COMMUNICATIONS PLAN

Davis-Besse Nuclear Power Plant

Reactor Pressure Vessel Head Replacement

October - November 2011
POC: Jamnes Cameron, RIII
630-829-9833

GOALS

- Be prepared to answer public questions on the reasons and timing for the licensee's replacement of the Reactor Pressure Vessel (RPV) Head
- Be prepared to answer internal questions on the reasons and timing for the licensee's replacement of the RPV Head

KEY MESSAGES

- NRC inspectors are closely monitoring all activities at Davis-Besse associated with the replacement of the reactor vessel head through direct inspections along with reviews of records, calculations, and procedures to make sure the new reactor head meets stringent regulatory requirements and that the work is done in accordance with NRC regulations in a way that ensures the safety of the workers and the public.
- NRC inspections associated with the head replacement began in mid-July with the review of design records and tests to ensure the new head was fabricated in accordance with its design and met design requirements.
- NRC resident inspectors, supplemented by specialists in metallurgy, radiation protection, security and other relevant areas, will directly observe all key activities and tests associated with the head replacement.
- The NRC will also monitor other activities that will be performed at Davis-Besse during the outage.
- After extensive discussions with the NRC, FirstEnergy decided to replace the reactor vessel head at Davis-Besse with a newly manufactured RPV head following the discovery of cracks in the RVP head nozzles in 2010 and the subsequent NRC special inspection.
- The decision to install a new head three years earlier than the company planned was motivated by the need to have confidence that the old RPV head does not develop additional cracking.

D/7

- FirstEnergy's commitment to replace the old head in October 2011 was documented in the confirmatory action letter (CAL) before the plant returned to service after the cracks had been fixed and the NRC made sure the repairs met NRC requirements.
- The new RPV head is made with material that is much less susceptible to primary stress corrosion cracking (PWSCC), which was the direct cause of nozzle cracking in 2002 and 2010.

BACKGROUND

In February 2002, plant workers at Davis-Besse identified cracks in the welds of five control rod drive mechanism (CRDM) nozzles penetrating the RPV head. The cracks were found during an inspection required by the NRC after similar cracks were found at the Oconee plant in 2000. As the inspection continued, Davis-Besse workers found a cavity next to one of the nozzles. The cavity was about 5 inches by 7 inches and went through six inches of the reactor vessel head carbon steel, leaving only the stainless steel liner between the reactor coolant and the containment atmosphere. The cavity formed as reactor coolant leaked through the cracks, leading to the large accumulation of boric acid on the reactor vessel head. These boric acid deposits on the top of the reactor head had never been cleaned off, causing significant degradation of the carbon steel portion of the vessel head which was a violation of NRC requirements.

Davis-Besse remained shut down for roughly two years (restarted in March 2004), making improvements to plant systems and addressing non-technical issues that were identified as root causes of the reactor vessel head degradation, such as human performance and safety culture. The Davis-Besse reactor vessel head was replaced in 2003 with an unused, similar design head from the canceled Midland plant. Prior to placing this head into service, the utility conducted additional inspection of the nozzles. The NRC evaluated this testing with no issues identified.

Following the discovery of cracking and corrosion in 2002, the NRC created new requirements including a new and rigorous inspection regime for all pressurized water reactor (PWR) head to make sure minor cracks are identified before they can result in a safety concern.

The Midland RPV head was only a temporary measure until a new reactor vessel head could be manufactured. The licensee's original plans were to replace the Midland RPV head in 2014. However, during the most recent refueling outage at Davis-Besse, which began on February 28, 2010, the licensee discovered the effects of primary water stress corrosion cracking (PWSCC), including small amounts of dry boric acid indicative of pressure boundary leakage, at the CRDM nozzles on the RPV head. This discovery, which was the result of visual and ultrasonic examinations required by THE NRC, prompted additional examinations using a combination of dye penetrant (PT) and eddy current testing. As a result of the examinations, the licensee repaired 24 of the 69 nozzles and conducted additional examinations to demonstrate that the repaired nozzles and the RPV head could be safely returned to service.

Based on crack growth analyses and the shortened RVP head operating period, an NRC Special Inspection Team (SIT) concluded that margins existed such that the likelihood for PWSCC induced nozzle leakage would remain low for the remaining RPV head operating service period. The SIT confirmed that ultrasonic testing (UT), bare metal visual (BMV), and PT examinations completed during the 2010 refueling outage of the CRDM nozzles and J-groove welds met NRC requirements.

In addition, the special inspection verified that Davis-Besse followed the new RPV head requirements after the Midland head was put into service. The fact that minor cracks were identified before they could challenge the integrity of the head demonstrates the effectiveness of these requirements.

A CAL was issued on June 23, 2010 confirming the licensee's commitment to shut down the plant no later than October 1, 2011 and replace the current RPV head with a new head consisting of material that is much less susceptible to PWSCC – the direct cause of nozzle cracking in 2002 and 2010.

COMMUNICATION TEAM

- The Team Leader for this Communication Plan is Jamnes Cameron, Chief, Reactor Projects Branch 6 (RPB6), Division of Reactor Projects (DRP), Region III (630) 829-9833.
- His backup is Dave Hills, Chief, Engineering Branch 1, Division of Reactor Safety, Region III (630) 829-9733.
- Other Team members include:
- Viktoria Mitlyng, Senior Public Affairs Officer, Region III (630) 829-9662
- Prema Chandrathil, Public Affairs Officer, Region III (630) 829-9663
- Allan Barker, Senior Regional Governmental Liaison Officer, Region III (630) 829-9660.
- Harral Logaras, Regional Governmental Liaison Officer, Region III (630) 829-9659
- Daniel Kimble, Senior Resident Inspector, Davis-Besse (419) 244-4494
- Michael Mahoney, Project Manager, Office of Nuclear Reactor Regulation (301) 415-3867

TIMELINE

• Communications Plan Prepared	No later than October 1, 2011
• Davis-Besse Mid-Cycle Outage Start*	October 1, 2011
• Blog Entries Established and Updated as Needed	October 4, 2011
• Old RPV Head Removed from Vessel and on Head Stand	October 7, 2011
• Core Offload Complete	October 13, 2011
• Shield Building Opening Established	October 18, 2011

• Containment Vessel Wall Opening Established	October 28, 2011
• Remove Old RPV Head from Head Stand to Temp Stand	October 27, 2011
• RPV Head Transfer Runway System Installed	October 28, 2011
• New RPV Head on Head Stand	October 29, 2011
• Old RPV Head to Service Building	October 30, 2011
• RPV Head Transfer Runway System Removed	October 31, 2011
• Containment Vessel Wall Opening Closed	November 4, 2011
• Begin Core Reload	November 4, 2011
• Shield Building Opening Closed*	November 17, 2011
• New RPV Head Installed and Tensioned*	November 11, 2011
• Press Release	1 day before reactor startup
• Reactor Startup*	November 23, 2011
• Sync to Grid*	November 24, 2011
• Reactor 100% Power*	November 29, 2011

- * Tentative based on licensee schedule

CHALLENGES

Currently identified challenges include:

- Effectively communicating the differences between the new RPV head and the RPV heads that caused the 2010 CRDM nozzle issues and those events identified in 2002 regarding the RPV head degradation issue.
- Effectively communicating why we allowed Davis-Besse to continue operations until October 1, 2011
- Public perception of Davis-Besse's history. Although the technical issue is not all that significant, the fact that it is occurring at Davis-Besse heightens the awareness of the issue.
- Communicate effectively the difference between Davis-Besse's shield building and concrete containments with steel liners

EVALUATION

Success for this communication plan will be:

- Effectively communicating key messages with the public and both internal and external stakeholders
- Answering any questions that may arise from the public / internal / external stakeholders regarding the Davis-Besse Head Replacement Outage

Q&As FOR DAVIS-BESSE

Two-loop pressurized water reactor designed by Babcock and Wilcox (B&W)

Why is Davis-Besse replacing their head (again)?

The current RPV head, from the cancelled Midland plant, was only a temporary measure until a brand new head could be manufactured. The new RPV head nozzles are constructed from materials (e.g. alloy 690) much less susceptible to primary water stress corrosion cracking, the direct cause of nozzle cracking in 2002 and 2010 (both Alloy 600). The new head is scheduled to be installed during a mid-cycle head replacement outage beginning on October 1, 2011.

Why is the head replacement starting on October 1, 2011?

After extensive discussions with the NRC, FirstEnergy committed to shut down the plant no later than October 1, 2011, and replace the RPV head. According to NRC assessments, the Midland head was not likely to develop cracking of the nozzles that could lead to leakage before October 1, 2011.

Is the head replacement part of a refueling outage? How long is the outage going to take? Is the licensee just replacing the head? Do plants normally shut down for mid-cycle outages?

The head replacement is a mid-cycle outage and not part of a refueling outage. It is not uncommon for plants to shut down mid-cycle to effect repairs on major components required for safety and operation of the plant. Other maintenance and test activities not associated with the RPV head replacement will be performed as well. The NRC will be closely monitoring the licensee's activities to ensure continued safe operation of the facility.

Please explain the head replacement process from start to finish.

After the reactor is safely shutdown, a hole is cut in the side of the shield building to allow the old RPV head to be removed since it is too large to fit through the equipment hatch. The hole in the shield building is created by a process called hydrodemolition, which uses ulrahigh-pressure water jets to disintegrate the outer concrete wall, exposing the rebar skeleton. The exposed rebar is then tagged, cut, removed, and stored for later use.

The old RPV head is disassembled. Fuel rods are removed from the reactor vessel and stored in the spent fuel pool.

A section of the steel containment inside the wall of shield building is cut and removed, completing the opening (the containment at Davis-Besse is a free standing steel vessel (about 1.5 to 2.5 inches thick) that is separated from the shield building by about 4 – 5 feet).

A runway system and transfer cart are then installed through the newly created opening. An existing crane inside containment along with specialized rigging equipment lift the head and place it onto the transfer cart WHICH BRINGS THE HEAD OUT OF CONTAINMENT AND SHIELD BUILDING.

- A mobile crane lifts the head onto a hydraulic transporter designed for heavy loads and is take to a permanent storage facility inside the protected area at the site.

-The new reactor head, which has been stored in a specially constructed building, is installed by reversing the process.

-The runway system and transfer cart are removed.

-The new reactor head is assembled.

-The removed steel containment section is then welded back into place.

-After testing to ensure containment integrity, refueling begins.

-The shield building wall is restored by reinstalling the previously removed rebar and pouring new concrete into the opening.

-The new head is attached to the reactor pressure vessel.

-The reactor, the containment, and the shield building undergo tests to ensure all safety requirements are met.

-After other required plant maintenance activities are completed, the plant is restarted.

How is the NRC going to inspect all these activities?

The NRC resident inspectors will be supplemented by other NRC personnel with expertise in areas of metallurgy, welding, and other disciplines to ensure the NRC is capable of inspecting as many activities as is possible to ensure public health and safety.

Isn't the old head highly radioactive? Are workers in danger moving it? Is the public in danger when the head is taken out of the containment building and is being transported to its next location?

The reactor head is radioactive but precautions will be taken to minimize the radiation exposure that workers handling the head will receive and to ensure that the amount received is well within limits for radiation workers. Radioactive reactor heads are regularly handled in all operating reactors during refueling operations and the Davis-Besse head has been handled several times during past refueling outages. All worker radiation exposures from the head have been within federal limits.

While the reactor head is radioactive it is not a danger to the public. The reactor head will remain on the reactor site in a concrete storage building. Radiation from the reactor head will not be detectable at offsite locations or even at the site boundaries.

Am I safe from radiation with a hole in the side of the steel containment?

Yes. While a hole existed in the side of the containment to allow exchange of reactor vessel heads, the nuclear fuel was not in the containment building. The fuel was removed from the reactor vessel and stored in the spent fuel pool. Additionally the licensee maintained their ventilation systems such that air flow, if any, was into the containment through the opening. The exhaust ventilation was through monitored and filtered exhaust paths.

What is going to happen to the old head?

A permanent storage facility has been constructed onsite in the Owner-Controlled Area (OCA) for long-term storage of the old head. This facility was also built to store the current steam generators which are scheduled to be replaced during the 2014 refueling outage.

Is the new replacement head susceptible to the same type of cracking seen in 2002 and 2010?

The new replacement head is much less susceptible to primary water stress corrosion cracking, the direct cause of the 2002 and 2010 nozzle cracking. The new head nozzles will consist of Alloy 690 materials as opposed Alloy 600.

What do you mean by low-susceptibility head?

Reduced probability of primary water stress corrosion cracking.

How can the NRC ensure the new head will be safe? How do we know cracking issues will not develop a third time?

The NRC has a rigorous inspection program and regulatory requirements in place to maintain public health and safety. The regulatory requirements are structured such that any anomalies that may arise can be identified before they become a significant safety concern. This was effectively demonstrated in 2010, where the early effects of PWSCC in CRDM nozzles were identified through NRC required examinations before they became a significant safety issue or challenged the structural integrity of the head. The new RPV head nozzles have been manufactured with material that is much less susceptible to PWSCC – the direct cause of the nozzle cracking in 2002 and 2010. The NRC continues to review the latest information available to ensure the safety of people and the environment.

In addition, RPV heads made of the new material currently in service have shown lower susceptibility to PWSCC.

Did the NRC order the licensee to replace their head? What is a Confirmatory Action Letter?

The NRC had extensive conversations with FirstEnergy regarding reasonable assurance that the Midland head would not develop leakage before the new head is installed. Due to some uncertainties associated with the reasons for the extensive cracking in the Midland head, the licensee committed to shut down the plant no later than October 1, as documented in a CAL between the NRC and Davis-Besse on June 23, 2010 (ML101740519). A CAL confirms a licensee's or contractor's agreement to take certain actions to remove significant concerns about health and safety, safeguards, or the environment.

Did the NRC perform any kind of special inspection after the 2010 nozzle cracking?

Yes, on September 9, 2010, the U.S. Nuclear Regulatory Commission (NRC) completed a Special Inspection at the Davis-Besse Nuclear Power Station to evaluate the facts and circumstances surrounding the identification of cracks on March 12, 2010, in the RPV head control rod drive penetration nozzles and J-groove welds.

Did the NRC figure out what caused the extensive cracking in the Midland head in a relatively short period of time?

We understand the primary cause of the cracking – PWSCC (primary water side stress corrosion cracking). We also understand the major factors that may have accelerated the process – the high head temperature and defects in the material and the processes that were used in fabrication and heat treatment of the nozzles. There are other factors, such as coolant chemistry and the storage method of the head prior to installation in 2002, whose contribution to the process in uncertain. (see question below on understanding of cause and application to other reactor heads).

Why was Davis-Besse allowed to continue operations after the 2010 head issue?

Based on observations, evaluations, and conclusions from the NRC special inspection; our evaluation of the licensee bases for determining that the current RPV head is acceptable for return to service; and the commitments described in the June 23, 2010 Confirmatory Action Letter, we have determined that the RPV head is acceptable for continued operations through October 1, 2011.

Specifically:

1. Licensee examinations were sufficient to identify appropriate nozzles for repair. The final repairs met regulatory requirements and provided for appropriate structural integrity and a reasonable assurance of low probability of leakage. In particular, our SIT has directly observed a substantive portion of the examination and repair activities and evaluated the results, and the licensee staff adequately addressed pertinent safety issues raised by the SIT inspectors. The NRC also had a national laboratory conduct independent reviews of selected examination results to verify the licensee's conclusions.

2. Based on an independent and conservative NRC evaluation of crack growth rate, we have concluded that there exists reasonable assurance for a low probability of leakage through at least October 1, 2011, when the licensee has committed to shut down the unit to replace the RPV head. This commitment sufficiently addresses our concern regarding uncertainties in crack initiation and rate of growth that impacted the later portion of the planned operating cycle length. Furthermore, enhancements to the licensee's reactor coolant system leakage monitoring program provides additional confidence that significant reactor coolant leakage that could challenge the structural integrity of the RPV head will not occur. Also, our resident inspectors HAVE CONTINUED their REVIEWS of the results of the licensee's reactor coolant system leakage monitoring program. This

monitoring provides the NRC with early indications should any significant increases be identified through the licensee's leakage monitoring program.

3. The NRC had sufficient confidence that cracks that may develop during this time will not lead to a significant safety concern, such as nozzle ejection. In order for nozzle ejection to occur, cracks would have to form and propagate circumferentially (around the cylindrical nozzle) to a significant extent. The examination results from the 2010 outage indicated that only two nozzles had developed very small circumferentially oriented cracks. These cracks would did not challenge the head's structural integrity. The cracks in the remaining identified nozzles were such that they would not directly challenge the structural integrity of the RPV head.

Did the NRC penalize the licensee for the last two head incidents?

The NRC issued a Red finding to Davis-Besse in 2002 because the licensee did not implement controls to prevent pressure boundary leakage, missed opportunities to identify it, and let it continue for such a long period of time that it resulted in significant degradation of the reactor vessel head.

In addition, the NRC issued a $5,450,000 fine for providing the NRC with incomplete and inaccurate information.

In 2010, the company followed all program and inspection requirements and identified pressure boundary leakage, which was contrary to a technical specification requirement (no RCS pressure boundary leakage), at the first opportunity before it could become a significant safety concern. Operation with pressure boundary leakage of low magnitude (below detection thresholds) would normally be considered a Severity Level IV violation. However, the NRC reviewed the licensee's root cause analysis of the event and concluded that the equipment failure could not have been reasonably avoided or detected by the licensee's quality assurance program or other related control measures. Therefore, the NRC exercised enforcement discretion and did not issue a violation for this issue.

The NRC did issue three Green (very low safety significance) Non-Cited Violations (NCV) to Davis-Besse in 2010 for the licensee's failure to use a nondestructive examination procedure qualified in accordance with applicable Codes and Standards for detection of flaws in control rod drive nozzle repairs; for the licensee's failure to perform repair welding on control rod drive mechanism nozzle No. 4 using a qualified weld procedure; and for the failure to provide documented instructions appropriate to the circumstances for the remote visual examination of the final dye penetrant examination completed on repaired nozzle No. 61.

Did the licensee/NRC inspect the Midland Head accordingly such that the 2010 event could have been avoided? In other words, was something missed?

The original Davis-Besse RPV was replaced in 2002 with an unused head from the cancelled Midland Unit 2 plant. The replacement RPV head was certified with the American Society of Mechanical Engineers (ASME) on August 27, 1975. However, from 1975 through 2002 the head was stored at the Midland plant and had not been maintained under an adequate quality assurance program. In 2002, to confirm that the reactor vessel head had not deteriorated during the storage period, the RPV head was subjected to a series of tests designed to identify any potential flaws in the head and revealed no problems. The results of these tests were reviewed by the NRC. On March 27, 2004, power operation commenced at the Davis-Besse Nuclear Power Station with the replaced RPV head.

Since the Midland head was placed in service, the licensee has implemented an inspection program of the head that met NRC requirements, and that program was confirmed by the SIT.

Did FENOC take all necessary corrective actions to prevent nozzle cracking and leakage? Does the NRC believe that the company did EVERYTHING in their power to prevent this from happening a second time? How can the NRC say that when FENOC itself admitted that they should have done more? Well, they didn't do it; what does that say about their safety culture?

The NRC SIT assessment is that FENOC's corrective actions associated with the 2002 nozzle cracking, leakage and damage to the reactor vessel head were adequate and effective. The SIT confirmed that the extent of licensee examination of the replaced head and CRDM nozzles met or exceeded NRC regulations for the entire time the head was in service.

FENOC stated -- and the NRC agrees -- that they could have taken additional voluntary actions to identify cracks and leaks. However, FENOC's actions to address reactor vessel head integrity following the 2002 event were in accordance with NRC regulations that are based on best available knowledge PWSCC to date. These actions were successful in maintaining the safety of the head. Nozzle cracks and minor leakage were identified through NRC-required inspections before they could result in reactor vessel head degradation.

How many RPV heads have been replaced in United States PWRs?

Aside from Davis-Besse, 36 of the 69 US pressurized water reactor pressure vessel upper heads have been replaced. Excluding Davis-Besse, 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.

Do you feel like you have a complete understanding of what happened at Davis-Besse so that you can make sure it doesn't happen at other plants?

We understand the primary cause of the cracking – PWSCC. We also understand the major factors that may have accelerated the process – the high head temperature and defects in the material. There are other factors, such as coolant chemistry and the storage method of the head prior to installation in 2002, whose contribution to the process in uncertain. However, as demonstrated at Davis-Besse, the NRC is confident that existing industry-wide requirements for reactor head inspections will result in finding cracking in reactor vessel nozzles prior to them impacting reactor head structural integrity. As always, we will continue to assess information gained from future testing for any generic implications.

Will you order more frequent inspections of Davis-Besse's new head?

The NRC has an established inspection regime for RPV heads that takes into account multiple factors associated with cracking and corrosion. This inspection regime has proven to be effective and Davis-Besse will be expected to perform inspections required by the NRC.

We know Davis-Besse operates at a temperature that is hotter than any other PWR, and we know it's a significant factor that causes corrosion. Will the NRC inspections of the new head take that into account?

Industry codes for new reactor vessel heads with stress corrosion cracking resistant materials, while considering reactor head temperature in particular situations, do not explicitly consider temperature in original inspection schedule requirements.

Will the NRC perform more frequent inspections of other plants with Alloy 600 heads?

While numerous cracks were identified at Davis-Besse in 2010, they were identified well before they could cause a significant safety issue. While there were minor leaks, there was almost no corrosion of the upper head surface beyond minor rusting. This was the first indication of a leaking nozzle in any US plant in the past six years. This is evidence that the current NRC inspection requirements work.

Based on the operating experience we have collected from other plants, and their basic differences in design, the NRC does not believe that there is a need to require more frequent inspections of heads at other plants at this time. The testing frequency has been successful at these plants in allowing identification of flaws before they can challenge the structural integrity of their reactor vessel heads.

While the increased speed of the crack growth appears to be caused by factors specific to Davis-Besse, if during the course of our reviews we identify indications of more generic contributors, we will evaluate whether changes to the inspection frequency at Davis-Besse or elsewhere are necessary.

The NRC is very focused on identifying safety concerns before they have the potential to present a hazard to safe plant operations. We have devoted significant efforts to understanding the cause of the 2010 issue at Davis-Besse, as well as ensuring that the problem gets corrected. This gives us confidence that we have been able to identify any safety concerns which are within our ability to foresee and prevent. However, new challenges continue to present themselves and new knowledge continues to come to light. For this reason, we include significant safety margins into our requirements and analyses. We are committed to using the people and resources necessary to identify and address issues before they challenge safe plant operation.

What is the purpose of a Reactor head?

The reactor head is the 'lid' for the reactor vessel. It provides for a method to get inside the vessel to do inspections of the vessel and to replenish fuel. It also provides for entries into the vessel for control rods that insert into the locations in the fuel array. These control rods provide for fine control of the nuclear reaction and provide a method for rapid shutdown (scram) of the nuclear reactor if and when necessary.

WHAT IS A CRDM NOZZLE? WHAT DOES IT DO?

The CRDM nozzle is the connection point to the reactor pressure vessel head for the control rod guide tubes which provide the movement path for the control rods into and out of the core.

How long is a typical RPV head supposed to last? What about Davis-Besse's head?

RPV heads are designed to last the lifetime of the plant. In the case of Davis-Besse, nozzle cracks and minor leakage were identified in 2010 through NRC-required inspections before they could result in reactor vessel head degradation. These cracks, a result of primary water stress corrosion cracking were identified at an early stage, such that plant safety was not challenged.

What is Primary Water Stress Corrosion Cracking (PWSCC)? How does it affect reactors?

Old RPV heads, such as the RPV head replaced in 2002 and the Midland head, have components made from a certain type of nickel-based metal alloy (Alloy 600). This type of alloy is particularly susceptible to PWSCC. The issue is a potential safety concern because RPV head nozzles that go through the reactor vessel head and into the reactor are made from this type of alloy.

If nozzle cracking goes undetected for a long period of time and becomes severe, it could break off during operation. This would compromise the integrity of the reactor coolant system pressure boundary – one of three primary barriers that protect the public from exposure to radiation. The break may also result in the ejection of a control rod, which could damage nearby components.