



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**

REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

October 2, 2012

Mr. Barry Allen
Site Vice President
FirstEnergy Nuclear Operating Company
Davis-Besse Nuclear Power Station
5501 North State Route 2, Mail Stop A-DB-3080
Oak Harbor, OH 43449-9760

SUBJECT: DAVIS-BESSE NUCLEAR POWER STATION - INSPECTION TO EVALUATE IN THE CHANGES IN THE REVISED ROOT CAUSE ANALYSIS REPORT FOR CRACKING IN REINFORCED CONCRETE SHIELD BUILDING OF THE CONTAINMENT SYSTEM 05000346/2012010(DRS)

Dear Mr. Allen:

On August 30, 2012, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection to evaluate your revised root cause analysis report associated with discovery of laminar subsurface cracks in the reinforced concrete shield building at the Davis Besse Nuclear Power Station. The enclosed inspection report documents the inspection results which were discussed on August 30, 2012, with you and other members of your staff.

These cracks were discovered on October 10, 2011, by your staff while performing hydrodemolition operations in support of reactor vessel head replacement. The NRC had previously initiated an inspection in accordance with the special and infrequently performed inspection procedure (IP) 71007 "Reactor Vessel Head Replacement" and confirmed adequate restoration of the containment system to assure functional integrity (NRC inspection reports (IR) 05000346/2011-005 and 05000346/2012-007). In addition, the later report discussed your assessment and the associated NRC review, that the shield building remained capable of performing its safety functions despite the cracking.

The NRC had previously reviewed your root cause efforts associated with your original Root Cause Analysis Report (RCR) - Concrete Crack within Shield Building Temporary Access Opening as documented in NRC IR 05000346/2011-009. The NRC inspection team concluded in that report that your staff established a sufficient basis for the causes of the shield building laminar cracking related to: the environmental factors associated with the 1978 blizzard, the lack of an exterior moisture barrier, and the structural design elements of the shield building.

During the current inspection, the NRC inspectors reviewed the changes in your revised RCR - Concrete Crack within Shield Building Temporary Access Opening and your contractor's revised supporting report – Root Cause Assessment Davis-Besse Shield Building Laminar Cracking.

B. Allen

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Based on the results of this inspection, no findings of significance were identified. The inspectors determined that the changes did not affect previous NRC conclusions regarding your root cause efforts.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records System (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

/RA/

David E. Hills
Engineering Branch 1
Division of Reactor Safety

Docket Nos. 50-346
License Nos. NPF-3

Enclosure: Inspection Report 05000346/2012010(DRS)

Attachment 1: Supplemental Information

Attachment 2: Photos and Diagrams

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No: 50-346
License No: NPF-3

Report No: 05000346/2012010(DRS)

Licensee: FirstEnergy Nuclear Operating Company (FENOC)

Facility: Davis-Besse Nuclear Power Station

Location: Oak Harbor, OH

Dates: July 18, 2012 through August 30, 2012

Inspectors: J. Neurauter, Team Lead
A. Wilson, Resident Inspector

Approved by: D. E. Hills, Chief
Engineering Branch 1
Division of Reactor Safety

Enclosure

SUMMARY OF FINDINGS

IR 05000346/2012010(DRS); 07/18/2012 – 08/30/2012, Davis-Besse Nuclear Power Station; Inspection to Evaluate Changes in the Revised Root Cause Analysis Report for Cracking in Reinforced Concrete Shield Building of the Containment System.

This report covers a 2-month period of inspection by one regional inspector supplemented by the Davis-Besse resident inspector. No findings were identified. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process" (SDP). Findings for which the SDP does not apply may be "Green" or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

A. Inspector-Identified and Self-Revealed Findings

No findings of significance were identified.

B. Licensee-Identified Violations

No violations of significance were identified.

REPORT DETAILS

SHIELD BUILDING DESCRIPTION

The containment system for the Davis-Besse site consists of three basic structures: a steel containment vessel (CV), a reinforced concrete shield building (SB), and the internal structures. The CV is a cylindrical steel pressure vessel with hemispherical dome and ellipsoidal bottom which houses the reactor vessel, reactor coolant piping, and other safety-systems. The CV is completely enclosed by a reinforced concrete SB (Attachment 2, Picture 1) having a cylindrical shape with a shallow dome roof. An annular space is provided between the steel CV and the interior face of the concrete SB of approximately 4.5 feet (ft) to permit construction operations and periodic visual inspection of the steel containment vessel. The SB has an inside radius of 69.5 ft and a height of 279.5 ft measured from the top of the foundation ring to the top of the dome. The thicknesses of the SB wall and the dome are approximately 2.5 ft and 2 ft, respectively, and the exterior SB wall has eight vertical cutouts, (called flutes) spaced 45 degrees apart. These flutes consist of shoulders that extend another 1.5 ft outward and gradually taper back to the outer cylindrical wall of the SB while reaching a point of tangency 17 ft 11 inches from the centerline of the flute, (Attachment 2, Picture 2). The CV and SB are supported on a concrete foundation founded on a firm rock structure. With the exception of the concrete under the CV, there are no structural ties between the CV and the SB above the foundation slab. The CV provides the primary means to contain the post accident environment and is designed to withstand and hold against accident induced pressure. The identified cracking does not involve the CV. The design of the SB provides for: shielding from radiation sources within the SB, controlled release of annulus atmosphere under an accident condition, and environmental protection of the CV.

BACKGROUND AND OVERVIEW

The Davis-Besse CV and SB lacked an access opening of sufficient size to permit removal of the old reactor vessel head and reinstallation of the replacement vessel head. Therefore, during the 17-mid-cycle outage, the licensee cut a temporary access opening in the SB and CV of sufficient size to support head replacement. The licensee reused and re-installed by welding the original plate section cut from the CV, to restore the temporary construction opening in the CV. The licensee installed new reinforcing steel, (i.e., rebar) to replace the original steel reinforcement and poured new concrete from an on-site batch plant, to restore the temporary construction opening in the SB. The inspectors reviewed the licensee activities associated with the restoration of the CV and SB access openings as documented in NRC inspection reports (IR) 05000346/2011005 and 05000346/2012007.

During construction of the SB access opening in the 17-mid-cycle outage, the licensee discovered subsurface cracking located near the outer rebar mat, which extended into areas of the SB that has not been modified since original construction. The licensee attempted to remove the cracks discovered during the hydrodemolition process (Attachment 2, Picture 3) using a manual chipping process. Using this method, the crack indications along the left and bottom edges essentially disappeared, but the crack at the top of the opening did not disappear. The licensee investigated and confirmed the extent of subsurface laminar cracking through the use of Impulse Response Testing and Core Boring Samples (CBS) taken from the SB. Specifically, laminar subsurface concrete cracks were identified along the outer rebar mat in the SB flute shoulders, at the top of the SB near the junction with the roof, and at the SB main steam line penetrations. The licensee was able to demonstrate that the SB remained structurally adequate for the controlling load cases and remained capable of performing its safety functions.

However, the SB areas with the laminar subsurface cracking were non-conforming with respect to the SB design and licensing bases. The licensee's analysis and associated NRC review are discussed in NRC IR 05000346/2012007.

The NRC issued a Confirmatory Action Letter (CAL) No. 3-11-001 to document the licensee actions required to demonstrate long-term confidence in the SB integrity. These actions included providing the NRC with the results of the root cause evaluation and corrective actions for the SB cracking.

The licensee's original root cause analysis report (RCR) and associated NRC evaluation are discussed in NRC IR 05000346/2012009. The NRC concluded in that inspection report that the licensee had established a sufficient basis for the causes of the shield building laminar cracking related to: the environmental factors associated with the 1978 blizzard, the lack of an exterior moisture barrier, and the structural design elements of the shield building. However, the NRC-identified minor weaknesses in the RCR generally associated with the level of detail in the documentation recorded that did not constitute performance deficiencies or findings because they did not adversely affect the outcome of the root cause process.

The licensee entered the NRC observations into its corrective action program and initiated a revision to the RCR and the supporting contractor report to address these minor weaknesses. On May 14, 2012, the licensee submitted a redacted (non-proprietary) version of its revised contractor root cause assessment report (ADAMS Accession Nos. ML12138A037, ML12138A049, ML12138A058, ML12138A067, ML12138A073, ML12138A081, and ML12138A089). Note that the NRC staff had access to the non-redacted version of the report for purposes of this inspection. On May 16, 2012, the licensee submitted a revision of the shield building RCR (ADAMS Accession No. ML12142A053).

4. OTHER ACTIVITIES

Cornerstones: Initiating Events, Mitigating Systems, Barrier Integrity, and Emergency Preparedness

40A5 OTHER ACTIVITIES

.1 Reactor Vessel Head Replacement (Inspection Procedure 71007) – Containment Restoration – Review of Changes in the Revised Shield Building Laminar Cracking Root Cause Analysis Report

a. Inspection Scope

From July 18 through August 30, 2012, the inspectors reviewed the licensee's revision to its RCR and the licensee's contractor revision to its supporting root cause assessment report, reviewed associated documentation, and interviewed licensee staff. The inspection activities included:

- Evaluate whether the changes affect RCR identified causes or previous NRC conclusions regarding the licensee's root cause efforts;
- Identify and evaluate any additional safety concerns regarding laminar cracking raised in the revised RCR or contractor's revised supporting report; and

- Review the licensee's changes to its RCR and the licensee's contractor changes to its supporting report previously reviewed by the NRC (Reference IR 05000346/2012009) with respect to the requirements of Title 10 of the Code of Federal Regulations (CFR) 50.9, "Completeness and Accuracy of Information."

b. Observations and Conclusions

b.1 The inspectors reviewed the licensee's revised RCR, the licensee's contractor revision to its supporting root cause assessment report, and associated licensee corrective action documents. In addition, the inspectors reviewed Condition Report (CR)-2012-12679 that documented licensee identified errors in its revised RCR. The inspectors did not identify any changes that affected the RCR identified causes or previous NRC conclusions regarding the licensee's root cause efforts.

b.2 The inspectors noted that in Section 3.3.4, "Surface Examination," the revised RCR discussed results of shield building inspections at the dome parapet including mentioning cracks first identified in 1976 that predated the blizzard of 1978. Specifically, the revised RCR noted, in part, that:

"On August 15, 1976, the Toledo Edison Company construction superintendent documented an examination of the shield building dome parapet that found a cracked and broken architectural flute shoulder corner at approximately 292 degree azimuth. There were also other hairline shrinkage cracks in the dome parapet at both corners of each architectural flute shoulder, at mid-width of each flute, and vertical around the periphery of the parapet that should not affect the structural integrity of the shield building dome parapet... None of the visual inspections of the shield building exterior surface identified any symptoms that would signify the presence of the concrete laminar cracking."

The NRC resident inspector visually examined the shield building dome parapet area and observed the cracks documented in the licensee's 1976 construction report. The inspectors confirmed that the cracks were not indicative of laminar cracking (no visible cracks at the top of the cylindrical wall in the circumferential direction). Therefore, the inspectors concluded that these cracks were most likely related to original construction and not to the laminar cracking identified in 2011.

The inspectors did not identify any new safety concerns related to laminar cracking in the revised RCR.

b.3 Title 10 CFR 50.9 states, in-part, that information provided to the NRC by a licensee shall be complete and accurate in all material aspects. The inspectors concluded that the changes in the revised RCR were clarifications that did not rise to a level to be considered "material" in that they were associated with the level of detail provided and did not affect the RCR outcome, (e.g., conclusions regarding causes of the laminar cracking), and hence NRC conclusions from its inspection of the original RCR. These tended to be details that were available to help support the licensee's root cause results, but had not been included in the original RCR, or had not been explained in the original RCR, as well as they could have been to make it more understandable.

c. Findings and Violations

No findings significance were identified.

4OA6 Meetings

.1 Exit Meeting

On August 30, 2012, the inspectors presented the inspection results to the Site Vice President, Mr. Barry Allen, and other members of the licensee staff. The licensee personnel acknowledged the inspection results presented and did not identify any proprietary content. The inspectors confirmed that all proprietary material reviewed during the inspection would be destroyed by shredding paper copies and deleting electronic copies.

ATTACHMENT: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee

B. Allen, Site Vice President
B. Boles, Director, Site Operations
K. Browning, Root Cause Evaluator
K. Byrd, Director, Site Engineering
J. Hook, Manager, Design Engineering
J. Sturdavant, Senior Specialist
G. Wolf, Supervisor, Regulatory Compliance

Nuclear Regulatory Commission

D. Kimble, Senior Resident Inspector

LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

Opened, Closed, and Discussed

None.

LIST OF DOCUMENTS REVIEWED

The following is a list of documents reviewed during the inspection. Inclusion on this list does not imply that the team reviewed the documents in their entirety but rather that selected sections of portions of the documents were evaluated as part of the overall inspection effort. Inclusion of a document on this list does not imply NRC acceptance of the document or any part of it, unless this is stated in the body of the inspection report.

4OA5 Other Activities

Corrective Action Records

CR-2012-04177; Observations from NRC Inspection Shield Building Root Cause Report; dated March 19, 2012

CR-2012-04178; Observations from NRC Inspection Shield Building Root Cause Report; dated March 19, 2012

CR-2012-12679; Errors in FENOC Root Cause Report on Shield Building Laminar Cracking; dated August 16, 2012

Other Documents

Performance Improvement International - Root Cause Assessment Davis-Besse Shield Building Laminar Cracking; Revision 2 dated April 18, 2012

Performance Improvement International - Root Cause Assessment Davis-Besse Shield Building Laminar Cracking; Revision 2.1 (Redacted) dated April 20, 2012

Root Cause Analysis Report-Concrete Cracking within Shield Building Temporary Access Opening; Revision 1 dated May 11, 2012

Visual Inspection of Shield Building Dome Area; dated September 2, 2005

LIST OF ACRONYMS USED

CAL	Confirmatory Action Letter
CBS	Core Boring Samples
CR	Condition Report
CV	Containment Vessel
ft	Feet
IMC	Inspection Manual Chapter
IP	Inspection Procedure
IR	Inspection Report
NRC	United States Nuclear Regulatory Commission
RCR	Root Cause Analysis Report
SB	Shield Building
SDP	Significance Determination Process

Photos and Diagrams

ATTACHMENT 2 – PHOTOS AND DIAGRAMS

Picture No. 1 – Davis-Besse Shield Building



Photos and Diagrams

Picture No. 3 - Davis-Besse Shield Building Laminar Subsurface Cracking

(Note: initial condition after hydrodemolition to create an opening in the shield building and is included to show the relative location of subsurface laminar cracking. Based upon core bore samples, the crack condition (e.g., crack width) shown does not represent the laminar crack conditions in the sections of the shield building unaffected by the hydrodemolition process.)



B. Allen

-2-

Based on the results of this inspection, no findings of significance were identified. The inspectors determined that the changes did not affect previous NRC conclusions regarding your root cause efforts.

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Sincerely,

/RA/

David E. Hills
Engineering Branch 1
Division of Reactor Safety

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Letter to Mr. Barry Allen from Mr. Steven A. Reynolds dated October 2, 2012.

SUBJECT: DAVIS-BESSE NUCLEAR POWER STATION - INSPECTION TO EVALUATE IN
THE REVISED ROOT CAUSE EVALUATION FOR CRACKING IN
REINFORCED CONCRETE SHIELD BUILDING OF THE CONTAINMENT
SYSTEM 05000346/2012010(DRS)

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