Harris Special Inspection Question & Answers

Q1. Why did Duke wait a year to address this issue?

A1. As soon as the licensee became aware of the condition, they immediately addressed the issue.

Q2. Why was this flaw not found during the 2012 spring refueling outage?

A2. There were a number of contributing factors, but ultimately, it was a failure on the part of the people performing the inspection.

Q3. What was the cause that led to missing this flaw?

A3. What we have identified on this inspection is that there was an examination that was performed by personnel who were qualified to do that inspection following approved procedures. The licensee is taking actions to correct the failure of the personnel to identify the defect.

Q4. What prompted the licensee to take a second look at the 2012 inspection data?

A4. In anticipation of the upcoming 2013 fall outage, the licensee requested a review of the previous outage examination data by an independent third party. It was during this review that the missed indication was revealed. Once the licensee was notified, they immediately took steps to address the issue.

Q5. Were any leaks found through the crack?

A5. No. Several examinations were completed by the licensee while addressing this issue, including a visual examination of the reactor vessel head, and at no time was there any indication of leakage.

Q6. How do you know this crack didn't exist all the way back to when the head was made, and how can we be sure other cracks aren't still there?

A6. The licensee has reviewed the data from previous examinations and verified that there was no evidence of the indication until the 2012 exam. Also, they verified that no additional indications were missed from the 2012 outage inspection data.

Q7. Will there be any increased inspections due to this event?

A7. Yes. There have been a number of additional inspections that have already been performed as part of the licensee's effort to correct this issue. Additionally, the licensee will now perform examinations on the vessel head every refueling outage. If Harris did not have these flaws, bare metal visual exams would have been required every 3 refueling outages or 5 years, whichever is less, and volumetric/surface exams would be required every 2.25 Re-inspection Years as defined by the NRC Confirmatory Order, NRC EA-03-009, dated 02/11/2003.

Q8. Why didn't the NRC catch this?

A8. Under a program required by NRC regulations, it is the responsibility of licensees and their contractors to utilize approved industry procedures and processes to identify a defect. The inspections the NRC performs are intended to verify that all licensees have sound work practices and procedures that will ensure the plants are operated and maintained safely. To accomplish this, we perform inspections on a sampling basis and maintain a focus on ensuring that the licensee keeps public health and safety first and foremost in their actions.

Q9. Is it safe for the plant to continue to operate?

A9. Yes. The NRC's inspection activities were performed to ensure that the licensee properly repaired the indication in the vessel and passed the examinations required by the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code prior to restarting the unit.

Q10. Are any cracks in the head/vessel acceptable? If so, what size?

A10. Yes, some cracks may be found to be acceptable in the head or vessel materials. Any such crack would require significant evaluation under the requirements of the ASME Code and NRC regulations to allow the plant to operate with such a crack. If not found to be benign (e.g., no growth in size and no structural impact), then reinspection is required until repair or replacement.

Q11. Where did this crack come from?

A11. The appearance of the crack indicated that the most likely cause was primary water stress corrosion cracking (PWSCC). Primary water stress corrosion cracking is an issue that is widely studied in the nuclear industry. It is well understood, and there are many initiatives designed to address it. The examinations that discovered this indication are one of these initiatives.

Q12. Was this similar to the issue at the Davis-Besse plant?

A12. No. Although the indication was found in a location similar to the one at Davis-Besse, there are several differences between the two cases. The most important differences are that this indication did not result in further degradation of the vessel head and that there was no indication of leakage at Harris.

Q13. How common are cracks like these?

A13. About one-third of all U.S. pressurized water reactors which are susceptible to this cracking have had one or more penetration nozzles with indications. The first indication of this type of cracking in upper head nozzles was in 1991 in France. Since that time, the NRC has developed rules and requirements for the inspection of all upper head nozzles to ensure reasonable assurance of structural integrity of the upper heads.

Q14. What is the worst possible accident that could have resulted from this crack, or how severe could this crack have become if it was not discovered at this time?

A14. The worst-case scenario for an indication like this would result in a leak that would be within the capacity of the required safety systems. The licensee is required to monitor leakage from the reactor coolant system, no matter how small, and they are required to take actions to address any such leakage. Inspections to identify leakage, actions to address leakage, and safety systems designed to mitigate such leakage – these are all examples of the multiple layers of protection designed into every nuclear power plant in the United States.

Q15. Due to the advancing age of the plant, can you still adequately predict/detect/repair cracks?

A15. Yes. For detecting or repairing indications, the age of the plant has no effect on the licensee's ability to do those activities. Predicting indications actually gets easier to do as the plant ages, as more information is gathered about the plant's specific operating history and the techniques used to perform these inspections are continuously improved over time.

Q16. How much information about the crack will be released to the public?

A16. It is the policy of the NRC to share the results of inspections with the public openly, primarily through issuing inspection reports. The inspection report covering our inspection of this event should be issued by July 11, 2013 through the public document room.

Q17. What kinds of examinations were used to look at the vessel head?

A17. The reactor vessel head is required to be examined using a variety of non-destructive examination techniques that include: ultrasonic examinations, liquid penetrant examinations and visual examinations.

Q18. What was done to repair the vessel head?

A18. The reactor vessel head was repaired using an NRC-approved method called "Inside Diameter Temper Bead Weld Repair."

Q19. Why didn't Duke Power replace the vessel head?

A19. Once the licensee determined their course of action, the NRC staff evaluated their proposal and determined that it met NRC regulations and the applicable provisions of the ASME Boiler and Pressure Vessel Code before the repair of this specific nozzle took place.

Q20. What are the pros and cons from a safety standpoint relative to a replacement solution versus a repair solution for the reactor head?

A20. It is the responsibility of the licensee to choose either to repair the existing head or to obtain a replacement head. In either case, the replacement would be done in accordance with ASME Boiler Pressure Vessel Code or NRC-approved alternative.

Q21. Many licensees have already replaced their vessel heads. Why hasn't Harris?

A21. Manufacturing a replacement vessel head is a considerable undertaking. Consideration must be made for proper mating of the head to the vessel, alignment of control rod drive mechanisms (CRDMs), and transportation of such a heavy load. Installation is a complicated procedure for which a licensee would need sufficient time to plan and execute. And finally, with the identification of cracking only in the last refueling outage, it may take some time for a new head to be built, transported and installed.

Q22. Why aren't these nozzles made of material that won't crack?

A22. There are many trade-offs in selecting materials for particular applications, including: inspectability, strength, and corrosion resistance. The licensee is very aware of the advantages and disadvantages of each material selection, and they design their maintenance and inspection programs to mitigate each disadvantage, based on the information available at the time.

Q23. What regulatory action has the NRC taken in response to this event?

A23. The NRC's initial actions in response to this event included dispatching a Special Inspection Team (SIT) to the site on May 22, 2013. The SIT's charter emphasis was to collect, analyze, and document factual information and evidence. The NRC Enforcement Policy will be applied to any findings developed during this inspection, as appropriate. The SIT report will be issued within 30 days following the formal exit meeting held with the licensee on June 11, 2013.

Q24. How much will this repair and shutdown cost Duke Power and will they pass it on to us?

A24. The NRC's primary function is to ensure the safe operation of the facility and that public health and safety are maintained. Repair scenario costs do not weigh in our decision making process.

Q25. Is the crack in the nozzle attributed to radiation and embrittlement?

A25. The indication was not attributed to radiation-induced embrittlement. The indication was induced by primary water stress corrosion cracking. Radiation-induced embrittlement occurs in the beltline region of the reactor vessel where a high neutron flux exists. Embrittlement does not occur on the vessel head. Embrittlement is limited by regulations. Capsules are periodically removed from the reactor pressure vessel and tested at laboratories to verify that limits of embrittlement are not exceeded.

Q26. What issues were considered in performing the repair?

A26. The ASME Code and NRC-approved alternatives address areas such as metals to be used, welding procedures, qualifications of welders, material stress/fatigue, in-process repair examinations, post-inspection repair examinations, and post-modification testing.

Q27. Are the areas of degradation at other facilities being found in similar locations? What is the NRC doing to ensure other plants don't have this issue?

A27. .Yes, experience has shown this area to be susceptible at many plants. Other locations within the reactor coolant pressure boundary made of these same materials can also be susceptible. The NRC has established inspection plans for each of these areas. Additional information about these requirements can be found at our web page at; http://www.nrc.gov/reactors/operating/ops-experience/pressure-boundary-integrity.html.

Q28. What was the age of the weld where the crack was found?

A28. The indication was found in one of the original vessel head welds. Shearon Harris Unit 1 has been in operation since May 2, 1987.

Q29. Has Duke Power re-evaluated ALL nozzle weld examinations?

A29. As an immediate corrective action, the licensee has performed a 100% review of all the 2012 refueling outage nozzle weld inspection data. Additionally, during their upcoming refueling outage, the licensee will be reexamining all of the nozzles again.

Q30. Could the personnel responsible for this event have made the same mistakes elsewhere?

A30. One of the SIT charter items was to investigate what, if any, generic implications this event might have. In support of this effort, both the licensee and the vendor who performed the 2012 inspections are currently evaluating the potential extent of condition for this issue.

Q31. Should the NRC require the replacement of all welds after so many years?

A31. The adequacy of welds in nuclear power plants are evaluated according to the stringent criteria contained within both industry standard codes (e.g. the American Society of Mechanical Engineers Boiler and Pressure Vessel Code) and the Code of Federal Regulations. The requirements for the timely replacement of welds are well understood and contained therein.

Q32. What has the NRC required of the industry after a similar issue with much more consequence occurred at Davis-Besse?

A32. The NRC uses a predictive model to establish inspections to address this type of cracking in upper heads. One of the primary factors is head temperature. The hotter the head temperature, the faster cracking initiates and grows. A crack in a hot head nozzle, such as those at Davis Besse, would take about 5 times as long to grow to the same size at a colder head temperature plant like Shearon Harris. However, our predictive model is only used until cracking is found. Once found, volumetric and bare metal visual inspections are conservatively required each refueling outage.

Q33. Why did the NRC decide to do a special inspection?

A33. While the CRDM nozzle flaws had not progressed to the point of being a significant safety concern, the NRC has an obligation to explore potential safety implications. The agency is also cognizant of public concerns since the situation at Davis-Besse in 2002 and is committed to being responsive to these concerns, to communicating with the public openly and clearly about the NRC's actions and findings. These considerations led the NRC to initiate the Special Inspection.

Q34. What is the industry experience in this area?

A34. The type of cracking that was identified here at Harris, called primary water stress corrosion cracking (PWSCC), is not a new issue and is well understood by the industry. PWSCC cracks are categorized in two ways. Axial cracks, which travel vertically up the nozzle, were found in pressurized water reactor control rod drive mechanism (CRDM) nozzles in the late 1980s. Circumferential cracks, which travel horizontally around the nozzle, were first identified in 2001 at the Oconee Nuclear Station. The NRC has issued various communications to nuclear power plants that address both of these types of cracks.

Q35. How many reactor vessel heads have been replaced?

A35. A little more than half of the 69 US pressurized water reactor pressure vessel upper heads have been replaced. All of the new heads use materials for their penetration nozzles and associated welds that are less susceptible to primary water stress corrosion cracking. Because BWRs are designed with their control rod drive mechanisms on the bottom of the vessel rather than on top, they don't operate with the reactor vessel completely full of water, and they do not operate with boron in the reactor coolant (as is the case with PWRs), they are not susceptible to this upper head penetration issue.