety related), Revision 0 3/19/2002 (Proprietary)
5. Dominion Engineering, Inc. Calculation No. C-5509-00-7 Davis Besse CRDM Nozzle Crack Opening Displacement Analysis, Revision 0 3/19/2002 (Proprietary)
6. Dominion Engineering, Inc. Calculation No. C-5509-00-5 Leak Rate through Axial Crack in Davis Besse CRDMs (non-safety related), Revision 1 3/19/2002 (Proprietary)
7. BAW-10190P Safety Evaluation for B&W-Design Reactor Vessel Head Control Rod Drive Mechanism Nozzle Cracking (Proprietary)