

Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

April 26, 2013

10 CFR 50.73

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

> Browns Ferry Nuclear Plant, Unit 3 Facility Operating License No. DPR-68 NRC Docket No. 50-296

Subject: Licensee Event Report 50-296/2013-003-00

The enclosed Licensee Event Report provides details of an automatic reactor shutdown due to an actuation of the reactor protection system from a turbine trip. The Tennessee Valley Authority is submitting this report in accordance with Title 10 of the Code of Federal Regulations (10 CFR) 50.73(a)(2)(iv)(A).

There are no new regulatory commitments contained in this letter. Should you have any questions concerning this submittal, please contact J. E. Emens, Jr., Nuclear Site Licensing Manager, at (256) 729-2636.

Respectfully,

Del

K. J. Polson Vice President

Enclosure: Licensee Event Report 50-296/2013-003-00 – Automatic Reactor Shutdown Due to an Actuation of the Reactor Protection System From a Turbine Trip

cc (w/ Enclosure):

NRC Regional Administrator - Region II NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

IE22 NRK

ENCLOSURE

Browns Ferry Nuclear Plant Unit 3

Licensee Event Report 50-296/2013-003-00

Automatic Reactor Shutdown Due to an Actuation of the Reactor Protection System From a Turbine Trip

See Enclosed

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L YES (If yes, complete 15: EXPECTED SUBMISSION DATE) L NO DATE N/A N/A N/A ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) On February 25, 2013, at approximately 1313 hours Central Standard Time, the Browns Ferry Nuclear Plant (BFN), Unit 3, reactor automatically scrammed due to an actuation of the Reactor Protection System from a turbine trip. The turbine tripped on low condenser vacuum due to a reactor feedwater piping separation. The Main Steam Isolation Valves were manually closed. There was one Safety Relief Valve that was manually operated to maintain reactor pressure due to the unavailability of the Main Turbine Bypass Valves upon loss of condenser vacuum. All systems responded as expected to the turbine trip. No Emergency Core Cooling System or Reactor Core Isolation Cooling (RCIC) system reactor water level initiation set points were reached. Reactor water level was controlled with the RCIC system and reactor pressure was controlled with the High Pressure Coolant Injection system. The root causes for this event are: the feedwater long cycle valve design is incorrect for its specified application and station personnel do not consistently consider risk when making decisions. The corrective actions to prevent recurrence are: issue and implement design change to replace BFN, Units 1, 2, and 3, feedwater long cycle valves and implemented a Strategic Performance Management process to reinforce and institutionalize conservative decision making principles at							7				м	IONTH	DAY	YEAR
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NARRATIVE

I. Plant Operating Condition Before the Event

At the time of the event, Browns Ferry Nuclear Plant (BFN), Unit 3, was in Mode 1 at approximately 92 percent power.

II. Description of Events

A. Event:

On February 25, 2013, at approximately 1313 hours Central Standard Time (CST), the BFN, Unit 3, reactor automatically scrammed due to an actuation of the Reactor Protection System (RPS) [JC] from a turbine trip. The turbine tripped on low condenser vacuum due to a reactor feedwater [SJ] piping separation. The Main Steam Isolation Valves (MSIVs) [ISV] [SB] were manually closed. There was one Safety Relief Valve (SRV) that was manually operated to maintain reactor pressure due to the unavailability of the Main Turbine Bypass Valves [JI] upon loss of condenser vacuum. All systems responded as expected to the turbine trip. No Emergency Core Cooling System (ECCS) [BJ][BO][BM] or Reactor Core Isolation Cooling (RCIC) system [BN] reactor water level initiation set points were reached. Reactor water level was controlled with the RCIC system and reactor pressure was controlled with the High Pressure Coolant Injection (HPCI) system. All control rods fully inserted and electrical offsite power was in a normal shutdown configuration and Residual Heat Removal was aligned for suppression pool cooling.

Also, Primary Containment Isolation System (PCIS) Groups 2, 3, 6, and 8 isolations were received due to low reactor water level. The PCIS consists of isolation valves that will automatically close as necessary to protect against the release of fission products, as well as, to conserve reactor coolant. Upon receipt of these isolations, the required components actuated, with the exception of one Group 6 valve, Drywell Continuous Air Monitor (CAM) Inboard Return Isolation Valve. The Drywell CAM Inboard Return Isolation Valve did not have indication following the isolation and was not able to be verified locally.

Due to the Drywell CAM Inboard Return Isolation Valve not actuating, BFN, Unit 3, Technical Specification (TS) Limiting Condition for Operation (LCO) 3.6.1.3 was entered. The BFN, Unit 3, TS LCO 3.6.1.3 requires that each Primary Containment Isolation Valve (PCIV) be Operable in reactor Modes 1, 2, and 3, and when the associated instrumentation is required to be Operable per LCO 3.3.6.1, "Primary Containment Isolation Instrumentation." On February 25, 2013, at approximately 1313 hours CST, TS 3.6.1.3 Condition A was entered due to one or more penetration flow paths with one PCIV inoperable. The TS 3.6.1.3 Required Action A.1 requires the affected penetration flow path to be isolated by use of at least one closed and de-activated automatic valve, closed manual valve, blind flange, or check valve with flow through the valve secured within four hours except for the main steam line which is required within eight hours. The TS 3.6.1.3 Required Action A.2 requires verification, once per 31 days, that the affected penetration flow path is isolated. Indication was subsequently restored following restoration of containment isolation signals, and the Drywell CAM Inboard Return Isolation Valve was manually isolated on February 25, 2013, at approximately 1422 hours CST with positive

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NARRATIVE	indication of isolation. On Febr isolation valves were deactivate					
	On February 25, 2013, at appro exceeded -1.0 inches. Suppres bands due to running HPCI sys was not able to be pumped dow	ssion pool wa stem for press	ater level sure con	could not be trol and supp	e maintain pression po	ed within normal ool water level
	The BFN, Unit 3, TS LCO 3.6.2 than or equal to -6.25 inches will approximately 1415 hours CST pool water level not within limits pool water level to be restored y approximately 1615 hours CST and completion time not being r Action B.1 requires the unit to b (Cold Shutdown) within 36 hours at approximately 1313 hours CST 2141 hours CST.	ith and -7.25 s in reactor M , TS 3.6.2.2 s. The TS 3.6 within limits v , TS 3.6.2.2 met for TS 3. be in Mode 3 rs. The BFN	inches v Nodes 1, Condition 6.2.2 Re vithin two Condition 6.2.2 Co (Hot Shi , Unit 3,	vithout differe 2, and 3. On A was ente quired Action b hours. On B was ente ndition A. Th utdown) withi entered Mod	ential pres n February red due to n A.1 requi February red due to he TS 3.6. in 12 hours le 3 on Fel	sure control and y 25, 2013, at o suppression ires suppression 25, 2013, at o required action 2.2 Required s and in Mode 4 oruary 25, 2013,
В.	Status of structures, componed of the event and that contributed the structure of the struc			at were inop	perable at	the start
	The reactor feedwater long cyc drain header caused a rapid los trip.					
C.	Dates and approximate times	of occurrer	ices:			
	February 25, 2013, at 1313 hou	ac Al du wi	ctuation of so, TS 3 ue to one ith one F	utomatically s of the RPS fr .6.1.3 Condi or more per CIV inoperal ered Mode 3	om a turbi tion A was netration fl ble. The B	ne trip. entered ow paths
	February 25, 2013, at 1324 hou			system was ter level.	initiated to	o control
	February 25, 2013, at 1326 hou		ne HPCI actor pre	system was essure.	initiated to	o control
	February 25, 2013, at 1415 hou	urs CST Th		6.2.2 Conditi		

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	isolation signals, and the Drywell CAM Inboard Return Isolation Valve was manually isolated.
February 25, 2013, at 1514 hours CST	Isolation valves were deactivated to satisfy TS LCO 3.6.1.3 Required Actions.
February 25, 2013, at 1615 hours CST	The TS 3.6.2.2 Condition B was entered due to required action and completion time not being met for TS 3.6.2.2 Condition A.
February 25, 2013, at 1649 hours CST	The BFN reported event to the NRC.
February 25, 2013, at 2141 hours CST	The BFN, Unit 3, entered Mode 4.

D. Manufacturer and model number (or other identification) of each component that failed during the event:

A section of reactor feedwater piping, BFN-3-MISC-003, separated resulting in a loss of condenser vacuum.

E. Other systems or secondary functions affected:

There were no other systems or secondary functions affected.

F. Method of discovery of each component or system failure or procedural error:

Operations personnel observed a scram turbine generator load reject annunciator in the control room resulting in a reactor scram. The reactor feedwater piping separation was discovered by Operations personnel via a remote camera.

G. The failure mode, mechanism, and effect of each failed component, if known:

The failure mode of the feedwater long cycle return line connection to the miscellaneous drain header was due to excessive vibration. The excessive vibration was a result of pipe movement due to seat leakage of one or more of the feedwater long cycle valves. The valve leakage caused flashing in the drain header which caused subsequent failure of the miscellaneous drain header pipe wall. This failure caused a loss of vacuum on the turbine which caused the turbine to trip. When the turbine tripped on low condenser vacuum, an automatic reactor scram occurred.

H. Operator actions:

Operations personnel responded in accordance with Emergency Operating Instructions on Low Reactor Water Level. Also, Operations personnel responded in accordance with the Abnormal Operating Instructions for the automatic scram.

I. Automatically and manually initiated safety system responses:

The BFN, Unit 3, reactor automatically scrammed due to the actuation of the RPS from a turbine trip. The MSIVs were manually closed. There was one SRV that was

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manually operated to maintain reactor pressure due to the unavailability of the Main Turbine Bypass Valves upon loss of condenser vacuum. Reactor water level was controlled with the RCIC system and reactor pressure was controlled with the HPCI system.

III. Cause of the event

A. The cause of each component or system failure or personnel error, if known:

Direct Cause

The direct cause of the event was the failure of the feedwater long cycle return line connection to the miscellaneous drain header due to cyclic fatigue. The cyclic fatigue was a result of pipe movement due to seat leakage of one or more of the feedwater long cycle valves. The pipe movement caused the material stress on the pipe connection to be much greater than the endurance level of 10,000 pounds per square inch (psi) for the carbon steel material.

Root Cause

Valve design used for flow control valves 3-FCV-003-0071, -0072, and -0073 is incorrect for the specified application. This led to valve leakage which caused flashing in the drain header with subsequent failure of the miscellaneous drain header pipe wall due to excessive vibration. The wall failure caused a loss of condenser vacuum with a subsequent reactor scram. Currently, the valves used in this application are solid disc gate valves. These valves are not ideally suited for severe (high differential pressure) applications.

B. The cause(s) and circumstances for each human performance related root cause:

Root Cause

Station personnel do not consistently consider risk when making decisions. Work orders to replace the BFN, Unit 3, feedwater long cycle valves have been cancelled with little or no justification. This exposed BFN, Unit 3, to continued risk of failed piping downstream of the feedwater long cycle valves providing the potential for degraded, or loss of, condenser vacuum. Work orders written in 2007 to replace valves with a more suitable valve were never worked and were subsequently cancelled in 2010.

IV. Analysis of the event:

The Tennessee Valley Authority (TVA) is submitting this report in accordance with Title 10 of the Code of Federal Regulations (10 CFR) 50.73(a)(2)(iv)(A) as any event or condition that resulted in manual or automatic actuation of any of the systems listed in 10 CFR 50.73(a)(2)(iv)(B), including: RPS which includes a reactor scram or a reactor trip, general containment isolation signals affecting containment isolation valves in more than one system or MSIVs, HPCI, and RCIC.

The BFN, Unit 3, scrammed due to the 8 inch reactor feedwater long cycle return pipe breaking at the connection with the 24 inch miscellaneous drain header which caused a rapid loss of

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	experiencing a significant amo marks noted on the piping at ir pipe movement was due to lea valve 3-FCV-003-0073. Also, 3-FCV-003-0071 and 3-FCV-0 normally closed valves leak pa to a low pressure (condenser excessive pipe movement. Th was the most probable cause drain header due to the materi 10,000 psi for the carbon steel The feedwater long cycle valve identified as leaking past their	ndividual support kage past the no normally closed fo 03-0072 were poins their seats, hig vacuum) normally the analysis used fo of the failure of the al stress being m material. es are solid disc g seats since instal	locations rmally clo eedwater tentially lo h pressu stagnan or this co e connec uch great late valve lation and	It was detended based feedwa long cycle f eaking past re and temp t system whi ndition detended tion with the ter than the es. These van d have been	ermined that ter long cycl low control w their seats. erature wate ich in turn ca rmined that i e 24 inch mis endurance li alves have c repaired nu	the excessive e flow control valves When these er was exposed aused the material fatigue scellaneous mit of ontinually beer merous times.
	The repair to these valves was leakage from these valves has Additionally, the leakage has o and at the wall of the miscellar	caused piping er aused failure of t	osion tha	at has lead to	o through wa	all leaks.
V .	Assessment of Safety Conse	equences				
	The RPS provides timely prote that threaten the integrity of th fuel cladding and reactor coola designed such that no single fa designed to automatically shut	e fuel barrier and ant system pressu ailure can prevent	the nucle ire bound t a reacto	ear system p Jary respecti or scram, and	process barri ively. The R d the RPS is	er, i.e. PS is

normal.

A. Availability of systems or components that could have performed the same function as the components and systems that failed during the event:

The MSIVs were manually closed. There was one SRV that was manually operated to maintain reactor pressure due to the unavailability of the Main Turbine Bypass Valves due to the loss of condenser vacuum. All systems responded as expected to the turbine trip. No ECCS or RCIC system reactor water level initiation set points were reached. Reactor water level was controlled by the RCIC system and reactor pressure was controlled with the HPCI system.

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	В.	For events that occurred will systems or components ne shutdown conditions, remo material, or mitigate the con	eded to shutd ve residual he	own the eat, conf	reactor and rol the relea	d maintain :	safe			
		All safety systems remained a	available during	g this eve	ent and oper	ated as desi	igned.			
	C.	For failure that rendered a t the elapsed time from disco service:								
		There were no safety systems	s rendered ino	perable a	as a result of	this event.				
	Th	erefore, TVA concluded that th	ere was minim	al safety	significance	for this eve	ent.			
VI.	Corrective Actions									
	Corrective Actions are being managed by TVA's corrective action program under Problem Evaluation Reports (PERs) 516455 and 687732.									
	Immediate Corrective Actions									
	A Temporary Alteration Control Form was initiated to cut and cap the feedwater long cycle lines downstream of each feedwater long cycle valve and upstream of the miscellaneous drain header.									
	Co	Corrective Actions to Prevent Recurrence								
	1.	 Issue and implement design change to replace BFN, Units 1, 2, and 3, feedwater long cycle valves. 								
	2.	Implemented a Strategic Perf institutionalize conservative d		-	•	einforce and	Ł			
	3.	Establish initial and continuin training to provide expected b and responsibilities.								
V ((.	Ad	ditional Information:								
	Α.	Previous similar events at t	he same plan	t:						
		A search of BFN Licensee Ev several years identified LER s Isolation Cooling System Dur condition concerning the read cycle lines. The analysis for therefore, the corrective action from occurring.	50-296/2013-0 ing Reactor Sh tor feedwater j that LER was c	02-00, M outdown. piping se ongoing a	anual Actua This LER ic paration on at the time of	tion of Reac dentified a si the feedwat f this event;	ctor Core imilar er long			
		A search was performed on the related to the condition which and 52947.								

Description Descriptin Descripting Descripting Descripting Descriptin						U.S. NUCLEA	R REGULATOR	Y COMMISSION
FACILITY NAME (1) DOCKET (2) LER NUMBER (6) PAGE (3) Browns Ferry Nuclear Plant, Unit 3 05000296 2013 00 8 of 8 NARRATIVE PER 41131 states, "Chemistry identified a threat to the integrity of the welded pipe connection of the 8 inch long cycle return line at the miscellaneous drain header and potential condenser vacuum issues with movement observed from the line giving a strong indication of long cycle valve leakage with subsequent flashing occurring in the long cycle return line." The PER 41131 was closed to PER 52947 which identified that excessive movement of the long cycle piping caused the weld to the miscellaneous drain header to fatigue. The piping movement was caused by flashing in the line due to leakage through one or more of the feedwater long cycle valves. However, the corrective actions did not address the risk of failing to repair and maintain the valves that were the cause of the pipe movement which resulted ultimately in the failure of the 8 inch long cycle feedwater return line at the tie into the 24 inch miscellaneous drain header. As a result of not addressing the actual failure mode and recognizing the risk associated with the long cycle return valves, BFN missed an opportunity to utilize available Operating Experience to prevent this event. B. Additional Information: In accordance with Nuclear Energy Institute (NEI) 99-02, this condition is not considered a safety system functional failure. D. Scram with Complications Consideration: In accordance with NEI 99-02, this event is considered an unplanned scram with complications.			LICEN	ISEE EVENT R	EPORT	(LER)		
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complications.		D. Scram wit	th Complication	s Consideration	:			
VIII. COMMITMENTS				02, this event is o	consider	ed an unplar	nned scram	with
	Viii.	COMMITMEN	тѕ					
There are no commitments.		There are no o	commitments.					