

SECURE AND RELIABLE RAIL TRANSPORTATION OF THE DAVIS BESSE RX HEAD

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ABSTRACT

This paper will identify the events leading up to FirstEnergy Nuclear Operating Company's decision to disposition the Davis Besse Nuclear Power Station's Reactor Vessel Head (Rx Head). The paper will detail the process utilized to identify the advantages of loading, securing, and transporting the Rx Head via rail methodologies and will also explain the responsibilities of Davis Besse and their Logistics Manager during the shipment process. Lastly, the paper will provide an overview of the sequence of events required to safely and economically transport the Rx Head from Davis Besse to a disposal site in Clive, Utah.

INTRODUCTION/OVERVIEW

On February 16, 2002, the Davis-Besse Nuclear Power Station in Oak Harbor, Ohio, began a refueling outage that included inspecting the nozzles entering the head of the reactor pressure vessel (RPV), the specially designed container that houses the reactor core and the control rods that regulate the power output of the reactor. Of these vessel head penetration (VHP) nozzles, the Davis-Besse's inspections focused on the nozzles associated with the mechanism that drives the control rods, known as the control rod drive mechanism (CRDM). Both the inspections and their focus were consistent with the license commitments in response to NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles," which the NRC issued on August 3, 2001.

In conducting its inspections, Davis-Besse found that three CRDM nozzles had indications of axial cracking, which had resulted in leakage of the reactor's pressure boundary. Specifically, Davis-Besse found these indications in CRDM nozzles 1, 2, and 3, which are located near the center of the RPV head. Davis-Besse decided to repair the three leaking nozzles, as well as two other nozzles that had indications of leakage but had not resulted in pressure boundary leakage.

The repair of these nozzles included roll expanding the CRDM nozzle material into the material of the surrounding RPV head and then machining along the axis of the CRDM nozzle to a point above the indications in the nozzle material. On March 6, 2002, Davis-Besse prematurely terminated the machining process on CRDM nozzle 3 and removed the machining apparatus from the nozzle. During the removal, the nozzle was mechanically agitated and subsequently displaced (or tipped) in the downhill direction (away from the top of the RPV head) until its flange contacted the flange of the adjacent CRDM nozzle.

To identify the cause of the displacement, Davis-Besse investigated the condition of the RPV head surrounding CRDM nozzle 3. This investigation included removing the CRDM nozzle from the RPV head, removing boric acid deposits from the top of the RPV head, and ultrasonically measuring the thickness of the RPV head in the vicinity of CRDM nozzles 1, 2, and 3.

Upon completing the boric acid removal on March 7, 2002, Davis Besse conducted a visual examination of the area, which identified a large cavity in the RPV head on the downhill side of CRDM nozzle 3. Follow up characterization by ultrasonic testing indicated wastage of the low alloy steel RPV head material adjacent to the nozzle. The wastage area was found to extend approximately 5 inches downhill on the RPV head from the penetration for CRDM nozzle 3 and was approximately 4 to 5 inches at its widest part. The minimum remaining thickness of the RPV head in the wastage area was found to be approximately 3/8 of an inch. This thickness was attributed to the thickness of the stainless steel cladding on the inside surface of the RPV head, which is nominally 3/8 inch thick.

Davis-Besse initially considered an option to repair the damage then decided to replace the RVH when it was confirmed that the RVH from the cancelled Midland Michigan facility was available and would fit.

Planning for disposal of the damaged RVH was initiated in April 2002. The first action taken was a preliminary waste classification of the damaged RVH by WMG Inc. to determine the waste class of the damaged RVH as one piece. This action determined that the damaged RVH could be disposed of as Class A waste as defined by 10 CFR 61 and transported as Radioactive SCO (Surface Contaminated Object) II.

DISPOSAL OPTIONS

Davis Besse identified three disposition options for the damaged RVH: Storage On Site until Decommissioning, Off Site Processing, and Off Site Direct Disposal. Storage of the Rx Head Onsite at Davis Besse required the erection of a storage facility capable of holding the damaged RVH and possibly the replacement Midland RVH when dispositioned in 2010. Davis Besse would also have to justify the use of Decommissioning Funds for unknown disposal costs in the next thirty years to disposition the RVH during decommissioning. Off Site Processing of the Rx Head identified risks as well, do to the unknowns of an actual volume to be free released vs. a volume to be buried at a low level disposal facility. Off Site Direct Disposal was the most attractive option to Davis Besse. With Direct Disposal Davis Besse could capture all costs associated with Packaging, Transportation, and Disposal as well as finalize the project once the damaged RVH was received at the Disposal Facility. Direct Disposal was based on the ability to transport the Rx Head to Clive, Utah based on various packaging options.

TRANSPORTATION OPTIONS

Working closely with MHF Logistical Solutions (MHF-LS), Davis Besse identified two means of transporting the Damaged RVH from Oak Harbor, Ohio to final disposition in Clive, Utah. The first option was utilizing public highways and heavy haul flatbed conveyances. This means of transportation would provide Davis Besse with a simple means of loading multiple packages, identified in the packaging section of this paper, but would require multiple heavy haul conveyances completing single, highly visible shipments traveling over public highways and becoming exposed to the general population and possible protestors.

The second and preferred option involved the movement of the damaged RVH via rail, directly from Davis Besse to final Disposition in Clive, UT. Davis Besse contracted with MHF Logistical Solutions to complete a preliminary clearance evaluation based on potential maximum dimensions and weights of the damaged RVH on a Heavy Duty Rail Car. MHF-LS researched all available rail conveyances based on the conveyances load areas and capacities combined with positioning the damaged RVH in various configurations on those rail conveyances. MHF-LS developed rail clearances when up righting the damaged RVH, installing counter balances and metal saddles on a depressed center, heavy-duty rail car, and lashing the damaged RVH to the rail car. With clearances issued to MHF-LS from all applicable railroads the damaged RVH would travel on, Davis Besse could ship the damaged RVH on private and secure rail lines. The RVH would not be visible to the general population or interact with various uncontrolled motorists on the public highways.

PACKAGING OPTIONS

Although the shipment of the Rx Head in one piece was feasible Davis Besse also identified two additional packaging options through the packaging Sub Contractor, WMG. The first option required partial segmentation of the RVH by cutting the RVH in half and creating two pieces that are 17' 6" long x 8' 9" wide x 10' high. Each package would be required to contain the applicable RVH half and meet DOT "Strong Tight" requirements. The package could ship via a rail or truck conveyance. The advantages of this package design were that the packages would not require rail clearances or any additional packaging once placed into the original container. The disadvantages of this packaging option was that Davis Besse would recognize longer packaging time frames, additional vendor costs for segmentation, plant personnel and equipment cost to support the multiple crane lifts (to position the RVH for segmentation and packaging), fabrication, monitoring, and demolition of a segmentation building, and heavy haul permits for highway transportation. Davis Besse would also have to establish a remote RCA because the segmentation area would be established in the non-RCA, Turbine Bay.

The second option required full segmentation of the RVH by cutting the flange area from the dome section producing four, quarter moon sections and one smaller dome section. Each package would again be required to contain each applicable Rx Head piece and meet DOT "Strong Tight" requirements. The advantages of this package design were that the packages would not require rail clearances or any additional packaging once placed into the original container. The disadvantages of this packaging option was that Davis Besse would recognize even longer packaging time frames, additional vendor costs for segmentation, plant personnel and equipment cost to support the multiple crane lifts (to position the RVH for segmentation and packaging), fabrication, monitoring, and demolition of a segmentation building, and heavy haul permits for highway transportation. Davis Besse would again have to establish a remote RCA because the segmentation area would be established in the non-RCA, Turbine Bay.

However, the option to utilize the RVH as the package itself remained the most attractive option. Davis Besse would utilize the support of their replacement subcontractors, Framatome and Master Lee, to apply Insta-coat adhesive in conjunction with a WMG shield plate and top hat to meet all applicable DOT regulations to ship the RVH as a Radioactive Class A waste. The package would have a maximum diameter of 17' 6", height of 10', and weight of 250,000 lbs. The advantages of this packaging option would allow Davis Besse to eliminate the various costs, personnel, and exposure associated with segmentation, reduce the amount of time to package the RVH, ship the RVH via a secure rail conveyance, and only require two critical lifts to package and position the RVH onto the rail car. Davis Besse did view this packaging option as posing any disadvantages to Davis Besse or the overall scope of the disposition project.

FINAL SCOPE OF WORK

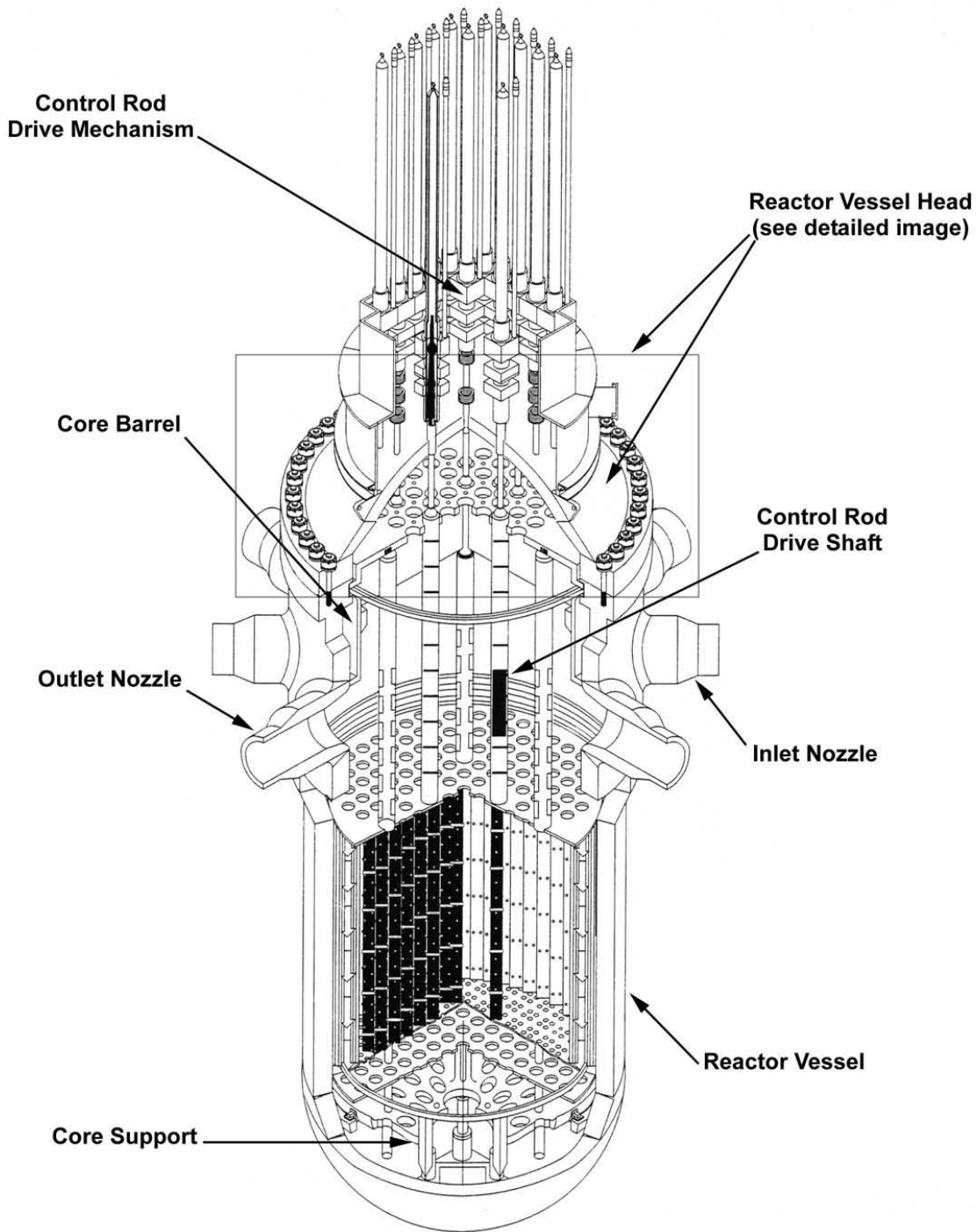
Davis Besse requested that MHF-LS work directly with their packaging contractor to ensure the rail car shipping saddles and counter balances were able to accept the RVH package with minimal amount of onsite work and to guarantee the RVH package would not exceed any of the dimensions identified in the previously completed clearance evaluations of the travel route. Davis Besse also requested that MHF-LS subcontract with Rigging International, the current on-site rigging contractor, to load the RVH onto the rail car. MHF-LS would again work with the Packaging Contractor to make certain the package design could support the up righting and loading of the RVH without jeopardizing the integrity of the container or alter the tie down locations.

Upon completion of the packaging, rigging/lifting, and blocking/bracing plans, MHF-LS finalized the fabrication and installation of the shipping saddles and counter balances to the heavy duty rail car at a

designated off site location. The rail car was then mobilized to Davis Besse after MHF-LS was notified that the RVH was completely packaged. MHF-LS instructed their rigging contractor to up right and secure the RVH to the rail car. MHF-LS provided a RVH Transportation and Emergency Response Plan to Davis Besse detailing the specific route the RVH would travel including the main switch locations between the railroads as well as identification of the Point of Contacts for both Davis Besse and MHF-LS in the event of an emergency and the specific instructions should the shipment be delayed or the package become breached or damaged.

When all shipping documentation was completed and the Transportation & Emergency Response plan approved, MHF-LS coordinated the shipment of the RVH. The RVH delivered to Clive, Utah in twelve days without any delays at the switchyards or during transfer from one rail line to another. The rail car and package did not interact with any personnel outside of those personnel with the applicable rail lines completing inspections at the switchyards and the package was not breached, damaged, or altered in any way. MHF-LS provided all rail line coordination and daily tracking reports to Davis Besse during the shipment.

Typical Pressurized Water Reactor



Reactor Vessel Head Degradation Location

