February 9, 2006

Mr. Mark B. Bezilla
Vice President
FirstEnergy Nuclear Operating Company
Davis-Besse Nuclear Power Station
Mail Stop A-DB-3080
5501 North State Route 2
Oak Harbor, OH 43449-9760

SUBJECT: DAVIS-BESSE NUCLEAR POWER STATION, UNIT 1 - REQUEST FOR ADDITIONAL INFORMATION RE: RESPONSE TO GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN-BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS" (TAC NO. MC4681)

Dear Mr. Bezilla:

On September 13, 2004, the Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," as part of the NRC's efforts to assess the likelihood that the emergency core cooling system (ECCS) and containment spray system (CSS) pumps at domestic pressurized water reactors (PWRs) would experience a debris-induced loss of net positive suction head margin during sump recirculation. The NRC issued this GL to all PWR licensees to request that addressees (1) perform a mechanistic evaluation using an NRC-approved methodology of the potential for the adverse effects of post-accident debris blockage and operation with debris-laden fluids to impede or prevent the recirculation functions of the ECCS and CSS following all postulated accidents for which the recirculation of these systems is required, and (2) implement any plant modifications that the above evaluation identifies as being necessary to ensure system functionality. Addressees were also required to submit information specified in GL 2004-02 to the NRC in accordance with Title 10 of the *Code of Federal Regulations* Section 50.54(f). Additionally, in the GL, the NRC established a schedule for the submittal of the written responses and the completion of any corrective actions identified while complying with the requests in the GL.

By letter dated March 4, 2005, as supplemented by letter dated September 1, 2005, FirstEnergy Nuclear Operating Company provided a response to the GL. The NRC staff is reviewing and evaluating your response along with the responses from all PWR licensees. The NRC staff has determined that responses to the questions in the enclosure to this letter are necessary in order for the staff to complete its review. Please note that the Office of Nuclear Reactor Regulation's Division of Component Integrity is still conducting its initial reviews with respect to coatings. Although some initial coatings questions are included in the enclosure to this letter, the NRC might issue an additional request for information regarding coatings issues in the near future.

Please provide your response within 60 days from the date of this letter. If you have any questions, please contact me at (301) 415-3154.

Sincerely,

/RA/

Stephen Sands, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-346

Enclosure:
Request for Additional Information

cc w/encl: see next page

Please provide your response within 60 days from the date of this letter. If you have any questions, please contact me at (301) 415-3154.

Sincerely,

/RA/

Stephen Sands, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-346

Enclosure:
Request for Additional Information

cc w/encl: see next page

DISTRIBUTION:

PUBLIC	RArchitzel	SLu
LPLIII-2 Reading File	WBateman	THaffera
RidsNrrDorlLplf	RidsNrrPMJHopkins	JLehning
RidsNrrLADClarke	HWagage	JHannon
RidsNrrPMSSands	MMurphy	BSingal, NRR DPR
RidsOgcRp	PKlein	
RidsAcrsAcnwMailCenter	MYoder	
RidsRgn3MailCenter	MScott	

Accession No.: **ML060380725** *per e-mail

OFFICE	LPLIII-2/PM	LPLIII-2/LA	DSS/SSIB	DCI/CSGB	LPLIII-2/BC
NAME	SSands	DClarke	DSolorio*	EMurphy*	MLandau
DATE	2/9/06	2/9/06	2/6/06	2/8/06	2/9/06

OFFICIAL RECORD COPY

Davis-Besse Nuclear Power Station, Unit 1

cc:

Manager - Regulatory Affairs
FirstEnergy Nuclear Operating Company
Davis-Besse Nuclear Power Station
5501 North State - Route 2
Oak Harbor, OH 43449-9760

Director, Ohio Department of Commerce
Division of Industrial Compliance
Bureau of Operations & Maintenance
6606 Tussing Road
P.O. Box 4009
Reynoldsburg, OH 43068-9009

Regional Administrator
U.S. Nuclear Regulatory Commission
801 Warrenville Road
Lisle, IL 60523-4351

Resident Inspector
U.S. Nuclear Regulatory Commission
5503 North State Route 2
Oak Harbor, OH 43449-9760

Barry Allen, Plant Manager
FirstEnergy Nuclear Operating Company
Davis-Besse Nuclear Power Station
5501 North State - Route 2
Oak Harbor, OH 43449-9760

Dennis Clum
Radiological Assistance Section Supervisor
Bureau of Radiation Protection
Ohio Department of Health
P.O. Box 118
Columbus, OH 43266-0118

Carol O'Claire, Chief, Radiological Branch
Ohio Emergency Management Agency
2855 West Dublin Granville Road
Columbus, OH 43235-2206

Zack A. Clayton
DERR
Ohio Environmental Protection Agency
P.O. Box 1049
Columbus, OH 43266-0149

State of Ohio
Public Utilities Commission
180 East Broad Street
Columbus, OH 43266-0573

Attorney General
Office of Attorney General
30 East Broad Street
Columbus, OH 43216

President, Board of County
Commissioners of Ottawa County
Port Clinton, OH 43252

President, Board of County
Commissioners of Lucas County
One Government Center, Suite 800
Toledo, OH 43604-6506

The Honorable Dennis J. Kucinich
United States House of Representatives
Washington, D.C. 20515

The Honorable Dennis J. Kucinich
United States House of Representatives
14400 Detroit Avenue
Lakewood, OH 44107

Gary R. Leidich
President and Chief Nuclear Officer
FirstEnergy Nuclear Operating Company
Mail Stop A-GO-19
76 South Main Street
Akron, OH 44308

Joseph J. Hagan
Senior Vice President of Operations and
Chief Operating Officer
FirstEnergy Nuclear Operating Company
Mail Stop A-GO-14
76 South Main Street
Akron, OH 44308

David W. Jenkins, Attorney
FirstEnergy Corporation
Mail Stop A-GO-18
76 South Main Street
Akron, OH 44308

Danny L. Pace
Senior Vice President, Fleet Engineering
FirstEnergy Nuclear Operating Company
Mail Stop A-GO-14
76 South Main Street
Akron, OH 44308

Manager, Fleet Licensing
FirstEnergy Nuclear Operating Company
Mail Stop A-GHE-107
395 Ghent Road
Akron, OH 44333

Manager, Site Regulatory Compliance
FirstEnergy Nuclear Operating Company
Davis-Besse Nuclear Power Station
Mail Stop A-DB-3065
5501 North State Route 2
Oak Harbor, OH 43449-9760

Jeannie M. Rinckel
Vice President, Fleet Oversight
FirstEnergy Nuclear Operating Company
Mail Stop A-GO-14
76 South Main Street
Akron, OH 44308

GL 2004-02 RAI Questions

Plant Materials

1. Identify the name and bounding quantity of each insulation material generated by a large-break loss-of-coolant accident (LBLOCA). Include the amount of these materials transported to the containment pool. State any assumptions used to provide this response.

2. Identify the amounts (i.e., surface area) of the following materials that are:

   (a) submerged in the containment pool following a loss-of-coolant accident (LOCA),

   (b) in the containment spray zone following a LOCA:

   - aluminum
   - zinc (from galvanized steel and from inorganic zinc coatings)
   - copper
   - carbon steel not coated
   - uncoated concrete

   Compare the amounts of these materials in the submerged and spray zones at your plant relative to the scaled amounts of these materials used in the Nuclear Regulatory Commission (NRC) nuclear industry jointly-sponsored Integrated Chemical Effects Tests (ICET) (e.g., 5x the amount of uncoated carbon steel assumed for the ICETs).

3. Identify the amount (surface area) and material (e.g., aluminum) for any scaffolding stored in containment. Indicate the amount, if any, that would be submerged in the containment pool following a LOCA. Clarify if scaffolding material was included in the response to Question 2.

4. Provide the type and amount of any metallic paints or non-stainless steel insulation jacketing (not included in the response to Question 2) that would be either submerged or subjected to containment spray.

Containment Pool Chemistry

5. Provide the expected containment pool pH during the emergency core cooling system (ECCS) recirculation mission time following a LOCA at the beginning of the fuel cycle and at the end of the fuel cycle. Identify any key assumptions.

6. For the ICET environment that is the most similar to your plant conditions, compare the expected containment pool conditions to the ICET conditions for the following items: boron concentration, buffering agent concentration, and pH. Identify any other significant differences between the ICET environment and the expected plant-specific environment.

7. For a LBLOCA, provide the time until ECCS external recirculation initiation and the associated pool temperature and pool volume. Provide estimated pool temperature and pool volume 24 hours after a LBLOCA. Identify the assumptions used for these estimates.

Plant-Specific Chemical Effects

8. Discuss your overall strategy to evaluate potential chemical effects including demonstrating that, with chemical effects considered, there is sufficient net positive suction head (NPSH) margin available during the ECCS mission time. Provide an estimated date with milestones for the completion of all chemical effects evaluations.

9. Identify, if applicable, any plans to remove certain materials from the containment building and/or to make a change from the existing chemicals that buffer containment pool pH following a LOCA.

10. If bench-top testing is being used to inform plant specific head loss testing, indicate how the bench-top test parameters (e.g., buffering agent concentrations, pH, materials, etc.) compare to your plant conditions. Describe your plans for addressing uncertainties related to head loss from chemical effects including, but not limited to, use of chemical surrogates, scaling of sample size and test durations. Discuss how it will be determined that allowances made for chemical effects are conservative.

Plant Environment Specific

11. Provide a detailed description of any testing that has been or will be performed as part of a plant-specific chemical effects assessment. Identify the vendor, if applicable, that will be performing the testing. Identify the environment (e.g., borated water at pH 9, deionized water, tap water) and test temperature for any plant-specific head loss or transport tests. Discuss how any differences between these test environments and your plant containment pool conditions could affect the behavior of chemical surrogates. Discuss the criteria that will be used to demonstrate that chemical surrogates produced for testing (e.g., head loss, flume) behave in a similar manner physically and chemically as in the ICET environment and plant containment pool environment.

12. For your plant-specific environment, provide the maximum projected head loss resulting from chemical effects (a) within the first day following a LOCA, and (b) during the entire ECCS recirculation mission time. If the response to this question will be based on testing that is either planned or in progress, provide an estimated date for providing this information to the NRC.

ICET 1 and ICET 5 Plants

13. (Not Applicable).

Trisodium Phosphate (TSP) Plants

14. Given the results from the ICET #3 tests (Agencywide Document Access and Management System (ADAMS) Accession No. ML053040533) and NRC-sponsored head loss tests (Information Notice 2005-26 and Supplement 1), estimate the

concentration of dissolved calcium that would exist in your containment pool from all containment sources (e.g., concrete and materials such as calcium silicate, Marinite™, mineral wool, kaylo) following a LBLOCA and discuss any ramifications related to the evaluation of chemical effects and downstream effects.

15. (Not Applicable).

16. (Not Applicable).

Additional Non-Coatings Questions

17. (Not Applicable).

18. (Not Applicable).

19. (Not Applicable).

20. (Not Applicable).

21. (Not Applicable).

22. (Not Applicable).

23. (Not Applicable).

24. The Davis Besse GL 2004-02 response (page 10 of Attachment 2) indicates scaffolding boxes have drain and vent holes that are smaller than the holes of the strainer media so that any debris generated by chemical reaction will remain within the box. The NRC staff does not understand why corrosion product or dissolved ions from the scaffolding would remain in the scaffolding box. Please clarify this statement.

Coatings

Generic - All Plants

25. Describe how your coatings assessment was used to identify degraded qualified/acceptable coatings and determine the amount of debris that will result from these coatings. This should include how the assessment technique(s) demonstrates that qualified/acceptable coatings remain in compliance with plant licensing requirements for design-basis accident (DBA) performance. If current examination techniques cannot demonstrate the coatings' ability to meet plant licensing requirements for DBA performance, licensees should describe an augmented testing and inspection program that provides assurance that the qualified/acceptable coatings continue to meet DBA performance requirements. Alternatively, assume all containment coatings fail and describe the potential for this debris to transport to the sump.

Plant Specific

26. (Not Applicable).

27. (Not Applicable).

28. (Not Applicable).

29. (Not Applicable).

30. The NRC staff's safety evaluation (SE) addresses two distinct scenarios for formation of a fiber bed on the sump screen surface. For a thin bed case, the SE states that all coatings debris should be treated as particulate and assumes 100% transport to the sump screen. For the case in which no thin bed is formed, the staff's SE states that the coatings debris should be sized based on plant-specific analyses for debris generated from within the ZOI and from outside the ZOI, or that a default chip size equivalent to the area of the sump screen openings should be used (Section 3.4.3.6). Describe how your coatings debris characteristics are modeled to account for your plant-specific fiber bed (i.e. thin bed or no thin bed). If your analysis considers both a thin bed and a non-thin bed case, discuss the coatings debris characteristics assumed for each case. If your analysis deviates from the coatings debris characteristics described in the staff-approved methodology, provide justification to support your assumptions.

31. Your submittal indicated that you had taken samples for latent debris in your containment, and that these were evaluated in an Enercon report DBE004-RPT-004 (ACT 03-0426). This report was not provided, please submit this report.

32. Your submittal did not provide details regarding the characterization of latent debris found in your containment as outlined in the NRC SE. Please provide these details.

33. You indicated that you would be evaluating downstream effects in accordance with WCAP 16406-P. The NRC is currently involved in discussions with the Westinghouse Owner's Group (WOG) to address questions/concerns regarding this WCAP on a generic basis, and some of these discussions may resolve issues related to your particular station. The following issues have the potential for generic resolution; however, if a generic resolution cannot be obtained, plant-specific resolution will be required. As such, formal RAIs will not be issued on these topics at this time, but may be needed in the future. It is expected that your final evaluation response will specifically address those portions of the WCAP used, their applicability, and exceptions taken to the WCAP. For your information, topics under ongoing discussion include:

    a. Wear rates of pump-wetted materials and the effect of wear on component operation
    b. Settling of debris in low flow areas downstream of the strainer or credit for filtering leading to a change in fluid composition
    c. Volume of debris injected into the reactor vessel and core region
    d. Debris types and properties
    e. Contribution of in-vessel velocity profile to the formation of a debris bed or clog
    f. Fluid and metal component temperature impact
    g. Gravitational and temperature gradients

h. Debris and boron precipitation effects
i. ECCS injection paths
j. Core bypass design features
k. Radiation and chemical considerations
l. Debris adhesion to solid surfaces
m. Thermodynamic properties of coolant

14. Your response to GL 2004-02 question (d)(viii) indicated that an active strainer design will not be used, but does not mention any consideration of any other active approaches (i.e., backflushing). Was an active approach considered as a potential strategy or backup for addressing any issues?

15. You stated that the debris generation analysis was based on NEDO-32686, Rev. 0 (BWR URG). Please discuss the evaluations performed to verify that the methodology applied in the debris generation analyses is at least as conservative as the Nuclear Energy Institute (NEI) guidance report “Pressurized Water Reactor Sump Performance Evaluation Methodology,” NEI 04-07, and the NRC staff’s SE of this guidance.

16. The Davis-Besse analyses and sump modification were completed prior to issuance of the NEI guidance (NEI 04-07) and the staff’s SE of that guidance. As such, Davis-Besse applied different analytical methods. Please discuss plans you have to identify and evaluate the impacts of the differences between the NEI/SE and the Davis-Besse methodologies.

17. You stated that the primary debris sources are reflective metallic insulation (RMI) insulation and coatings, and that the debris is both particulate and chips. Please provide the debris size distribution assumptions applied in the head loss analyses and discuss the technical basis for the distributions assumed.

18. It appears that part of the September 2005 response to GL 2004-02 was not transmitted into ADAMS correctly. Information appears to be missing on the bottom of Page 8. Please provide the omitted information.

19. The September 2005 response to GL 2004-02 stated that debris interceptors were credited in the debris transport analysis. The NRC staff requests that you describe how credit was applied for the debris interceptors, and state the final debris transport fractions derived for the types of debris considered in the evaluation.

20. Are there any vents or other penetrations through the strainer control surfaces which connect the volume internal to the strainer to the containment atmosphere above the containment minimum water level? In this case, dependent upon the containment pool height and strainer and sump geometries, the presence of the vent line or penetration could prevent a water seal over the entire strainer surface from ever forming; or else this seal could be lost once the head loss across the debris bed exceeds a certain criterion, such as the submergence depth of the vent line or penetration. According to Appendix A to Regulatory Guide 1.82, Revision 3, without a water seal across the entire strainer surface, the strainer should not be considered to be “fully submerged.” Therefore, if applicable, explain what sump strainer failure criteria are being applied for the “vented sump” scenario described above.

21. The September 2005 response to GL 2004-02 discussed the potential of scaffolding in vented boxes to contribute to chemical effects. The conclusion is that no problem exists, mainly because the boxes' vent holes are smaller than the holes in the strainer. The staff does not consider this conclusion to be complete, inasmuch as the accumulation of debris upon the strainer might reduce the effective flow holes through the strainer to a dimension that is smaller than the flow holes in the scaffolding boxes. While the GL response notes that, due to the small quantity of fibrous debris sources at Davis-Besse, the formation of a classical 1/8" thin bed of fibrous debris might not be likely in most scenarios (e.g., assuming both the upper and lower modules are available), the possibility remains that sparser fiber beds could be sufficient to filter out chemical precipitants (i.e., chemical precipitants would not necessarily be of the same dimensions or have the same adhesion characteristics as the fine particulate used to arrive at the 1/8" thin bed thickness). In addition, chemical species might leave the box in one form or size (e.g., as a dissolved ion), interact with other chemical species in the pool-at-large and then take on a different form or size prior to accumulating upon the strainer surface. The staff requests additional information concerning these two scenarios which do not seem to have been adequately addressed by the analysis provided in the GL response.

22. Please state the quantity of latent fiber assumed in the evaluation.

23. The NUREG/CR-6224 correlation was used to calculate the head loss across the Davis-Besse strainer. This correlation was designed and validated essentially to model debris beds where a fibrous layer filters out particulate debris. However, as the GL response stated, it might not be likely for a 1/8" fiber layer to form on the Davis-Besse strainer because the quantity of fibrous material inside containment has been strictly reduced and controlled. Thus, for a bed composed mainly of coating debris and RMI, it is not clear to the staff why the NUREG/CR-6224 correlation is appropriate. Please provide justification that the NUREG/CR-6224 correlation provides conservative head loss results for the low-fiber debris beds that have been analyzed as forming at Davis-Besse.

24. What size are the holes in the divider plate between the upper and lower strainers? What analysis has been performed to demonstrate that debris could not pass through the lower strainer and create blockage at the divider plate, thereby concentrating debris mainly upon the upper section of the strainer?

25. The September 2005 GL response stated that FirstEnergy Nuclear Operating Company (FENOC) performed computational fluid dynamics (CFD) analysis to calculate debris transport. Please explain how you used CFD results to determine the amount of debris that transports to the sump screen.

26. It was not clear to the NRC staff from the September 2005 GL response whether FENOC accounted for possible erosion of large debris pieces from containment spray and sump pool recirculation flows. If you did, please explain how you modeled erosion. If not, please justify.