Q&As FOR DAVIS-BESSE SHIELD BUILDING ISSUES

Q1. When did FENOC discover cracks in the reactor shield building at the Davis Besse nuclear power plant?

A2. On October 10, while conducting work to replace the Davis-Besse reactor vessel head, plant workers identified cracks in the shield building. The shield building is a 2.5 foot thick reinforced concrete building surrounding a 1.5 inch thick steel containment vessel that encloses the reactor. The two buildings are separated by a 4.5 foot hollow space.

Q2. What was NRC's response and how did NRC inspectors reach the conclusion that the shield building is safe?

A2. The NRC put together a team of about ten specialists from the NRC Midwestern office in Illinois and the NRC Headquarters office in Maryland to provide a thorough and independent review of FENOC's testing of the cracks, their methodology, calculations and analyses to determine the impact of the cracks on the building's ability to perform its safety function.

To make a conclusion about the safety of the shield building, the NRC team:

-monitored the licensee's activities at the plant as they were identifying the extent and nature of the cracks

-examined the licensee's methodology for assessing the impact of the cracks on the shield building

-made sure the samples taken from the building were sufficient to indicate the extent and the severity of the cracks in the building as a whole

-reviewed the calculations and the assumptions on the shield building's ability to withstand stresses it would be under during normal operation and during events such as tornadoes and earthquakes.

-continued to ask questions about the specifics of the licensee's calculations; challenged their assumptions; requested additional information; and made sure the calculations demonstrated that the shield building has sufficient structural strength to fulfill its safety function.

Q3. What kind of cracks were found?

A3. The cracks are known as "laminar cracking," which is cracking of material, including concrete, in which there is a separation of layers, or planes. In this case, the inspectors were examining cracking along the outermost layer of rebar and concrete.

Q4. How many cracks are there in total?

A4. The cracking was identified by areas/regions and not by number of cracks. The NRC reviewed the extent of testing on the shield building done by the utility and concluded that an adequate amount of testing and samples were obtained in order to support the company's conclusion regarding the condition of the shield building.

Q5. Are the cracks found at Davis-Besse visible?

A5. No. A visible crack can be identified by visual examination of the concrete surface. The cracks at Davis-Besse are non-visible; they do not penetrate to the concrete surface area and cannot be identified by visual examination of this surface.

Q6. Why does there appear to be a large crack in the picture released on the public website?

A6. What is visible from the picture is the result of the hydrodemolition method (material removal using high pressure water), which likely enlarged the crack to appear wider than the cracking confirmed by core bores directly above that section. The existing cracks, as confirmed by core bores, were in general less than 0.01 inches in width.

Q7. What tools did FENOC use to examine the building for cracks?

A7. FENOC performed various activities to understand the extent and characteristics of the cracks including impulse response mapping and core bores.

Q8. What is impulse response mapping?

A8. Impulse response mapping is a test performed from the outside surface of a building or structure to obtain an indication of the internal conditions of the structure and typically can identify cracking. The inspection involves striking the region of interest with a hammer like instrument which emits a vibration in the structure. The response from the structural region is received through a receptor. Based on the differences in the response between regions, the condition of the interior of the structure can be obtained. This is a non-destructive method of examining the interior of the structure. Non-destructive means there is no physical change or damage to the structure being examined.

Q9. What are core bores? How were they analyzed and by whom?

A9. Core bores are a sample in the form of a cylinder taken from the shield building in order to examine the condition of the cracks. The utility engaged a contractor to retrieve these samples and sent them out to be examined. The NRC reviewed the analysis performed making sure the utility addressed its questions and concerns. Additional tests will be performed as a part of the utility's root cause analysis.

Q10. Did FENOC look at the entire building? If not, how much of the building did they examine? Why is that sufficient?

A10. FENOC performed tests in certain locations of the building. As a result, FENOC had to make conservative assumptions regarding the extent of cracking in their technical analysis that bounded the possible worse case condition. The NRC reviewed in detail the utility's extent of examinations to ensure an adequate sample was taken. Questions and concerns were communicated to the utility and answers were provided to the NRC such that the NRC was satisfied that the extent of the sampling and analysis was sufficient to ensure the shield building will meet its safety functions.

Q11. Did FENOC have a methodology for their approach to determine the extent of cracking? What's the NRC's review of this methodology?

A11. NRC reviewed FENOC's method for determining the extent of cracking. The NRC also examined how the findings were incorporated into the utility's analyses to ensure the extent of cracking was adequately addressed and the safety functions of the shield building could still be met.

Q12. Does the NRC have any outstanding questions and/ concerns?

A12. The NRC concluded that the shield building could meet its safety functions. NRC staff continues to evaluate whether the shield building, in its current condition, conforms to design code requirements identified in the plant's licensing basis. The NRC will pursue the resolution of this issue through its inspection activities.

Q13. When did the NRC receive the utility's analysis? How long did it take the NRC to review the utility's analysis?

A13. The utility performed various analyses to address the cracks identified in the shield building and provided them to the NRC for review. Soon after receiving them, the NRC reviewed the information from the utility requesting clarifications or additional information as necessary. The NRC took the time necessary to conduct a thorough review of the utility's analyses and ensured the shield building can meet its safety functions prior to the plant restarting.

Q14. What is a CAL? What does it do?

A14. CAL stands for Confirmatory Action Letter. It is a letter issued to the utility to confirm an agreement to take certain actions in response to a certain issue. The NRC uses CALs to alleviate concerns about health and safety, safeguards, or the environment.

Q15. What happens if they don't follow the CAL?

A15. The NRC expects utilities to adhere to any obligations or commitments contained in a CAL, but the CAL does not constitute a legal requirement. The NRC does require the utility to contact the NRC if the utility determines that it cannot meet any of the conditions contained in the CAL or if the utility intends to change any of the commitments, so that the NRC may determine if the utility's proposed actions are acceptable. If the utility does not fulfill the commitments made through a CAL, the NRC can take additional actions, including but not limited to, issuing an order requiring the utility take all actions necessary to maintain the safety of the plant.

Q16. How long is it good for?

A16. A CAL remains open and in effect until the utility has fulfilled all the commitments made through the CAL and until the NRC has reviewed the completion of activities and is satisfied with the results. The NRC will document the closure of the CAL typically through a letter to the utility or in an NRC inspection report.

Q17. Has FENOC provided the NRC with a root cause analysis? Does the NRC need the root cause before restart?

A17. FENOC is currently in the process of performing a root cause analysis. A root cause was not necessary before restart as the NRC has reasonable assurance that the shield building can perform its safety functions.

Q18. How could the NRC let the plant restart without having the root cause, without having an understanding of what caused these cracks?

A18. The NRC has reasonable assurance that the shield building can fulfill its safety function. NRC issued a Confirmatory Action Letter documenting the licensee's commitments to:

-Monitor the extent and the size if the cracks before and during the next refueling outage to ensure that the extent of cracking and condition of cracking assumed in the analyses remain valid

-Submit a root cause evaluation by February 28, 2012.

-Develop a long-term monitoring program that will effectively monitor the cracks in the shield building going forward after the root causes of the cracking are understood.

NRC will closely monitor these actions.

Q19. Can the cracks get worse? How quickly can they get worse? Can you guarantee they won't get worse?

A19. The NRC has commitments from the company to monitor the cracks in the shield building to detect changes in the conditions of the cracks. Additionally, the root cause analysis will provide a clearer picture of what caused these cracks and what actions need to be taken to adequately monitor them long-term.

Q20. What is the NRC going to do if the root cause is not completed to NRC's satisfaction?

A20. The NRC will review the utility's root cause analysis and ensure it is thorough and complete. If the NRC identifies any concerns they will engage the utility and ensure that the utility will take appropriate actions to address the issue.

Q21. How many plants with the same shield building design are there in the country? How many of them have had an opening cut in the shield building?

A21. There are eight additional sites, comprising thirteen units, in the country with a shield building design similar to Davis-Besse. Of these thirteen units, four units have had an opening cut in the shield building. None identified cracking similar to that seen at Davis Besse. The plants with a similar shield building design to Davis-Besse are St. Lucie Units 1 and 2, Waterford Unit 3, Prairie Island Units 1 and 2, Kewaunee Unit 1, Sequoyah Units 1 and 2, Watts Bar Unit 1, Catawba Units 1 and 2, and McGuire Units 1 and 2. In addition to Davis-Besse cuts have occurred in Sequoyah Unit 1, St. Lucie Units 1 and 2, and Watts Bar Unit 1.

Q22. Have there been plants with the same design and issues?

A22. The NRC has not identified similar issues in plants with a shield building design similar to Davis-Besse’s.

Q23. Is this a generic issue? Has the NRC informed other plants with the same shield building design of this situation?

A23. The NRC will review this issue for generic implications upon receiving FENOC’s root cause analysis. If the NRC identifies implications for other plants with similar shield building designs, the NRC will take actions to address this.

Q24. Why did you not hold a public meeting prior to the plant restarting?

A24. The NRC issued a press release communicating its conclusion to the public prior to the plant restarting instead of holding a public meeting before restart. In addition, the NRC will be holding a public meeting to provide an opportunity for the public to obtain additional information regarding the cracks identified in the shield building. The NRC will also issue a publically available inspection report after the conclusion of its inspection.

Q25. Does the NRC have a requirement for what type of concrete must be used for these types of building?

A25. The shield building was designed and constructed in accordance with NRC and industry code requirements to be able to fulfill certain safety functions. Some of the requirements for the concrete include the ability to maintain structural integrity during seismic events and withstand the impacts of flying objects such as those generated during a tornado.

Q26. What code or standard applies to the shield building structure?

A26. ACI 307-69, Specification for the Design and Construction~~s~~ of Reinforced Concrete
ACI 318-63, Building Code Requirement for Reinforced Concrete
ASME Code, Section III, 1968
These codes are part of the licensee’s Updated Final Safety Analysis Report.

Q27. Can the shield building still take a hit from a flying object during a tornado? What about an earthquake?

A27. Yes. The shield building is designed to provide environmental protection of the containment vessel from adverse weather conditions including flying objects generated by tornados. The NRC has concluded that the licensee has provided reasonable assurance that the shield building can fulfill its intended safety function in its current condition.

Q28. How can a building with cracks still stand strong and function?

A28. The licensee provided the NRC with analysis and calculations that appropriately incorporated the effects of the cracking to show that the shield building can maintain its structural integrity with the existing cracks. The NRC staff reviewed this analysis and concluded that the licensee provided reasonable assurance that the shield building is capable of performing its safety function.

Q29. What happens if a piece of the shield building crashes into the steel containment vessel building? Have you analyzed for this scenario?

A29. The reinforced concrete shield building and steel containment vessel were built to perform their safety functions in the event of natural phenomena such as tornados and earthquakes. Based on our evaluation of the licensee's extent of condition and technical analysis of the Davis-Besse shield building cracking, the NRC staff concluded that the licensee has provided reasonable assurance that the shield building is capable of performing its safety functions, and, therefore, that the shield building will protect the steel containment vessel.

Q30. How does the NRC plan to monitor these cracks to ensure they do not get worse?

A30. The NRC issued a Confirmatory Action Letter confirming commitments by FENOC to have available to the NRC a root cause for the shield building cracking and to establish a shield building monitoring program. This program includes actions to monitor the existing cracks to ensure they do not challenge the safety functions of the shield building.

Q31. How does the NRC plan to inspect the shield building? What does the inspection procedure call for?

A31. The NRC will inspect the company's implementation of shield building monitoring commitments documented in the Confirmatory Action Letter; review the licensee's root cause of the shield building cracking and the long-term monitoring program to determine if the shield building can continue to perform its safety functions. In addition, the license renewal inspection team is continuing to evaluate this issue and will take all necessary actions to ensure the licensee addresses any concerns they may have prior to Davis-Besse entering their period of extended operation.

Q32. What inspections of the shield building has the NRC conducted in the past at Davis-Besse before this incident?

A32. The Davis-Besse shield building has been previously cut through for the first head replacement in 2002. The 2002 cut was located inside the original construction opening, while the 2011 cut is a larger area that includes sections outside the original construction opening. The NRC performed an inspection of those activities and ensured the shield building was returned to its original design and was able to meet its design function. The utility has also performed visual inspections of the outer surface of the shield building. These inspections were reviewed by NRC inspectors as a part of the 2011 head replacement activities.

Q36. Why are these cracks only being found now, since the building was cut open before? Did the licensee miss something?

A33. The NRC and the licensee did not identify any cracks in the shield building when it was opened in 2002 for the previous reactor vessel head replacement. While the opening in 2002 was positioned within the area of the opening that had been made in the concrete during original construction, the 2011 opening extended beyond this original entry into portions of concrete that have never been cut.

Q34. What impact do these cracks have on license renewal?

A34. The NRC's license renewal team is continuing to evaluate this issue and will take all necessary actions to ensure the licensee address any concerns the NRC may have prior to granting license renewal along with reviewing the issue for any generic concerns for other facilities.

The following three questions which were part of the NRC's original review of the shield building's safety were also raised by Davis Lochbaum of the Union of Concerned Scientists in a November 4 letter to the NRC. Responses are provided below.

Q35. Are the dead loads from the structural elements properly considered in the design analysis of the building?

A35. The dead load is the weight that has to be supported by a structure. The NRC has reviewed the original design calculation for this building. The dead loads were considered in the original calculation, and they were also considered in the analyses that incorporate the cracking. The NRC did not identify any concerns related to it.

Q36. What type of cement was used in the architectural concrete?

A36. The cement used in the architectural concrete was the same as that used in the structural portion.

Q37. If the concrete/cement in the shield building is the same as that in the "architectural concrete" elements and all have the same age and environmental exposure history, would numerous cracks identified in one suggest comparable conditions in the other? If not, why not?

A37. The concrete referred to as the "architectural" concrete is additional concrete incorporated into the design for aesthetic reasons. While not credited in the design for structural strength purposes, this concrete was part of the same pour and has the same material as the 2 ½ foot thick main structural shell of the building. Cracking has been identified primarily in the architectural regions and in some isolated areas of the structural region, specifically near the main steam line penetration and the dome of the shield building. Cracking can be of structural concern in the architectural and structural regions depending on how close cracks are to the outer layer of structural rebar. The core bores and impulse mapping performed by FENOC to determine the extent of the cracking in the shield building demonstrated that only certain regions of the building had cracks. None of the cracks found to date penetrate deeper than the outer layer of rebar in the shield building. NRC staff concluded that the impulse response mapping and core bores performed by FENOC provide a representative sample of the overall condition of the shield building. However, in order to provide an additional safety margin, FENOC structural analysis assumed a greater degree of cracking than was found during the testing of the shield building. FENOC has committed to providing a root cause analysis of shield building cracking to the NRC by February 28. This analysis will enhance the current understanding of extent of the cracking and areas prone to this phenomenon. The NRC will review the results of FENOC's root cause and ensure necessary actions are taken to address the findings.