FENOC

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Docket Number 50-346

NP-33-05-004-00
10CFR50.73

License Number NPF-3

November 28, 2005

United States Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Ladies and Gentlemen:

LER 2005-004-00
Davis-Besse Nuclear Power Station, Unit No. 1
Date of Occurrence – September 29, 2005

Enclosed is Licensee Event Report (LER) 2005-004-00, which is being submitted to provide written notification of the discovery that the Containment Hydrogen Analyzers were inoperable due to the presence of check valves in the moisture removal system. These check valves prevented proper drainage of accumulated condensate, and may have resulted in erroneous high readings of the analyzers during accident conditions. This event is being reported in accordance with 10 CFR 50.73(a)(2)(i)(B) as a condition prohibited by the Technical Specifications because at the time of discovery, the Technical Specifications required two independent containment hydrogen analyzers be operable, with a maximum allowed outage time of 72 hours. Commitments associated with this LER are listed in the attachment.

Very truly yours,

Barry S. Allen
for Mark B. Bezilla

GMW

Attachment
Enclosure

cc: Regional Administrator, USNRC Region III
DB-1 Project Manager, USNRC
DB-1 NRC Senior Resident Inspector
Utility Radiological Safety Board

IE22

COMMITMENT LIST

The following list identifies those actions committed to by the Davis-Besse Nuclear Power Station in this document. Any other actions discussed in the submittal represent intended or planned actions by Davis-Besse. They are described only as information and are not regulatory commitments. Please notify the Manager – Regulatory Compliance (419-321-8585) at Davis-Besse of any questions regarding this document or associated regulatory commitments.

COMMITMENTS	DUE DATE
1. Remove the non-conforming check valves from each channel of the Containment Hydrogen Analyzer Moisture Removal System and successfully perform moisture trap functional tests for each channel.	1. Completed October 19, 2005
2. A detailed configuration walkdown will be performed of the Containment Gas Analyzer System cabinet, and the as-built configuration will be reconciled as appropriate to design documents.	2. April 30, 2006

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104 EXPIRES 6/30/2007
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)	Estimated burden per response to comply with this mandatory collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

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4. TITLE
Containment Hydrogen Analyzers Inoperable due to Presence of Check Valves in Moisture Removal System

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER 05000
09	29	2005	2005 -	004 -	00	11	28	2005	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE: 1	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*			
	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(a)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
10. POWER LEVEL: 100	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER Specify in Abstract below or in NRC Form 366A
	☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Gerald M. Wolf, Staff Engineer, Regulatory Compliance	(419) 321-8001

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED	15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☐ YES *(If yes, complete EXPECTED SUBMISSION DATE).* ☒ NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On September 29, 2005, with the plant in Mode 1 at approximately 100 percent power, a periodic test of the Channel 1 Containment Hydrogen Analyzer moisture removal system showed the condensate did not drain as required. Investigation of the system revealed the presence of a check valve which required approximately 2 pounds per square inch pressure to operate. This check valve prevented the gravity-drainage system from functioning properly, and during accident conditions the accumulated condensate would fill the analyzer piping and cause the thermal conductivity detector to falsely indicate an off-scale high hydrogen concentration. A similar check valve was also found in the Channel 2 analyzer, but this check valve had a displaced O-ring seal at the time of discovery, which allowed the channel to successfully pass the periodic test of the moisture removal system.

This condition is being reported in accordance with 10 CFR 50.73(a)(2)(i)(B) as a condition prohibited by the Technical Specifications because at the time of discovery, the Technical Specifications required two independent containment hydrogen analyzers be operable. The probable cause of the presence of these check valves is a lack of configuration control of the Containment Hydrogen Analyzers during earlier plant operating cycles. The check valves have been removed from the system.

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

DESCRIPTION OF OCCURRENCE:

System Description:

Following a loss of coolant accident (LOCA), hydrogen may be generated in containment due to metal-water reaction, radiolytic decomposition, and corrosion of metals. In accordance with regulatory requirements, a Containment Hydrogen Control System [BB] is provided to control the concentration of hydrogen that may be released post-LOCA. The Davis-Besse Nuclear Power Station (DBNPS) Containment Hydrogen Control System consists of the Hydrogen Dilution System, the Hydrogen Purge System, and the Containment Gas Analyzer System (CGAS). If a sufficient amount of hydrogen is generated, it may react with oxygen present in the Containment Vessel [VSL] atmosphere at rates rapid enough to lead to high temperature and overpressurization of the Containment Vessel. The Containment Hydrogen Control System components are designed to be operated as necessary to maintain the maximum hydrogen concentration in the Containment Vessel at or below acceptable levels following a LOCA.

The hydrogen concentration inside containment following a design-basis accident is determined by two redundant Containment Gas Analyzer (CGA) trains external to the containment vessel. The CGAS, each consisting of a heat exchanger, recombiner, and sample pumps, is required to be started after the Containment Spray System [BE] has been initiated during accident conditions to detect the buildup of hydrogen in the Containment Vessel. The system is mechanically connected to a containment penetration, which allows a sample of containment atmosphere to be conditioned, analyzed, and returned to the containment. The analyzer systems will initiate an alarm on excessive hydrogen concentrations.

Prior to the containment atmosphere sample entering the thermal conductivity cell for hydrogen measurement, the high temperature, high humidity air passes through a sample cooler and a moisture separator to separate the condensate from sample flow. The condensate accumulates in a moisture trap while the vapor passes through the analyzer and is returned to containment. Upon high level in the moisture trap, an internal level switch closes the moisture separator inlet isolation solenoid valve and opens the moisture trap vent and drain isolation solenoid valves. The accumulated condensate then gravity drains to a nearby floor drain. When the condensate has drained, the level switch returns the three solenoid valves to their normal positions. The condensate must be removed from the containment atmosphere sample to ensure accurate hydrogen concentration readings. If the condensate is allowed to accumulate, the condensate would fill the analyzer channel piping causing the thermal conductivity detector to falsely indicate off-scale high hydrogen concentration.

Event Description:

On September 29, 2005, with the DBNPS operating at approximately 100 percent power, test DB-MI-04729, "Channel 1 Containment Vessel Atmosphere Hydrogen Analyzer Condensate Moisture Removal System Inspection and Moisture Trap System Functional Test" (Revision 00), was performed to conduct a visual inspection and functional test of the condensate moisture removal system. While performing this test for the first time, water did not drain as required from the condensate moisture removal system to the floor drain, resulting in a test failure.

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

DESCRIPTION OF OCCURRENCE: (continued)

At the time of discovery, DBNPS Technical Specification (TS) 3.6.4.1 required two independent containment hydrogen analyzers to be operable in Modes 1 and 2. With one analyzer inoperable, the TS Limiting Condition for Operation (LCO) 3.6.4.1 Action a required the analyzer be restored to operable status within 30 days or be in at least Hot Standby (Mode 3) within the next six hours. CGAS Channel 1 was therefore declared inoperable due to the failed test on September 29, 2005.

Investigation into this issue on October 2, 2005, discovered that the solenoid drain valve is a pilot-operated valve requiring a differential pressure of up to one pound per square inch (psi) to ensure opening. The existing configuration only provided approximately 0.1 psi across the drain valve. Because this design deficiency existed in both CGAS channels, both hydrogen analyzers were declared inoperable per TS 3.6.4.1 on October 3, 2005. Technical Specification LCO 3.6.4.1 Action b required at least one inoperable analyzer be restored to Operable status within 72 hours or be in at least Hot Standby within the next six hours. On October 3, 2005, testing was performed on CGAS Channel 2, which showed water did drain as required; however, Channel 2 remained inoperable because of the solenoid drain valve design deficiency described above.

The FirstEnergy Nuclear Operating Company (FENOC) had previously submitted a request for an amendment to the DBNPS TS to delete the TS requirements related to the combustible gas (Containment Hydrogen) control systems (dated July 29, 2004). This request was based on the changes to 10 CFR 50.44, "Standards for Combustible Gas Control System in Light-Water-Cooled Power Reactors," that became effective on October 16, 2003. On August 1, 2005, the Nuclear Regulatory Commission (NRC) issued Amendment No. 265 to the DBNPS TS to eliminate the requirements related to combustible gas control systems and relocate the requirements for the containment hydrogen analyzers to the DBNPS Updated Safety Analysis Report (USAR) Technical Requirements Manual. However, at the time of discovery of the design issue that rendered both hydrogen analyzers inoperable (October 3, 2005), this TS Amendment had not yet been implemented. On October 5, 2005, with the DBNPS still operating at approximately 100 percent power, TS Amendment No. 265 was implemented, obviating the need for a plant shutdown.

On October 13, 2005, while replacing the Channel 1 hydrogen analyzer moisture trap drain isolation solenoid valve with a solenoid valve that has no differential pressure operating requirement, a check valve was discovered in the moisture trap drain piping. This check valve appears to have been installed since the moisture trap was first installed during initial plant construction. Had this check valve been recognized as in-place, it should have been removed when the CGAS was modified in 2003 from a pressurized drainage system to a gravity drainage system as a result of the deficiencies documented in DBNPS Licensee Event Report 2003-005-01. When this check valve was removed from the bottom of the moisture trap, approximately one pint of water immediately drained from the moisture trap. A similar check valve was found in the outlet of the moisture trap for the Channel 2 hydrogen analyzer and removed.

Laboratory testing of the removed drain solenoid valves determined that the removed valves, while certified by the manufacturer to operate with a minimum differential pressure of 1 psi to assure positive valve opening, operated over the entire operating range of pressures required. It was concluded that CGAS Channel 1 failed the moisture trap functional test on September 29, 2005, due to the presence of the check valve, which requires a differential pressure of approximately 2 psi to operate. CGAS Channel 2 passed the moisture trap functional test on October 3, 2005, because the installed check valve had a displaced O-ring seal on its seating surface, preventing it from fully seating.

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DESCRIPTION OF OCCURRENCE: (continued)

The presence of the check valves at the moisture trap outlet resulted in both trains of the Containment Hydrogen Analyzers being incapable of performing their intended function because there was not assurance that accumulated moisture would be removed for the full range of accidents in which the analyzers were required to operate. At the time both analyzers were determined to be inoperable (October 3, 2005), Technical Specification 3.6.4.1 required both analyzers to be operable or a plant shutdown be commenced within 72 hours. Since this deficiency apparently existed since the plant restarted in April 2004 and may have existed prior to this time, the plant was operated in a condition prohibited by the Technical Specifications, which is reportable per 10 CFR 50.73(a)(2)(i)(B).

APPARENT CAUSE OF OCCURRENCE:

The moisture trap system for the CGAS was historically considered below the level of design detail, as previously discussed in DBNPS Licensee Event Report (LER) 2003-005-01. The problem of components associated with vendor-supplied panels or skids not being depicted on drawings was the subject of a major investigation and configuration management efforts at the DBNPS between 1987 and 1990. Walk downs performed during this timeframe identified numerous components provided with vendor-supplied skids and cabinets that were not identified on plant drawings. The generic root cause for these components not being identified on plant drawings was determined to be insufficient control over the plant's configuration. Corrective actions taken at that time included performance of plant walk downs to identify components not depicted on drawings and changes in the processing of vendor drawings to ensure future modifications did not result in recurrence of the problem.

In 2003, after discovery of the cooling water isolation valves being closed since original installation of the CGAS, additional walk downs of the CGAS were performed as documented in DBNPS LER 2003-005-01. During these 2003 walk downs, several less visually obvious components in the CGAS cabinet were discovered, which included the level switches within the moisture traps. Additionally, the 2003 walk downs discovered an air regulator outside of the cabinet as documented in LER 2003-005-01, possibly due to previous walk downs emphasizing only the interior of the cabinet.

The cause of Containment Hydrogen Analyzer Channel 1 failing the periodic test of the condensate moisture removal system was the unknown presence of a check valve at the outlet of the moisture trap. This check valve was similar in appearance to a pipe/tubing fitting. Channel 2 passed its functional test because the check valve at the outlet of the moisture trap was defective in that the o-ring was displaced out of its sealing area, allowing the condensate to drain. While a definitive root cause for the presence of these check valves at the outlet of the moisture traps could not be determined, the most probable cause is a lack of configuration control since the check valves may have been placed in the moisture trap outlet when configuration was not closely maintained. This probable cause is supported by the following:

- The vendor fabrication drawings did not identify a check valve at the bottom of the moisture traps.
- The system configuration was not controlled until 1990, and walkdowns conducted prior to controlling the system configuration appeared to only locate and capture the components identified on the fabrication drawings and translate them into controlled station documents and drawings.

APPARENT CAUSE OF OCCURRENCE: (continued)

While testing would not have prevented this event, if a performance monitoring or testing program were in place for the CGAS drain system, then the deficiency would have been discovered much earlier, since the check valves were most probably installed prior to 2003.

ANALYSIS OF OCCURRENCE:

The function of the CGAS is to monitor post-accident hydrogen concentration in the Containment Vessel atmosphere so that procedures can be implemented to keep hydrogen concentration within required limits. The inoperability of the CGAS does not render the physical equipment required to lower containment hydrogen concentration inoperable. However, with the CGAS inoperable, the ability to detect post-Loss of Coolant Accident (LOCA) containment vessel hydrogen concentration may be impaired.

The inability of the CGAS moisture removal system to function as required may have resulted in condensate backup up into the analyzer element. This would cause a false off-scale high hydrogen indication, which may lead to premature manual operation of the Hydrogen Dilution System or the Hydrogen Purge System in conjunction with hydrogen dilution. These systems are manually initiated and administratively controlled in order to assure that the maximum containment repressurization pressure during hydrogen dilution operation (18 psig) does not exceed 50 percent of the Containment Vessel design pressure, consistent with the requirements of 10 CFR 50.44(f). Premature operation of these Combustion Gas Control Systems would have no adverse effect on the accident mitigation process.

In order to ensure a conservative safety margin, the combustible gas control systems would be started no later than the time the hydrogen concentration reaches three volume percent. This limit is reached approximately 17 days after the accident. With the presence of the check valves in the Containment Hydrogen Analyzers moisture removal system, the moisture traps would not be drained of condensate, and the thermal conductivity elements would be saturated with condensate causing a false high hydrogen concentration indication within a matter of minutes following CGAS initiation. It is reasonable to assume that plant operators would recognize such an indication as an equipment malfunction and utilize an alternate means to measure hydrogen concentration within the Containment Vessel. This alternate capability is provided by the Emergency Containment Atmosphere Grab Sampling System (ECAGSS – previously known as the Post Accident Sample System, or PASS) [IP]. In the event the CGAS hydrogen monitors are unavailable, hydrogen concentration can be determined from the off-gas and containment atmosphere samples of the ECAGSS. Although the ECAGSS is a non-safety grade system which does not receive essential power and would be unavailable following the assumed loss of offsite power, its availability immediately following a LOCA is not essential. Given the minimum 17-day time required to reach the three volume percent of hydrogen concentration, it is reasonable to assume that power would be restored which would allow the sample to be taken and analyzed.

In November 1999 the NRC initiated a study to develop a framework for risk-informing 10 CFR Part 50. One of the first candidates selected for study was 10 CFR 50.44, "Combustible Gas Control," because it was believed that little to no risk significance or benefit may be associated with some of the technical requirements of this regulation. The framework for this study considered both design basis accidents as well as severe accidents and used quantitative safety goals. Based on the knowledge of the time,

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

ANALYSIS OF OCURRENCE: (continued)

the rule was implemented in November 1978 to control combustible gases, such as hydrogen, that could burn or detonate and thereby challenge the integrity of containment. Other regulatory provisions in implementing documents, such as Regulatory Guide 1.7, "Control of Combustible Gas Concentrations in Containment following a Loss-of-Coolant Accident," have imposed additional requirements beyond those stated in 10 CFR 50.44 (e.g., safety-grade continuous monitors for measuring hydrogen concentration). From the study performed by the NRC, for design basis accident conditions in large, dry containments like that of the DBNPS, hydrogen combustion is not a significant threat to the integrity of the Containment Vessel. Based on advances in the NRC's understanding of the risk to nuclear power plants from the production and combustion of hydrogen, the NRC concluded that the hydrogen release postulated from a design basis LOCA is not risk-significant because it would not lead to containment failure. However, the NRC determined that 10 CFR 50.44 should retain the requirement for measuring the concentration of hydrogen in containment because hydrogen monitoring following severe accidents is useful to assess the degree of core damage that can facilitate emergency response decision-making. Therefore, from a design basis accident perspective, inoperability of the CGAS is not risk significant as determined by the NRC study. From a severe accident perspective, the ability to measure hydrogen is useful for emergency assessment purposes. However, with the CGAS inoperable, an alternate capability to measure containment hydrogen concentration is provided by the ECAGSS. In 2003, 10 CFR 50.44 was revised to incorporate these positions. Based upon this change in regulation, FENOC submitted an application for a Technical Specification change regarding Combustible Gas Control Systems in July 2004 (License Amendment Request Number 03-0021, letter Serial Number 3044). The NRC issued Amendment Number 265 to the DBNPS Operating License on August 1, 2005, to eliminate the requirements related to combustible gas control systems from the Technical Specifications. This Technical Specification Amendment was implemented on October 5, 2005, obviating the need for a plant shutdown with both channels of the CGAS inoperable.

Based on the above, the apparent inoperability of the CGAS had minimal safety significance and would have reasonably been addressed by operator action to either initiate Hydrogen Control Systems or perform alternate sampling.

CORRECTIVE ACTIONS:

The non-conforming check valves were removed during implementation of the engineering change to install solenoid valves that do not require a differential pressure to operate. The moisture trap functional test for Channel 1 was successfully completed on October 15, 2005, and the moisture trap functional test for Channel 2 was successfully completed on October 19, 2005. Continued periodic performance of these functional tests, developed as a result of DBNPS LER 2003-005, will provide a means of assuring that the drain system and its associated components are functioning properly.

A detailed configuration walkdown will be performed of the CGAS cabinet, and the as-built configuration will be reconciled as appropriate to design documents.

LICENSEE EVENT REPORT (LER)

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FAILURE DATA:

LER 2003-005 documents a previous condition where the CGAS was rendered inoperable, in part, due to an inoperable moisture removal system. As a result of the 2003 condition, tests were developed to periodically perform functional tests of the condensate moisture removal system. It was during the first performance of this test that the condition described above involving the installation of check valves in the moisture removal system was discovered.

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

NP-33-05-004-00 CRs 05-05217, 05-05256, 05-05349, 05-05379