EDO Principal Correspondence Control

FROM: DUE: 05/13/02 EDO CONTROL: G20020265
DOC DT: 05/01/02
FINAL REPLY:

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Representative March Kaptur

TO:

Chairman Meserve

FOR SIGNATURE OF : ** PRI ** CRC NO: 02-0323

Chairman Meserve

DESC:

Safety Issues at the Davis-Besse Nuclear Power Plant - Licensee Inspections and Safety Procedures

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Ref. G20020184 and G20020263.

Template: SECY-017 E-RIDS: SECY-01

OFFICE OF THE SECRETARY
CORRESPONDENCE CONTROL TICKET

Date Printed: May 01, 2002 16:01

PAPER NUMBER:	LTR-02-0323	**LOGGING DATE:**	05/01/2002
ACTION OFFICE:	EDO		

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ADDRESSEE:	Richard Meserve
SUBJECT:	Safety issues at the Davis Besse nuclear power plant, licensee inspections and safety; procedures.....
ACTION:	Signature of Chairman
DISTRIBUTION:	Chairman, Comrs, OPA, RF, OCA to Ack
LETTER DATE:	05/01/2002
ACKNOWLEDGED	No
SPECIAL HANDLING:	Authors: Rep M. Kaptur Rep Edward Markey
NOTES:	Commission Correspondence
FILE LOCATION:	Adams

DATE DUE:	05/15/2002	**DATE SIGNED:**	

Congress of the United States

Washington, DC 20515

May 1, 2002

The Honorable Richard A. Meserve
Chairman
Nuclear Regulatory Commission
Washington, D.C.

Dear Chairman Meserve:

We are writing to express our concerns regarding the safety issues raised by recent events at the Davis-Besse nuclear power plant in Ohio. These events indicate that we only very narrowly averted a nuclear catastrophe of the magnitude of Three Mile Island or worse. Moreover, past correspondence one of us (Rep. Markey) received from the NRC regarding the problem of cracks in reactor vessel head penetrations (cracks in reactor vessel heads precede holes, such as the one in the Davis-Besse reactor) was inaccurate at best, misleading at worst, since NRC dismissed these concerns and insisted that such problems would be detected long before they became significant safety problems. The events at Davis-Besse clearly indicate that this was not the case.

According to NRC documents, licensee filings, and press reports, on March 6, 2002, the operator of the Davis-Besse nuclear power plant discovered that boric acid in the reactor's cooling water had eaten a hole nearly all of the way through the six-inch-thick lid of the reactor. This corrosion reportedly left less than a half-inch thick stainless steel liner to hold in cooling water at the plant, and that liner had begun to buckle, raising concerns about what might have happened had the liner given away. An article in the New York Times reported that:

> "If the liner had given way in the Ohio reactor, experts say there would have been an immediate release of thousands of gallons of slightly radioactive and extremely hot water inside the reactor's containment building.
>
> "The plants have pipe systems that are meant to pump water back into a leaking vessel, but some experts fear that if rushing steam and water damaged thermal insulation on top of the vessel, the pipes could clog. In that event, the reactor might have lost cooling water and suffered core damage – possibly a meltdown – and a larger release, at least inside the building."

While such reports are quite troubling, some experts contacted by my staff have raised far more disturbing concerns about the events at Davis-Besse, suggesting that we came very close to an accident of similar or greater severity to the Three Mile Island

disaster. These experts note that the two most important safety systems in a nuclear power plant are the control rod drive system and the reactor vessel. The control rod drive system stops the fission process and the reactor vessel contains the fuel and fission products in what experts term a "coolable geometry," -- meaning that the reactor vessel keeps the nuclear fuel in an arrangement that can be cooled. As we understand it, in order to protect public health and safety, the control rod drive system must quickly terminate the fission process (scram the reactor) and the reactor vessel must remain intact so decay heat can be removed from the fuel. If either fails, we have been informed that a core meltdown can result.

However, we am also informed that neither of these functions have backup systems. Redundant scram systems apparently were considered in the very early days of the nuclear industry and not included in the design basis as they reportedly were difficult to design and the failure of the system was considered incredible. Similarly, for the reactor vessel, licensees have never constructed redundant vessels or added systems that would mitigate the vessel's failure.

At Davis-Besse, both of these safety systems could have failed if the stainless steel clad had failed. Experts consulted by my staff have suggested that, unlike other safety-related systems, there appears to have been no detailed engineering studies or analysis done of this type of accident or how to respond to it. As a result, if the hole in the reactor had blown through, the operator could have been "flying blind" – without established procedures or routines that would result in a safe shutdown of the plant. It has therefore been suggested that the worst-case result is not merely leakage of radioactive water onto the containment vessel floor, but an uncontrolled meltdown with no established, fully-analyzed procedures or guidance available to the operator or the Commission with respect to how to safely shut down the reactor and prevent a catastrophe.

Six years ago, one of us (Rep. Markey) repeatedly raised safety concerns with the Commission regarding the problem of cracks in reactor vessel head penetrations. At the time, the NRC claimed that there were no significant safety issues in this area that required immediate action. It appears from the Davis-Besse events that the Commission's responses to these questions were at best inadequate, and at worst, misleading.

> Specifically, on March 27, 1996, the Commission told the Congress that "there is no immediate safety concern regarding this issue" and that the NRC staff planned to meet with the nuclear industry to determine what further actions are required in this area.

Rep. Markey subsequently raised this issue again, in connection with the Subcommittee on Energy and Power's September 5, 1996 NRC oversight hearing. At

that time, the NRC reported that, based on its review of a Nuclear Energy Institute "White Paper" on the subject, as well as results of inspections and other analyses,

> "the NRC staff has determined that VHP [Vessel Head Penetration] cracking does not pose an immediate safety concern because the cracks would result in detectable leakage before failure, and the leakage would be detected during visual examinations performed as part of surveillance walkdown inspections."

The NRC response indicated, nonetheless, that "degradation of the VHPs is an important safety consideration that warrants further evaluation" and that in order to "ensure safety in the long-term" the NRC planned to issue a Generic Letter to request information on licensee inspection plans. Subsequent events at Davis-Besse would seem to suggest that this Generic Letter was not effective in addressing this issue.

We now understand that the cracks that grew into the hole in the Davis-Bessie vessel head had already formed up to six years before the aforementioned Congressional inquiries, and that they had actually propagated through the wall of control rod nozzles by 1996. According to the Probable Cause Summary Report submitted by the licensee, "the factors that caused corrosion of the RPV head in the regions of nozzles #2 and #3 are CRDM nozzle leakage associated with through-wall cracking, followed by boric acid corrosion of the PRV low-alloy steel."

Obviously, despite the Commission's 1996 assurances to the Congress that such cracking would be detected before failure, the full nature and scope of the threat this posed to the reactor's safe operation was not detected in any visual examinations of the reactor vessel head for another six years, and then was detected only by accident. It also seems apparent now that visual inspections were incapable of detecting significant cracking based on the presence of insulation in the reactor vessel head.

This failure raises concerns about both the adequacy of licensee inspections and safety procedures and NRC oversight of such activities. In light of this situation and in order to carry out our oversight and legislative responsibilities, we request that the Commission provide us with responses to the following questions:

1. Does the safety analysis for nuclear power plants consider cracks or holes specifically located in the reactor vessel head (in addition to any analysis of pressurized thermal shock)? In other words, have such analyses specifically examined the safety consequences of a hole in a reactor vessel head? If not, why not?
2. If the stainless steel clad had failed, what assurance does the NRC have that the safety systems at Davis-Besse or any other plants would have mitigated the event? Please fully describe and document any back-up safety system that would have prevented, slowed or minimized the uncontrolled meltdown that might have begun.

3. What thermal hydraulic analysis has the NRC performed to determine whether or not a hole or crack in the reactor vessel head would not have resulted in a core meltdown? Provide any analysis or supporting documentation.
4. If the clad had failed, what would the consequential damage to the control rod drive system have been?
5. Is it possible for the control rod drive systems to withstand the thermal and hydraulic forces generated by the breaking of the clad and successfully scram the reactor? Provide any supporting analysis to justify the answer.
6. If the control rod drive system were damaged as the result of a reactor vessel rupture in the RPV head, would a reactor scram occur before or after the damage to the control rods? Provide any supporting analysis to justify the answer.
7. If the damage occurred before the scram occurred, what would have been the consequences assuming the remaining safety systems worked?
    a. Is it possible that the control rod insertion mechanism would have been disabled at or around the same time that the emergency core cooling systems were reflooding the reactor with water to replace that lost as a result of the rupture?
    b. What would have been the consequences of such a chain of events?
    c. Would the containment have failed?
    d. Would there have been offsite releases?
    e. What would have been the dose rates within the vicinity of Davis Besse?
    f. Would regulatory limits have been exceeded? If so, by how much?
8. Page 1 of the Probable Cause Summary Report of the Initial Investigative Team for Root Cause (hereinafter referred to as "March 22, 2002 Report") states that "Deferral of the modification to the service structure for improved access when the modification was first considered resulted in the continued limited ability to prevent significant boric acid accumulations and allow for better visual determination of leakage sources."
    a. Why was modification of the service structure deferred?
    b. Who made this decision?
    c. Did the NRC staff approve such deferral, and if so, on what basis?
    d. How many other licensees have deferred and/or never undertaken similar modifications to assure access to their service structures?
9. The March 22, 2002 Report states that "Boric acid that accumulated on the top of the RPV head over a period of years inhibited the station's ability to confirm visually that neither nozzle leakage nor vessel corrosion was occurring. Evidence available now shows that leakage from the nozzles began 2 to 4 operating cycles ago."
    a. Why wouldn't the presence of boric acid on the top of the RPV head been an indication to the licensee or to NRC inspection personnel that there was a problem? Is it normal for there to be boric acid accumulations on the top of the RPV for years?
    b. Is it the NRC's policy that if boric acid or anything else obscures the top of the RPV head, that the licensee is free to ignore it for years and thereby

fail to confirm visually that neither nozzle leakage nor vessel corrosion was occurring?

c. Why was leakage from the nozzles not immediately detected at the time it was occurring?
d. Why was this leakage not successfully detected in routine inspections, as the NRC assured Congress it would be in 1996?
e. If the normal presence of insulation in the RPV has the effect of preventing inspections from successfully detecting cracks that could result in leaks, then what was the basis for the NRC's 1996 assurances to me that such cracks could be detected long before leaks occurred?
f. It now appears that both the Davis-Besse and Oconee nuclear reactors operated for many months (perhaps years) with through-wall cracks in the CRDM nozzles. Based on this experience, how can the NRC be sure that its reliance on "leak-before-break" and inspections is justified? Doesn't this experience strongly suggest that either the Technical Specification limits on unidentified leakage need to be tightened or that the vessel head penetrations need to be instrumented to allow leakage to be immediately detected?
g. The Updated Final Safety Analysis Report (UFSAR) for Davis-Besse doesn't appear to allow for the presence of boric acid in the RPV head. Four modes of failure are described, including 1) ductile yielding; 2) brittle fracture; 3) fatigue; and 4) NDTT (Nil Ductility Temperature Transition, also known as "reactor embrittlement"). Nowhere is boric acid corrosion mentioned. In light of this, shouldn't the presence of boric acid <u>alone</u> in the RPV have immediately halted operation of the reactor and triggered a full investigation by the licensee and the NRC?
h. Wasn't Davis-Besse operating outside its design basis? If so, if a rupture had occurred, isn't it true that there would have been no basis for knowing whether the event could have been controlled?

10. The March 22, 2002 Report states that "Historically, there have been problems with CRDM flange leakage both at Davis-Besse and the industry. This appears to have obscured the recognition that boric acid accumulation on the RPV might also be due to nozzle leakage."
    a. What is the nature and safety significance of the flange leakage problem?
    b. Where did the leakage come from?
    c. Please provide a list of all other reactors that have been affected.
    d. What measures have been undertaken to address these problems at these reactors?
    e. If, at Davis-Besse, CRDM flange leakage obscured recognition that boric acid accumulation on the RPV might also be due to nozzle leakage, couldn't this have occurred elsewhere? What has been done to determine whether or not this has occurred?

11. The March 22, 2002 Report states that "The potential for significant corrosion of the RPV head as a result of accumulating boric acid and local leakage was not recognized as a safety significant issue by the staff and management of the plant."
    a. Isn't the RPV lined with stainless steel to protect it from significant corrosion?
    b. If so, how could the potential for significant corrosion not be recognized as a safety significant issue?
12. The key events timeline set forth in the March 22, 2002 report notes that sometime between 1994-1996 "CRDM nozzle #3 crack propagates through wall of nozzle;" that in 1998 and 2000 the licensee "did not identify nozzle leakage on head, nor was boric acid accumulation successfully removed from nozzle #3;" and that in 1999 "noteworthy corrosion at nozzle #3 of the RPV head initiated, as evidenced by iron oxide in the containment atmosphere." How and why were these apparent warning flags ignored by the licensee?
13. The March 22, 2002 report states "It should be noted that there is strong circumstantial evidence that the iron oxide that Davis-Besse began to collect in radiation monitor filters in 1999 was indicative of the RCS leak and corrosion in nozzle #3. As Operational Experience, this information would be potentially beneficial to other plants." Has the NRC asked other plants to check for accumulation of iron oxide in their radiation monitor filters? If not, why not? If so, what have they found? Since iron oxide is rust, why didn't the operators assume that they had a corrosion problem in 1999, take steps to identify its source, and then fix the problem?
14. According to the NRC reports, the air filters on the containment radiation monitors were replaced far more frequently than normal due to plugging from iron oxide (i.e., rust) and boric acid in the air. This buildup of material on the filters (i.e. plugging) was likely due to the corrosion that was occurring in the reactor vessel head.
    a. What corrective action did the Davis-Besse licensee take, if any, in response to the abnormal condition?
    b. Did anyone bring the problem to the attention of management?
    c. Were any problem reports written? If so, provide copies.
    d. What were the responses, if any, to these reports?
    e. Is the absence of problem or corrective action reports a violation of 10CFR50 Appendix B, the NRC's quality assurance requirements?
    f. Please provide any documentation related to any corrective action that Davis-Besse took in response to the plugging of the air filters in the containment radiation monitors. Did the resident inspector or regional personnel know of the problem with the plugging of the air filters?
    g. If not, why not? Provide any NRC documentation related to the NRC knowledge of the plugging of the air filters.
15. If a manufacturer of reactor vessels proposed to construct a vessel with a stainless steel plug of the same size using the same process (welding, heat treating, etc.) that Davis Besse is likely to use, would the vessel be qualified for nuclear service

(i.e. qualify for an N stamp)? If not, why should the proposed repair be acceptable?

16. In the responses to the NRC request for additional information related to this event, many of the licensees are relying on results from the current inspection process to justify the continued operation of their plants. Why is this justified given that those very inspection processes failed to discover the hole in Davis-Besse's vessel head?
17. The nuclear industry is relying heavily on an EPRI report related to corrosion rates in their reactor vessel head inspection programs. Those programs are at least in part related to the continued operation of plants. The experience at Davis-Besse may not be consistent with the EPRI study. Will the NRC require an independent evaluation of the EPRI report in light of the Davis-Besse experience to justify its continued use as a basis for developing reactor vessel head inspection programs? Has the NRC performed an evaluation itself?
18. Neither the NRC nor the nuclear industry has been able to pinpoint with any certainty the exact cause of the corrosion in the Davis-Besse head. It could have come from above the head from small leaks in the control drive housing flanges, from below through cracks in the penetration or both. Without knowing the origin of the leakage and its exact cause, how can any sort of effective corrective action program be developed to prevent occurrence elsewhere?
19. Both the nuclear industry and the NRC considered failures in the reactor vessel of the type that occurred at Davis-Besse to be not credible. As such, there is no analysis that demonstrates that the public health and safety is maintained. The Davis-Besse event shows that such failures are credible.
    a. What changes to the regulations does the NRC anticipate in response to this event that was previously considered incredible?
    b. What implications does this have for the NRC's decision to adopt what it has termed "risk-informed" regulation? Did the risk-informed approach to regulation successfully identify the Davis-Besse event as a risk for which appropriate regulations needed to be prepared?
    c. If not, what does this say about the efficacy of the NRC's "risk-informed" regulation model?
    d. Does the NRC intend to reconsider "risk-informed" regulation in light of the Davis-Besse experience?
    e. If such events are to be reviewed, what criteria will the NRC use to judge whether or not new design basis accidents should be backfitted to older plants or required for new designs? If the NRC does not intend to do such reviews, why not?
20. There is some indication that the Europeans (especially the French) have taken much more aggressive corrective action than the US in response to cracking around CRDM nozzles.
    a. What caused the Europeans to adopt this more aggressive approach?
    b. Has the NRC office monitored the actions of Europeans?

c. By whom and what office?
d. Did that office know of the actions taken by the French?
e. Did that office inform the Commissioners?
f. To what extent did the NRC take any action knowing what the Europeans did?
g. Provide any papers, correspondence or other documents related to the European response to this problem.
h. Is there any technical basis that the Europeans should have taken more aggressive action?

21. We understand that some NRC staff members wanted to ask FirstEnergy additional questions last fall about its request to delay CRDM nozzle inspections, but that NRC senior management overruled this request. Is this true? Please provide a copy of all correspondence between NRC staff and between NRC staff and the Commission relating to the delay in the CRDM nozzle inspections.
22. We have seen press reports indicating that FirstEnergy ordered a new reactor vessel head for Davis-Besse in December, months before it reported the hole in the existing RPV to the NRC. What does this suggest regarding what the licensee knew about problems with the reactor? Did the licensee tell the NRC staff that it was planning to replace the RPV head at the time that it was requesting a delay in the CRDM nozzle inspections? If not, should it have done so?

Thank you for your assistance and cooperation in this matter. Should you have any questions about this request, please have your staff contact Mr. Jeffrey S. Duncan (Rep. Markey) at 202-225-2836 or Nathan Facey (Rep. Kaptur) at 202-225-4116.

Sincerely,

Edward J. Markey
Member of Congress

Marcy Kaptur
Member of Congress