Dominion Energy Kewaunee, Inc.
N490 Hwy 42, Kewaunee, WI 54216
Web Address: www.dom.com

Dominion®

DEC 04 2009

ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Serial No. 09-757
LIC/JG/RO
Docket No.: 50-305
License No.: DPR-43

DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION
LICENSEE EVENT REPORT 2009-008-00

Pursuant to 10 CFR 50.73, Dominion Energy Kewaunee, Inc., hereby submits the following Licensee Event Report applicable to Kewaunee Power Station.

Report No. 50-305/2009-008-00

This report has been reviewed by the Facility Safety Review Committee and will be forwarded to the Management Safety Review Committee for its review.

If you have any further questions, please contact Mr. Jack Gadzala at (920) 388-8604.

Very truly yours,

Stephen E. Scace
Site Vice President, Kewaunee Power Station

Attachment(s)

Commitments made by this letter: NONE

IE22
NRR

cc: Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
2443 Warrenville Road
Suite 210
Lisle, IL 60532-4352

Mr. P. S. Tam
Sr. Project Manager
U.S. Nuclear Regulatory Commission
One White Flint North, Mail Stop O8-H4A
11555 Rockville Pike
Rockville, MD 20852-2738

NRC Senior Resident Inspector
Kewaunee Power Station

NRC FORM 366 (9-2007) U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2010
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: 80 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.

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Kewaunee Power Station	**05000305**	**1** OF **4**

4. TITLE
Inadequately Controlled Reactor Coolant System Dilution Results in Violation of Technical Specifications

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
10	10	2009	2009	008	00	12	04	2009	FACILITY NAME	

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (*Check all that apply*)			
N	☐ 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	☐ 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)
0	☐ 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
	☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (*include Area Code*)
William R Behrendt	**920-388-8583**

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 15. EXPECTED SUBMISSION DATE*) ☒ NO				

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

On October 10, 2009, while the reactor was in refueling shutdown mode, the boron concentration of the reactor coolant system was inadvertently reduced below the 2500 ppm limit required by Kewaunee Power Station (KPS) Technical Specifications (TS), resulting in a violation of TS requirements.

At the start of the event, the reactor vessel head was removed, the reactor was defueled, and the refueling cavity was flooded. Operators had begun diluting reactor coolant system (RCS) water in the residual heat removal (RHR) flow path to reduce the boron concentration in the refueling cavity. This activity inadvertently reduced the reactor coolant boron concentration in the RHR system below the minimum value required by TS. With RCS boron below the minimum TS limit, operators began transferring fuel assemblies from the spent fuel pool into the reactor. A sample of RCS water obtained from the RHR system shortly after commencement of refueling activities showed a boron concentration of about 2300 ppm. Upon confirmation of the boron concentration, fuel handling was suspended and boron concentration of the RCS was restored to required limits.

This event is being reported pursuant to 10 CFR 50.73 (a)(2)(i)(B), any operation or condition which was prohibited by TS.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REV NO.	
Kewaunee Power Station	05000305	2009	- 008 -	00	2 OF 4

NARRATIVE

Event Description:

On October 10, 2009, while the reactor [RCT] was in refueling shutdown mode, the boron concentration of the reactor coolant system (RCS) [AB] was inadvertently reduced below the 2500 ppm limit required by Kewaunee Power Station (KPS) Technical Specifications (TS), resulting in a violation of TS requirements.

Prior to the event, preparations had been in progress to begin loading fuel into the reactor. The reactor vessel [RPV] head was removed, the reactor was defueled, and the refueling cavity was flooded. A sample of RCS boron obtained from the residual heat removal (RHR) [BP] system at 0445 on October 10, 2009, indicated a boron concentration of 2640 ppm. An earlier sample of RCS boron obtained from the refueling cavity indicated 2643 ppm boron.

Operators had begun diluting RCS water in the RHR flow path to reduce boron concentration in the refueling cavity. Blended flow was initiated to the RCS using Boric Acid Tank (BAT) [TK] A. Concurrently, operators also began raising refueling cavity water level to ensure the required level would be maintained during core reload. The dilution activity had been calculated to reduce the boron concentration of the water in the refueling cavity while ensuring it remained greater than 2500 ppm.

A sample of RCS boron obtained from the refueling cavity at 0745 on October 10, 2009, indicated boron concentration had slightly decreased to 2633 ppm. Based on the refueling cavity boron sample, the shift manager granted permission at 0754 to start fuel movement to reload the reactor core.

At 0755, a sample of RCS boron obtained from the RHR system indicated a boron concentration of 2310 ppm. This sample was obtained on the A Train of RHR, while the B RHR pump was running at the time. Operators questioned the validity of the boron sample and confirmatory samples were initiated. At 0807, operators began transferring fuel assemblies from the spent fuel pool into the reactor. Fuel movement for core reload continued while confirmatory samples were taken.

Subsequent samples of RHR boron concentration obtained at 0825, 0900, 0938, and 1004 all confirmed that RHR system boron was less than 2500 ppm.

At 1038, the shift manager directed that all fuel assemblies be placed in a safe condition and fuel movement be stopped. At this point, six fuel assemblies had been loaded into the core. The RCS was subsequently borated to restore boron concentration to required limits.

KPS TS 3.8, “Refueling Operations”, states the following.

a. During REFUELING OPERATIONS:

   1. When there is fuel in the reactor, a minimum boron concentration as specified in the COLR shall be maintained in the Reactor Coolant System during reactor vessel head removal or while loading and unloading fuel from the reactor. The required boron concentration shall be verified by chemical analysis daily.

KPS COLR 2.12, “Refueling Boron Concentration (TS 3.8.a.5)”, requires a minimum boron concentration of 2500 ppm.

On October 10, 2009, during refueling operations, the boron concentration of the reactor coolant system was inadvertently reduced below the 2500 ppm limit specified in the COLR. Consequently, when there was fuel in the reactor, the minimum boron concentration as specified in the COLR was not maintained in the RCS during loading of fuel, resulting in a violation of TS requirements.

This event is being reported pursuant to 10 CFR 50.73 (a)(2)(i)(B), any operation or condition which was prohibited by the TS.

Event and Safety Consequence Analysis:

Upon recognition of the condition, all fuel assemblies were placed in a safe condition and fuel movement was stopped. At this point, only 6 of 121 fuel assemblies had been loaded into the core (one of which was on the opposite side of the core and decoupled from the remaining five). One of the five coupled fuel assemblies contained a rod control cluster assembly, which provided significant negative reactivity. The reactor core configurations during this event were physically incapable of achieving criticality at the measured RCS boron concentration. The RCS was subsequently borated to restore boron concentration to required limits. Therefore, this event had minimal risk significance.

Cause:

The primary cause of this event was that operators did not appropriately consider RCS flow path dynamics and transient boron concentrations when applying the calculated final estimated dilution concentration to performance of the dilution activity. Operators did not properly consider that significant localized dilution could occur in the smaller volume of the RHR system while the dilution activity was in progress, which could result in the RCS water in the RHR system being significantly diluted below the 2500 ppm boron concentration required for fuel movement.

The final in a series of dilution activities occurred approximately 25 minutes before fuel movement. The intent of these dilution activities was to dilute the refueling cavity via the RHR system. This activity is accomplished by injecting diluted RCS water into the RHR system, which mixes with RCS water in the refueling cavity to dilute the cavity boron concentration.

Under ideal mixing conditions, about half the water in the refueling cavity would generally mix in the time that elapsed while this activity occurred. However, operating experience shows that an undercurrent develops in the reactor vessel, which allows little mixing of RHR water with the cavity. RHR flow into the reactor vessel equals RHR suction flow from the vessel. Mixing with the refueling cavity water is primarily driven by the 60 gpm makeup flow (with 1 charging pump in operation), which flows into the cavity after mixing with RHR flow. RHR and charging flow both enter on the B leg of the RCS, flowing down the outside of the core barrel. At the bottom of the reactor vessel, flow is then directed upward through a diffuser to the top of the core barrel. At the top of the core barrel, the RCS hot legs connect, which is also the suction of the RHR pump(s). The flow arrangement with an empty core barrel results in only a minimal amount of RHR flow entering the reactor cavity for mixing.

Based on this flow dynamic, significant time is required for adequate mixing between RCS water in the RHR system and the refueling cavity. Until the RCS water was thoroughly mixed, the boron concentration in the RHR system (the source of the dilution) could be significantly lower than the calculated final boron concentration of the total RCS. However, dilution and makeup activities prior to fuel movement were not precluded, nor was a boron sample required following dilution or makeup activities that may have occurred prior to fuel movement.

The second cause was that operators inappropriately used sample results taken prior to the dilution activity as the baseline and acceptance criterion that the RCS met the boron specification prior to fuel movement.

Operators inappropriately relied on the calculation of final RCS boron concentration as the basis for concluding that boron concentration would not drop below the minimum 2500 ppm required for fuel movement. No consideration was given to RHR system boron concentration changes. Operators only attributed the boron concentration requirement to the reactor cavity and spent fuel pool. Insufficient time was allotted for mixing among the various water volumes and achieving equilibrium boron concentration.

A contributing cause was the incorrect assumption that the initial RHR sample from A Train RHR was invalid because RHR pump A was not running. However, RHR trains had been cross-connected on night shift, with a single running RHR pump providing flow in both RHR loops. Therefore, the initial boron sample was valid and representative of the RCS boron concentration in the RHR system. Information was not adequately conveyed to the oncoming operators during shift turnover from nights to days regarding the RCS boron dilution and RHR system configuration.

Corrective Actions:

As immediate corrective action, all fuel movement was stopped until boric acid concentration was increased to greater than 2500 ppm in the RHR system, Reactor Cavity, and SFP.

Actions were initiated to perform the following activities to prevent recurrence:

1. Revise Blender Control procedures and the Reactor Data Manual to reflect the calculations to be utilized when performing boration/dilution to the reactor cavity.
2. Revise Procedure OP-KW-NCL-FH-003 to include requirement to perform boron sampling and verification of RCS boron via RHR, reactor cavity and spent fuel pool sample points with date and time of sample annotated.
3. Revise Procedure OP-KW-NCL-FH-003, "Pre-Refueling Checklist" to include requirement to perform boron sampling immediately prior to fuel movement and an additional requirement that controls boration and dilution activities following receipt of sample results.

Similar Events:

A review of Licensee Event Reports covering the past three years did not identify any similar events.