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From: James Caldwell
To: Jared Heck
Date: 07/05/2007 2:11:30 PM
Subject: Fwd: FENOC response to April 2 letter

Sent to me by myself so I don't know who Eric sent his e-mail to

>>> James Caldwell 05/09/2007 7:23 PM >>>

>>> Eric Duncan 05/03/2007 8:18 AM >>>
To all,

Please find attached FENOC's response to our letter that requested that FENOC provide us with their perspective on the Exponent Report as well as the implications of the Exponent Report.

Eric.

>>> <rritzman@firstenergycorp.com> 05/02/2007 5:44 PM >>>

Attached is the FENOC response to the Exponent Report questions from the NRC April 2 letter

(See attached file: Exponent Report RAI Approved Copy.pdf)

P285

FENOC
FirstEnergy Nuclear Operating Company

76 South Main Street
Akron, Ohio 44308

Danny L. Pace
Senior Vice President, Engineering

330-384-3733
Fax: 330-384-3799

Docket Number 50-346

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May 2, 2007

United States Nuclear Regulatory Commission
Document Control Desk
Washington, D.C 20555-0001

Subject: **Request for Response Regarding Report Prepared by Exponent Failure Analysis Associates and Altran Solutions Corporation Regarding Reactor Pressure Vessel Head Wastage at the Davis-Besse Nuclear Power Plant**

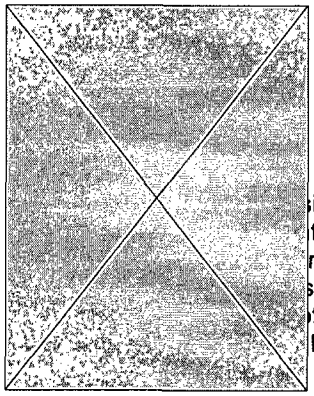
On March 20, 2007, the FirstEnergy Nuclear Operating Company (FENOC) submitted a report prepared by Exponent Failure Analysis Associates and Altran Solutions Corporation (Exponent) regarding the Davis-Besse Reactor Vessel Head wastage event to the Nuclear Regulatory Commission (NRC). By letter dated April 2, 2007, the NRC requested a response to four specific issues and a confirmation that the information Exponent provided during the referenced conference calls has not changed, and that the response be provided by May 2, 2007.

FENOC's responses to these four issues are included as Attachment 1 to this letter. These responses are consistent with the information previously provided to the NRC. While additional details are contained in Attachment 1, the technical information previously provided by Exponent has not materially changed.

The April 2, 2007, letter from the NRC states:

> Exponent stated that: (1) no new information was identified in their report that the NRC was not already aware of and was not already readily available;...

As previously stated during the conference calls referenced in the April 2, 2007, letter, the development of the Exponent Report relied upon data that was not known at the time the FENOC Root Cause Report was finalized in August 2002.



ignificant of this data was the metallurgical examination of the Davis-
trol Rod Drive Mechanism (CRDM) Nozzle 3 nozzle, weld and cavity,
rgonne National Laboratory (ANL) crack growth measurements on the
se Nozzle 3 Alloy 600 CRDM material, and the NRC/ANL data on the
f low alloy steels in molten metaboric acid. This data was either
by or later made available to the NRC. The purpose of the Exponent

Response to Request for Written Response

NRC Request 1:

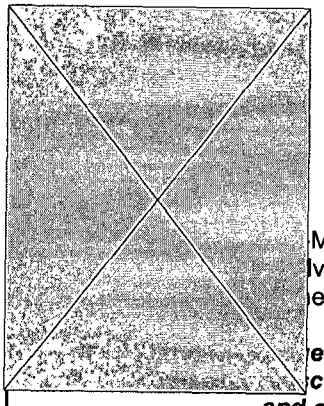
"provide your perspective on the overall conclusions and assumptions in the Exponent Report, as well as any assessments or interpretations of the Exponent Report provided to you by others and your response(s) thereto;"

FENOC Response:

The Exponent Report was prepared at FENOC's request in support of an on-going insurance claim with Nuclear Electric Insurance Limited (NEIL) and was transmitted to the NRC on March 20, 2007. As set forth below in response to NRC Request 2, the analyses of the Davis-Besse Control Rod Drive Mechanism (CRDM) cracking and Reactor Pressure Vessel (RPV) head degradation in the Exponent Report were developed using information that has been published by the NRC and the industry over the last several years, subsequent to the 2002 submission of the FENOC Root Cause Report and Licensee Event Report (LER) for the event.

As also discussed below in response to NRC Request 2, the conclusions in the Exponent Report with respect to the underlying root causes of the RPV head degradation at Davis-Besse are consistent with the root causes identified by the FENOC Root Cause Report, with the exception that Exponent concluded that the degradation time line was more rapid than originally believed five years ago. FENOC has entered the Exponent Report into the Corrective Action Program, has evaluated the conclusions, and believes that the Exponent organization has set forth an informed analysis that more accurately characterizes the timeline of the reactor head degradation event based on their use of more recently available test data in conjunction with detailed analytical modeling. FENOC has not specifically evaluated all of the assumptions used by Exponent; however, FENOC believes that the conclusions in the Exponent Report reflect a more accurate representation of the timing of the events.

Since the Exponent Report outlined a different perspective on the evolution of the event based on recent research findings, it was provided to the NRC and the Nuclear Energy Institute (NEI). NEI organized a review by an expert panel for the Materials Executive Oversight Group (MEOG) to assess current inspection guidance in light of the conclusions identified in the report. Thus far, there have been no inspection guidance changes or generic safety implications identified; the report summarizing the results of the expert panel review is expected to be completed in



May. Since the matters discussed in the Exponent Report are lved in the insurance arbitration and other litigation, there will be er assessments and interpretations of this report.

est 2:
cuss any differences between the Exponent Report information and conclusions drawn therein, and information previously provided in your Root Cause Analysis Report and Licensee Event Report for the Davis-Besse reactor pressure vessel head wastage event. Provide your evaluation of any differences, including which views you conclude are correct, and the rationale for your conclusions;"

including, but not limited to, a very high crack growth rate for the Alloy 600 nozzle material, the presence of a very large weld crack which significantly increased leakage and metal removal rates late in Cycle 13, and high corrosion rates caused by molten boric acid previously thought to be innocuous to low alloy steel.

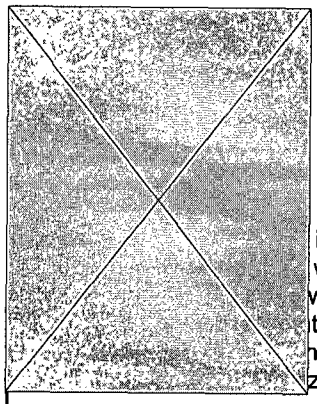
The FENOC Root Cause Report stated that "a reasonable time-frame for the appearance of leakage on the RPV head at Davis-Besse is approximately 1994 - 1996. Utilizing an average PWSCC crack growth rate of approximately 4 mm/year through the 16 mm thick CRDM nozzle material, the timeframe at which crack initiation occurred would correspond to approximately 1990 $\pm$ 3 years." The FENOC Root Cause Report further stated that the corrosion rate began to increase significantly starting at about the eleventh Refueling Outage (RFO) and acted for a four year period of time.

The investigation that formed the basis for the FENOC Root Cause Report did not have the benefit of three critical items of technical information that became available years later and which, in part, formed the basis for the Exponent Report. These items are:

- The detailed test data published by the NRC/Argonne National Laboratory (ANL) in November 2006 that provided definitive information on the specific crack growth rates for the Davis-Besse CRDM Nozzle 3 Alloy 600 material.

- The results of the detailed metallurgical examinations of the nozzle remains, weld region, and large wastage cavity from CRDM Nozzle 3. This not only provided invaluable information on the nozzle, weld, and cavity, it also identified a previously unknown large weld crack at Nozzle 3. This weld crack was in line with the wastage cavity, had not been found during the non-destructive examination (NDE) inspection prior to the nozzle removal, and clearly contributed significantly to leakage and cavity growth once it was uncovered late in the sequence of events. The results of this metallurgical examination were not available until June 2003.

- The boric acid corrosion data published by the NRC/ANL in July 2005 for corrosion rates in re-wetted molten metaboric acid for thermal-hydraulic conditions that were thought to be present in the annular crevice and wastage cavity during the evolution and growth of leakage of the wastage cavity at Davis-Besse CRDM Nozzle 3.



impact of these data on the definition of the timeline for crack growth wastage cavity development was likewise three-fold. First, the crack vth rate data reported by the NRC/ANL program in 2005 was a key t to the fracture mechanics analysis and the development of the more nitive timeline for the growth of the axial crack at Davis-Besse zle 3 CRDM presented in the Exponent Report.

Second, the detailed metallurgical examination of the CRDM Nozzle 3 tube and weld and the identification of the large weld crack at Nozzle 3 was a key input into the analysis of the nozzle and weld crack leakage flow presented in the Exponent Report.

in the annular crevice and the wastage cavity over time, in order to better assess the potential for different metal removal processes and rates to exist at different times. We undertook the CFD [Computational Fluid Dynamic] modeling work with this objective in mind."

Thus, in developing the timeline of the wastage cavity development at Davis-Besse CRDM Nozzle 3, part of the Exponent investigation and analysis was to undertake detailed CFD modeling to provide information on the thermal-hydraulic conditions in the developing wastage cavity. This CFD modeling work provided new results and findings that were not available at the time of the FENOC Root Cause Report, and, in fact, was one of the key missing inputs to the timeline development that the FENOC Root Cause Report identified.

Based on the new data described above and on detailed stress, fracture mechanics and CFD analyses, the following conclusions regarding the timeline for crack growth and RPV head degradation that are different from those discussed in the FENOC Root Cause Report and LER were noted in the Exponent Report:

- Based on the stress and fracture mechanics analyses described in the Exponent Report, Exponent concluded that the axial crack at CRDM Nozzle 3 reached the top of the weld and began leaking in mid-1999, in the middle of Cycle 12, and further, that a through-wall CRDM nozzle crack would have developed in a little over three years. This crack growth timeline is substantially shorter than that presented in the Root Cause Report.

- In the Exponent Report, it was concluded that during 12RFO, in April-May 2000, this crack at CRDM Nozzle 3 would have grown to approximately 0.6 inch above the weld, and that leakage from this crack would have been miniscule.

- In the Exponent Report, it was further concluded that the boric acid accumulation on the RPV head at Nozzle 3 from this leakage would have been less than 1 cubic inch, and that while this small amount of boric acid may have been visible had it not been obscured by much larger deposits of boric acid from leaking CRDM flanges, degradation of the RPV head low alloy steel would not have been visible during 12RFO with "through-the-mouse-hole" video inspection techniques even if the RPV head had been completely cleaned of boric acid deposits. In addition, complete cleaning of the boric acid accumulation from the RPV head at this time would

also have removed the very small amount of boric acid that originated from the CRDM nozzle crack, making it unlikely that the wastage cavity would have been detected.

- With respect to the timeline of cavity growth at CRDM Nozzle 3, it was concluded in the Exponent Report that the downward cavity growth accelerated in the May-October 2001 time period, as the leak rate increased and moisture penetrated into the cavity. The downward growing cavity intersected with the upward growing crack late in 2001, resulting in the rapid removal of the remaining one inch of RPV head metal above the weld and the beginning of under-cutting of the cavity at the leak location. This process then suddenly uncovered the large pre-existing weld crack, resulting in a rapid increase in leak flow, causing the large wastage cavity to develop between October-November 2001 and February 2002 when it was discovered during 13RFO.

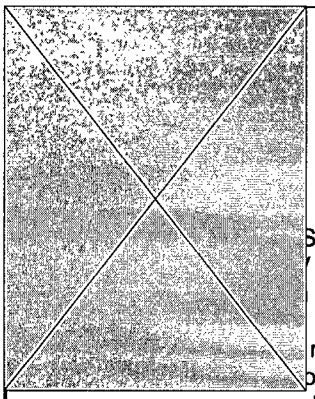
Although the exact timing and sequence of the Reactor Vessel Head wastage event will never be known with exact certainty, Exponent has set forth an informed analysis using more recently available test data in conjunction with detailed analytical modeling and sound engineering techniques. FENOC believes that this analysis more accurately characterizes the timeline of the reactor head degradation event than the Root Cause Report developed in 2002. The reason that they are different from the conclusions set forth in the FENOC Root Cause Report and the LER is that the conclusions in the Exponent Report are based on data commissioned by the NRC that has become available since 2002, and on crack growth and CFD analyses performed by Exponent that were completed based on these data.

NRC Request 3:

"discuss any implications, or lack thereof, regarding the adequacy of both the specific and more broad-based corrective actions for the Davis-Besse reactor pressure vessel head wastage event, as well as for the closure of the NRC's Confirmatory Action Letter (CAL) 3-02-001 items. Specifically provide the rationale for your conclusions regarding the adequacy of the corrective actions;"

FENOC Response:

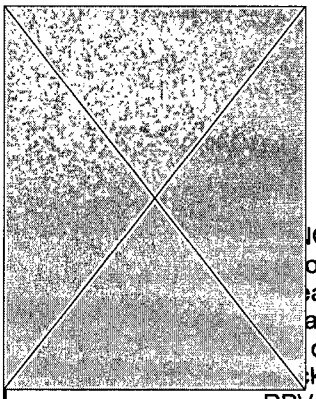
FENOC conducted a review of the corrective actions from the original Root Cause Reports and the actions that closed the Confirmatory Action Letter. The conclusion of this review was that the principal technical root causes of the cracking and subsequent degradation remain in agreement between the two reports. As previously discussed, the root causes of



SCC of the CRDM Alloy 600 nozzle material and material loss from the
' head as a result of leakage from cracked nozzles is consistent in
reports.

rationale used in the review was focused on the conclusions in the
onent Report related to the timeline aspect of the degradation. The conclusion of this part of the review was that none of the specific or more broad-based corrective actions for the Davis-Besse RPV head wastage event are affected by the more rapid timeline for the head wastage that the Exponent Report sets forth.

The corrective actions, both completed and on-going, are adequate to assure the safe operation of the Davis-Besse Nuclear Plant. No modifications to any of the corrective actions were determined to be necessary for either the root cause corrective actions or the subject



NOC does not intend to revise the Root Cause Analysis Report. The onent Report was developed with the benefit of four additional years of earch and data accumulation, and was based on analyses that were available in 2002. Additionally, the industry has on-going research other activities to develop additional understandings of both Alloy 600 king and boric acid wastage of low alloy steel components such as RPV heads. Consequently, it is expected that reports based on contemporary and relevant information will continue to be published, and it would not serve either the industry or Davis-Besse to continually update

Commitment List

The following list identifies those actions committed to by FirstEnergy Nuclear Operating Company (FENOC) for the Davis-Besse Nuclear Power Station, Unit No. 1. Any other actions discussed in the submittal represent intended or planned actions by FENOC. They are described only as information and are not regulatory commitments. Please contact Mr. James J. Powers, Director, Fleet Engineering, at (330) 384-4930 with any questions regarding this document or associated regulatory commitments.

Commitment	Due Date
None	N/A