



# Davis-Besse Reactor Vessel Head Damage NRC UPDATE

December 2003

This is the sixteenth periodic update on the NRC response to the reactor vessel head damage at the Davis-Besse Nuclear Power Station. The updates will be available at public meetings of the NRC Davis-Besse Oversight Panel which is coordinating the agency's activities related to the damage. Each update will include background information to assist the reader in understanding issues associated with the corrosion damage.

## NRC Outlines Process for Reviewing Possible Restart

The NRC has three important inspections planned and underway that will provide a basis for a decision on the request by FirstEnergy to resume operations at the Davis-Besse Nuclear Power Station.

On November 23, FirstEnergy submitted a restart report, documenting the work done by the utility to correct the problems which led to the corrosion damage to the reactor vessel head and other safety issues found during subsequent reviews. The utility asked the NRC to schedule a public meeting on possible restart and permit restart of the plant.

The NRC inspections are focusing on both the readiness of plant safety systems and the plant management and staff for a possible restart of the plant. The information gathered in these inspections will be discussed in a public meeting with the utility on the restart of the plant. The date for this meeting will be announced after it is set.

One remaining inspection is the restart readiness assessment team inspection which will last about two weeks. A central element of this inspection is a round-the-clock monitoring of control room activities for a three-day period while the plant is being prepared for a possible startup. The inspection will also review the readiness of plant safety systems.

### Key Steps Remaining

- ❖ **Ongoing** - Management and Human Performance, Phase III (Safety Culture)- This inspection focuses on FENOC's actions to improve management effectiveness and human performance and its processes to survey and assess the safety culture among the staff at Davis-Besse – how the management and workers will identify and deal with safety concerns.
- ❖ **To be scheduled** - Public meeting between FirstEnergy and NRC panel to discuss preliminary results of the Safety Culture inspection
- ❖ **Ongoing** - Resolution by FirstEnergy of remaining safety system equipment issues including installation and testing of high pressure injection pumps
- ❖ **Planned** - Restart Readiness Assessment Team Inspection - including continuous observation of control room activities.
- ❖ **To be scheduled** - Public restart meeting between FirstEnergy and NRC panel
- ❖ **Pending** - Panel recommendation to Regional Administrator
- ❖ **Pending** - Decision by Regional Administrator in consultation with other NRC officials

## Process for Reviewing Restart - continued

The inspectors want to observe the plant staff operating as they increase temperatures and pressures in the reactor system, similar to the activities conducted for the reactor cooling system test in September. Increasing temperature and pressure in reactor cooling system - known as Mode 4 and Mode 3 - is accomplished by running the cooling system pumps without actually withdrawing control rods to start the nuclear reaction.

During the September test, there were two incidents of inadequate performance by the operating staff which led to the unexpected draining of an emergency system tank, in one instance, and the unplanned insertion of control rods into the reactor in the second. The reactor was not started up for the pressure test, and there were no safety consequences of the performance errors.

The second inspection underway is the management and human performance inspection which is examining FirstEnergy's efforts to improve the safety culture of plant management and staff. The safety culture includes attitudes toward plant safety as well as the willingness of the staff to raise safety concerns - known as the "safety conscious work environment."

FirstEnergy is expected to provide information on its plans for monitoring and improving the staff's safety culture at the December 3 meeting with the NRC oversight panel. The NRC inspection team will review the utility's plans as well as other aspects of its activities to enhance the safety culture.

The results of the management and human performance inspection will then be presented in a public meeting with FirstEnergy which will take place before a decision on plant restart is made.

In addition, routine resident staff inspection continues on a daily basis assessing plant operations, maintenance, testing and engineering activities.

Once the NRC restart readiness inspection has observed plant operations and evaluated plant safety systems, the NRC oversight panel will hold a restart meeting with FirstEnergy to discuss the basis for the company's request to resume operations. This meeting, like all other NRC Davis-Besse meetings, will be open to public observation and will include an opportunity for questions and comments from the public.

Following the restart meeting, the NRC oversight panel will review the information presented in the meeting as well as the findings of NRC inspections and reviews since the plant was shut down in February of last year.

The panel will submit a recommendation to James Caldwell, NRC Regional Administrator, on the readiness of the plant, including its management and staff, to resume operations. The panel will also prepare a report discussing the basis of its recommendation. The report will be available to the public.

Mr. Caldwell will confer with other NRC officials before reaching his decision of whether the plant may resume operation.

The decision on restart will be announced publicly. Mr. Caldwell's decision, along with the panel's recommendation and supporting report, will be posted on the NRC's web site.

If the NRC authorizes restart, the NRC Oversight Panel will continue to monitor plant activities and meet periodically with the utility and the public until the agency is satisfied that the plant's performance warrants resuming normal regulatory oversight.

### NRC Responds to Letters

The NRC continues to receive letters and e-mails expressing interest and concern about Davis-Besse -- now totaling several thousand.

The agency is responding to all these letters -- attached to this Update newsletter is a sample of the response.

## Davis-Besse Restart Checklist

The Oversight Panel has created a "restart checklist" categorizing 31 actions in seven major areas which FirstEnergy needs to complete before the NRC can consider making a decision on whether Davis-Besse may restart. The NRC oversight panel has determined that the utility has adequately completed 23 of those actions.

NRC inspections are directed at evaluating the checklist items as well as reviewing the ongoing work at Davis-Besse.

The completed items are shown in italics and have a check mark in front of the item. For the completed items, the list also includes the inspection report which documents the NRC's review of the item. The items that remain to be completed are underlined.

### 1. Adequacy of Root Cause Determinations

- ✓ *1.a Penetration Cracking and Reactor Pressure Vessel Corrosion (Report No. 50-346/03-04)*
- ✓ *1.b Organizational, Programmatic and Human Performance Issues (Report No. 50-346/02-18)*

### 2. Adequacy of Safety Significant Structures, Systems, and Components

- ✓ *2.a Reactor Pressure Vessel Head Replacement*
- ✓ *2.b Containment Vessel Restoration Following Reactor Pressure Vessel Head Replacement (Report No. 50-346/03-05)*
- ✓ *2.c Structures, Systems, and Components Inside Containment (Report No. 50-346/03-10)*
- ✓ *2.c.1 Emergency Core Cooling System and Containment Spray System Sump (Report No. 50-346/03-17)*
- ✓ *2.d Extent-of-Condition of Boric Acid in Systems Outside Containment (Report No. 50-346/03-22 - to be issued)*
- 2.e High Pressure Injection Pump Internal Clearance/Debris Resolution*

### 3. Adequacy of Safety Significant Programs

- ✓ *3.a Corrective Action Program*
- ✓ *3.b Operating Experience Program (Report No. 50-346/03-09)*
- ✓ *3.c Quality Audits and Self-Assessments of Programs (Report No. 50-346/03-23 - to be issued)*
- ✓ *3.d Boric Acid Corrosion Management Program (Report No. 50-346/03-17)*
- ✓ *3.e Reactor Coolant System Unidentified Leakage Monitoring Program (Report No. 50-346/03-09)*
- ✓ *3.f In-Service Inspection Program (Report No. 50-346/03-09)*
- ✓ *3.g Modification Control Program (Report No. 50-346/03-09)*
- ✓ *3.h Radiation Protection Program (Report No. 50-346/03-17)*

## NRC Inspection Reports Being Prepared

- ❖ **Report Pending** - Corrective Action Team Inspection - This inspection looked at the effectiveness of the corrective action program at Davis-Besse – how the utility finds, evaluates, and fixes problems.
- ❖ **Report Pending** - Engineering and Maintenance Backlog Review - This inspection assessed the work FirstEnergy plans to complete after possible restart of the plant to determine if the utility has properly characterized and evaluated the work items which will be deferred.
- ❖ **Report Pending** - Completeness and Accuracy Review - This inspection evaluated the findings of a FirstEnergy review of documents previously submitted to the NRC to assure that the information submitted was complete and accurate.
- ❖ **Report Pending** - Reactor Cooling System Test (Normal Operating Pressure) - This inspection monitored the plant's test of the reactor vessel and associated piping to assure there are no leaks in the system as well as reviewing the performance of the plant staff.

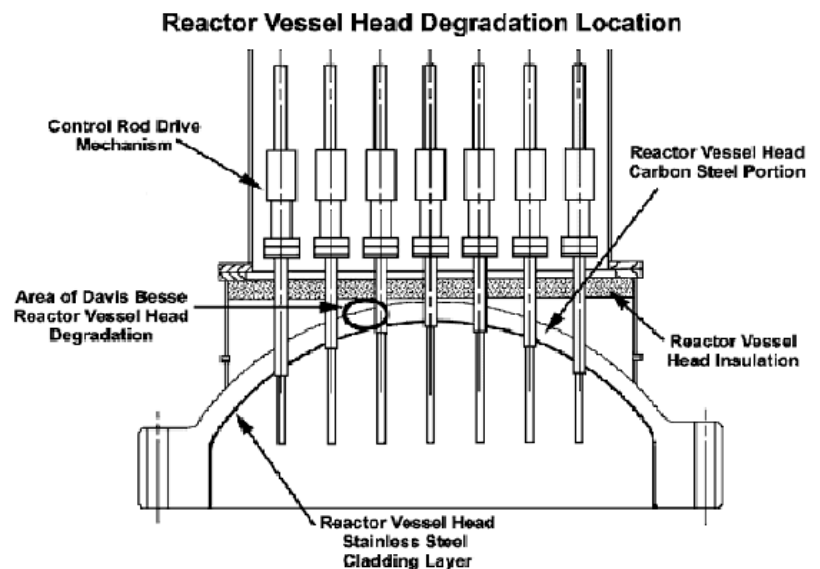
- ✓ 3.i *Process for Ensuring Completeness and Accuracy of Required Records and Submittals to the NRC - (Report No. 50-346/03-19 - to be issued)*
- 4. **Adequacy of Organizational Effectiveness and Human Performance**
  - ✓ 4.a *Adequacy of Corrective Action Plan (Report No. 50-346/02-18)*
  - 4.b Effectiveness of Corrective Actions
- 5. **Readiness for Restart**
  - ✓ 5.a *Review of Licensee's Restart Action Plan (Report No. 50-346/03-22 - to be issued)*
  - 5.b Systems Readiness for Restart
  - 5.c Operations Readiness for Restart
  - 5.d Test Program Development and Implementation
- 6. **Licensing Issue Resolution (Not discussed in inspection reports)**
  - ✓ 6.a *Verification that Relief Requests A8 and A12 regarding the Shell to Flange Weld (previously submitted by letter dated September 19, 2000) is not Impacted by the Midland RPV Head*
  - ✓ 6.b *American Society of Mechanical Engineers (ASME) Code Relief Request for Failure to Maintain Original Radiographic Tests of the Midland Head to Flange Weld (Planned Relief Request A26)*
  - ✓ 6.c *ASME Code Relief Request for Inability to Radiographically Test 100% of the Midland Reactor Pressure Vessel Head to Flange Weld (Planned Relief Request A27)*
  - ✓ 6.d *Resubmit Relief Request A2 (previously submitted by letter dated September 19, 2000) for ASME Code for Inability to Perform 100% volumetric and surface examination of Head to Flange Weld*
  - ✓ 6.e *Reconciliation Letter that Demonstrates How the New Reactor Pressure Vessel Head Correlates With the ASME Code and QA Index for Section III and Section XI - Commitments*
  - ✓ 6.f *Verification Letter of Technical Specification Pressure/Temperature Curves for New Vessel Head - Commitment*
  - ✓ 6.g *Request to relocate High Pressure Injection and Low Pressure Injection Subsystems Flow Balance Testing from Technical Specifications 4.5.2.h to Updated Safety Analysis Report Technical Requirements Manual*
- 7. **Confirmatory Action Letter Resolution**
  - 7.a Verification that Confirmatory Action Letter Items are Resolved, Including a Public Meeting to Discuss Readiness for Restart

## Background Summary: What Happened at Davis-Besse

In March 2002 plant workers discovered a cavity in the head or top of the reactor vessel while they were repairing control rod tubes which pass through the head. The tubes, which pass through the reactor vessel head, are called control rod drive mechanism nozzles. Cracks were detected in 5 of the 69 nozzles.

In three of those nozzles, the cracks were all the way through the nozzle, allowing leakage of reactor cooling water, which contains boric acid.

Corrosion, caused by the boric acid, damaged the vessel head next to Nozzle No. 3, creating an irregular cavity about 4 inches by 5 inches and



approximately 6 inches deep. The cavity penetrated the carbon steel portion of the vessel head, leaving only the stainless steel lining. The liner thickness varies somewhat with a minimum design thickness of 1/8 inch. Subsequent examination by Framatome, FirstEnergy's contractor, found evidence of a series of cracks in the liner, none of which was entirely through the liner wall.

After circumferential cracks - around the nozzle wall - were found in the control rod drive nozzles at Unit 3 of the Oconee Nuclear Power Station in 2001, the NRC required all pressurized water reactor (PWR) operators to report to the NRC on structural integrity of the nozzles and their plans to inspect the nozzles. Plants with similar operating history to Oconee Unit 3, including Davis-Besse, were to inspect their reactor vessel head penetrations by December 31, 2001, or to provide a basis for concluding that there were no cracked and leaking nozzles.

FirstEnergy Nuclear Operating Company requested an extension of the inspection deadline until its refueling outage beginning March 30, 2002, and provided the technical basis for its request. The NRC did not allow the plant to operate until March 30, but agreed to permit operation until February 16, provided that compensatory measures were taken to minimize possible crack growth during the time of operation. The NRC was unaware that nozzle leakage or corrosion had occurred at Davis-Besse when it agreed to the February 16 date.

### **Barriers Built into Nuclear Plants to Protect Public Health and Safety**

The design of every nuclear power plant includes a system of three barriers which separate the highly radioactive reactor fuel from the public and the environment. The Davis-Besse reactor head damage represented a significant reduction in the safety margin of one of these barriers, the reactor coolant system. The reactor coolant system, however, remained intact, as well as the other two barriers, the fuel and the containment.

#### 1. Fuel Pellets and Rods

The first barrier is the fuel itself. The fuel consists of strong, temperature-resistant ceramic pellets made of uranium-oxide. The pellets are about the size of a fingertip. They retain almost all of the highly radioactive products of the fission process within their structure.

The pellets are stacked in a rod made of a zirconium alloy. At Davis-Besse, each fuel rod is about 13 feet long. The rods are assembled into bundles, with each assembly containing 208 rods. The reactor core contains 177 fuel assemblies. Any fission products which escape from the pellets are captured inside the cladding of the rod, which is designed to be leak-tight. Small pin hole leaks do occasionally occur, however, and the operating license requires leakage monitoring and contains limits on the maximum allowable leakage of radioactive materials from the fuel rods.

#### 2. Reactor Coolant System

The second barrier is the reactor coolant system pressure boundary. The reactor core is contained inside the reactor pressure vessel, which is a large steel container. Thick steel pipes supply cooling water to the reactor and carry away the heated water after it passes through the reactor core. The pressure vessel, the connected piping, and other connected components make up the reactor coolant system pressure boundary. At Davis-Besse, the reactor coolant system contains about 60,000 gallons of cooling water, circulated by four large pumps at a rate of about 360,000 gallons per minute.

This system is designed to be leak-tight at operating conditions which include a water temperature of 605° F and a water pressure of 2,150 pounds per square inch. The operating license contains limits on the maximum allowable amount of leakage from the system, and it specifies requirements for monitoring any leakage. If a leak is identified as being through any solid wall of the system (reactor vessel, cooling pipes or other components) continued operation of the plant is prohibited, no matter how small the leak rate.

**Next Davis-Besse NRC Oversight Panel Meetings**  
**2 p.m. and 7 p.m., Tuesday, Jan. 13, Oak Harbor High School**

### 3. Containment Building

The third barrier is the containment building. This is a large cylindrical building which contains the entire reactor coolant system. None of the piping that contains the high-temperature and high-pressure reactor coolant water extends outside the containment building. The containment is a 1 ½ inch thick steel cylinder, rounded at the top and bottom, which is designed to be leak-tight. This steel structure is surrounded by a reinforced concrete shield building, which is the round building visible from the outside of the plant. Its walls are 2 to 3 feet thick.

### **NRC's Response to Vessel Head Damage**

The NRC responded to the vessel head degradation with a series of actions, some specific to Davis-Besse and others aimed at other PWR plants. The agency directed all PWR licensees to report on the condition of their reactor heads and later specified more stringent examination for inspecting the reactor heads. The NRC also established a Lessons Learned Task Force to review the agency's activities associated with the Davis-Besse reactor head issue.

### NRC Davis-Besse Oversight Panel

An NRC Davis-Besse Oversight Panel was created in April 2002 to make sure that all corrective actions, required to ensure that Davis-Besse can operate safely, are taken before the plant is permitted to restart and that Davis-Besse maintains high safety and security standards if it resumes operations. Should the plant restart, the Oversight Panel will evaluate if Davis-Besse's performance warrants reduction of the NRC's heightened oversight and, if so, recommend to NRC management that the plant return to a regular inspection schedule. The panel was established under the agency's Manual Chapter 0350.

The panel brings together NRC management personnel and staff from the Region III office in Lisle, Illinois, the NRC Headquarters office in Rockville, Maryland and the NRC Resident Inspector Office at the Davis-Besse site. The eight-member panel's chair and co-chair are John Grobe, a senior manager from Region III, and William Ruland, a senior manager from NRC headquarters.

The agency has supplemented the resident inspection staff with an additional resident inspector who began work at Davis Besse in September, bringing the total staff there to three.

### **Public Participation in the Process**

The NRC's experience is that members of the public, including public officials and citizens, often raise questions or provide insights that are important to consider. If you have questions or want to provide information or a point of view, please contact us. For feedback on this newsletter, contact Viktoria Mitlyng 630/829-9662 or Jan Strasma 630/829-9663 (toll free 800/522-3025 - ext -9662 or -9663). E-mail: opa3@nrc.gov. Extensive information about the Davis-Besse reactor vessel head damage and the ensuing activities is available on the NRC web site: <http://www.nrc.gov> - select "Davis-Besse" under the list of key topics.



UNITED STATES  
**NUCLEAR REGULATORY COMMISSION**

REGION III  
801 WARRENVILLE ROAD  
LISLE, ILLINOIS 60532-4351

Dear Citizen:

Thank you for your interest and concern over the U. S. Nuclear Regulatory Commission's (NRC) regulation of the Davis-Besse Nuclear Power Plant. The NRC has received a large number of letters and e-mails concerning Davis-Besse. Since many of the issues and questions raised are similar, we are sending letters like this one to each of those who took the time to forward their concerns to us.

Our primary mission is to protect public health and safety and ensure that each nuclear power plant operates safely. This is our most important responsibility, and we take our mission very seriously.

While performing NRC-required inspections and repairs of control rod drive tubes in the top of the reactor in March 2002, FirstEnergy Nuclear Operating Company personnel discovered substantial corrosion damage to the vessel head.

Because of the damage – and the violations of NRC requirements that led to it – the agency has required that FirstEnergy perform thorough reviews of plant safety systems as well as address the reactor vessel head damage before restart. The company replaced the reactor head with an unused one from another plant. The reviews of the design and function of the safety systems have resulted in a number of repairs and improvements to plant equipment. These reviews and repairs are continuing.

In addition, the agency has required that FirstEnergy take steps to assess and improve the safety culture at the plant. Safety culture includes the attitudes of plant management and employees toward placing the highest priority on safety in plant operations. It also deals with how FirstEnergy encourages workers to raise safety concerns without fear of retaliation.

The damage to the reactor vessel head – and the management decisions that contributed to the problem – are viewed most seriously by the NRC. No other operational issue has received more attention from the agency in the past two years.

In April 2002, the NRC set up a special panel to oversee the agency's response to the vessel head damage and to manage the inspection program for ongoing work at the plant. The panel set forth a checklist of the important tasks that must be completed by FirstEnergy before the agency would consider permitting the plant to restart.

Since then, the NRC has conducted extensive inspections by nearly 50 members of the NRC staff and contractors. These inspections are continuing. The NRC has also added a third resident inspector to its staff at the Davis-Besse plant to expand its daily coverage of activities there.

The oversight panel has held at least 33 public meetings near Oak Harbor, Ohio: a monthly meeting with the utility, open to public observation, in the afternoon followed by a meeting directly with the public in the evening. Some 30 additional public meetings have been held in the Oak Harbor area, the Region III Office in Illinois, and NRC Headquarters in Rockville, Maryland, to discuss specific issues.

The oversight panel has monitored the ongoing investigation by the NRC's Office of Investigations which is looking at possible wrongdoing in connection with the reactor vessel head damage. The findings of this investigation will be fully considered in any decision for possible restart of the plant.

The NRC also established a Lessons Learned Task Force to evaluate the NRC's own actions associated with the reactor vessel head damage. The task force made a number of recommendations to improve NRC processes, and the majority of these recommendations have been adopted by the agency.

Shortly after the vessel head damage was found, the NRC created a web site for the many documents related to Davis-Besse issues, including NRC inspection reports, meeting transcripts, and documents submitted by FirstEnergy. These documents can be reviewed at the NRC home page - <http://www.nrc.gov>. Select "Davis-Besse" from the Key Topics listing.

In addition, we have issued monthly updates on the NRC's regulatory activities for Davis-Besse. These, too, are available on the NRC's Davis-Besse web site. A copy of the most recent issue is enclosed.

Throughout this period, the NRC has been firmly focused on the safety of the Davis-Besse plant and residents of the surrounding area. The schedule and economic impact of the continuing outage on FirstEnergy have not been a factor in NRC actions.

When FirstEnergy requests permission to restart Davis-Besse, I can assure you that the NRC will make its decision on the possible restart in a careful, deliberate, and responsible manner. Restart will not be considered until FirstEnergy has resolved to the NRC's satisfaction all of the items on the NRC oversight panel's restart checklist and the agency has completed its planned inspections of plant and organizational improvements.

The NRC's decision will be based on sound regulatory and technical findings, in keeping with the requirements of federal statutes and NRC regulations. FirstEnergy will not be permitted to resume operation of the Davis-Besse plant unless we have sufficient evidence that the plant equipment and the plant management and staff are ready to safely return the plant to service and operate it safely.

Thank you for giving me the opportunity to explain the NRC's regulatory process for the Davis-Besse plant.

Sincerely,

A handwritten signature in black ink that reads "James L. Caldwell". The signature is written in a cursive, flowing style.

James L. Caldwell  
Regional Administrator