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A Duke Energy Company

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March 27, 2000

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

SUBJECT: Duke Energy Corporation
Catawba Nuclear Station Unit 2
Docket No. 50-414
Licensee Event Report 414/99-006 Revision 1

Attached please find Licensee Event Report 414/99-006 Revision 1, entitled "Reactor Trip Caused by an Electrical Ground in an Electrical Connector on the Turbine Electrical Trip Solenoid Valve". This LER was revised to include the results of a failure analysis on the failed component. Questions regarding this Licensee Event Report should be directed to J. W. Glenn at (803) 831-3051.

The only commitments in this Licensee Event Report are those described in the "Planned Corrective Actions" section.

Sincerely,

G. R. Peterson

Attachment

IE22

xc:

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NRC FORM 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001

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TITLE (4)

Reactor Trip Caused by an Electrical Ground in an Electrical Connector on the Turbine Electrical Trip Solenoid Valve.

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
12	30	99	99	006	01	03	27	00	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	100	20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
		20.2203(a)(1)	20.2203(a)(3)(i)	50.73(a)(2)(ii)	50.73(a)(2)(x)
		20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
		20.2203(a)(2)(ii)	20.2203(a)(4)	X 50.73(a)(2)(iv)	OTHER
		20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
J.W. Glenn, Regulatory Compliance	(803) 831-3051

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE
P2h	TD	CON	NA	Yes						

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On December 30, 1999 at 1821 hours with Catawba Unit 2 operating in Mode 1 "Power Operation" at 100% power, a reactor trip occurred. The cause of the reactor trip was actuation of the turbine trip instrumentation inputs to the Solid State Protection System (SSPS) logic. This was due to an electrical ground within an electrical connector on the normally energized Turbine Electrical Trip Solenoid Valve (ETSV). This caused the normally energized ETSV to de-energize and dump Emergency Trip System (ETS) pressure, resulting in the pressure switches on the ETS header sensing pressure dropping below their set point and thus sending a signal that the turbine was tripped to the SSPS. The SSPS then initiated a reactor trip. All systems responded as designed to shut down the reactor and maintain it in a safe shutdown condition. This event is being reported as an automatic actuation of the reactor protection system. A failure analysis performed on the connector determined that the root cause of the problem was a misapplication of the connector insert insulating material, which is made of neoprene. This connector will be replaced with a high temperature model.

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Background

Catawba Nuclear Station Unit 2 is a Westinghouse Pressurized Water Reactor [EIIS:RCT]. Unit 2 was operating in Mode 1, "Power Operation" at 100% power immediately prior to this event. The event is being reported pursuant to 10CFR50.73 (a)(2)(iv), [any event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature (ESF) [EIIS:JE], including the Reactor Protection System (RPS) [EIIS:JC]].

The Turbine [EIIS:TRB] Emergency Trip System (ETS) is a part of the Main Turbine Hydraulic Oil System (LT)[EIIS:TD]. Normal ETS pressure is 1600 psig. This pressure is monitored by four pressure switches [EIIS:PS]. A reactor trip signal is generated by the Solid State Protection System (SSPS) [EIIS:JF] when 2 of 4 turbine Electro-Hydraulic pressure switches sense pressure dropping below 550 psig when above the P-9 (Power Range Neutron Flux) interlock [EIIS:IEL], or 4 of 4 Turbine Stop Valves [EIIS:V] closed when above P-9.

Plant conditions immediately prior to the trip were: Reactor Power 100%, Turbine Load 1234 MWe, Reactor Coolant System (NC)[EIIS:AB] Tavg 587.2 degrees F., Reactor Coolant System Pressure 2228 psig, Reactor Coolant System Boron Concentration 329 ppm, Cycle Burnup 384.5 Effective Full Power Days.

No systems, structures, or components were out of service at the time of this event that contributed to the event.

Event Description (dates and approximate times)

12-30-1999 1821 The Unit 2 Reactor tripped. Operations entered Procedure EP/2/A/5000/E-0 "Reactor Trip or Safety Injection". Post trip conditions were normal. There was a turbine trip on reactor trip.

12-30-1999 1822 Main Feedwater (CF)[EIIS:SJ] isolation upon reactor trip with low Tavg occurred as designed and Main Feedwater Isolation Valves [EIIS:ISV] closed as designed.

12-30-1999 1822 An Auxiliary Feedwater System (CA)[EIIS:BA] Automatic start signal was generated and the Auxiliary Feedwater Turbine Driven Pump [EIIS:P] and both Motor [EIIS:MO] Driven Auxiliary Feedwater Pumps started as designed.

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

12-30-1999	1825	Operations entered Procedure EP/2/A/5000/ES-0.1 "Reactor Trip Response".
12-30-1999	1827	Auxiliary Feedwater Turbine Driven Pump was secured.
12-30-1999	2143	A failure investigation team was formed to investigate the trip.
12-30-1999	2244	Both Motor Driven Auxiliary Feedwater Pumps were secured.
12-31-1999		Testing was performed on the Solid State Protection System (SSPS), main turbine stop valve limit switches, and main turbine hydraulic oil system pressure switches. No problems were found during this testing.
1-1-2000		Trip investigation activities continued. A plan was developed and approved to troubleshoot potential malfunctions associated with the turbine electro-hydraulic system.
1-2-2000	0235	Failure investigation continued with planned testing/ cycling of main turbine stop valves and control valves [EIIS:FCV]. The test plan required resetting and tripping the turbine three times. Upon the first reset, the low ETS pressure trip annunciator [EIIS: ANN] (setpoint of 400 psig) was received in the Control Room [EIIS:NA]. Also during the reset, smoke was noted at the electrical trip solenoid valve [EIIS:PSV].
1-2-2000	0805	Maintenance determined that there was an electrical ground within the connector [EIIS:CON] at the electrical trip solenoid valve.
1-2-2000		The failed connector was replaced.
1-2-2000	1500	A Plant Operations Review Committee Meeting approved the restart of Unit 2. A fuse [EIIS:FU] and four relays [EIIS:RLY] in the electrical trip solenoid valve circuit were to be replaced before restart as a precaution due to unknown stresses that may have been caused by the short circuit current associated with the grounded connector.

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1-3-2000	0349	The fuse and the four relays were replaced. Functional testing was completed on the turbine reset and turbine trip circuitry associated with the electrical trip solenoid valve.
1-3-2000 through 1-4-2000		Restart of Unit 2 was delayed by a problem (unrelated to the trip) with the Digital Rod Position Indication System [EIIS:AA].
1-4-2000	2148	Unit 2 returned to Mode 1, "Power Operation".

Causal Factors

A Failure Investigation Team determined that an electrical ground within an electrical connector on the normally energized Electrical Trip Solenoid Valve caused the valve to de-energize and dump ETS pressure. The pressure switches on the ETS header sensed pressure dropping below the set point of 550 psig (on 2 of 4 channels) and sent a signal that the turbine was tripped to the SSPS. The SSPS initiated a reactor trip. There was a subsequent turbine trip on reactor trip. One of the pins in the connector exhibited a very low resistance to ground (3.8 ohms from Pin "C" to the case of the connector).

A detailed failure analysis determined that the root cause of the connector failure was the misapplication of the connector insert insulating material which is made of neoprene. Visual examination of the connector supports this conclusion. The neoprene insert at the failure point on the connector exhibits signs of accelerated aging. The inserts are hardened and there are charred deposits on the end of the inserts which are indications of electrical tracking.

Based on input from a material and environmental qualification subject matter expert, the combination of neoprene, high temperature, and humidity promotes a phenomenon called "outgasing". Outgasing of the neoprene material, in conjunction with high humidity and any contamination on the surface of the insert, forms a conductive deposit on the surface providing an alternate conductive path. With the electrical current acting as a catalyst, the neoprene deteriorates further, promoting more leakage current. This is a slow, cascading process which can take place over several years before reaching the catastrophic failure point.

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There is no previous history of failures of these connectors at Catawba. The connector failure is EPIX reportable. Automatic actuations of the Reactor Protection System due to equipment failures are not a recurring problem. In the past twenty four months there have been no other automatic reactor trips.

Corrective Actions

Subsequent

1. The failed connector, a fuse, and four relays were replaced.

Planned

1. Unit 1 and Unit 2 ETSV connectors (both male and female sections) will be replaced with an "upgrade" model designed for high temperature.

2. An evaluation will be performed to determine if there are other similar connectors in risk significant applications that should be replaced.

Safety Analysis

This event is bounded by the analysis of the turbine trip transient in Section 15.2.3 of the Updated Final Safety Analysis Report. There is an insignificant effect on Core Damage Frequency associated with this event.

After the Reactor Trip, all plant systems functioned as designed. Reactor parameters stabilized at normal no-load conditions thirty minutes after the trip.

The SSPS functioned as designed by tripping the Reactor. Reactor Trip breakers [EIIS:BRK] opened within the required timeframe. All Control Rods [EIIS:ROD] inserted normally. A Main Feedwater Isolation signal was generated due to Reactor Trip with Low Tavg (</= 564 degrees F.) as designed. All Main Feedwater valves closed within five seconds of the receipt of this signal.

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Primary System Pressure Control functioned normally. No Pressurizer [EIIS:PZR] Relief Valves (PORVs) [EIIS:RV] or Pressurizer Safety Valves lifted. Pressurizer Spray Valves and Backup Heaters [EIIS:HTR] controlled pressure as designed.

Secondary System Pressure Control functioned normally. No Steam Generator [EIIS:SG] PORVs or Safety Valves lifted. Condenser [EIIS:COND] Steam Dump Valves functioned as designed.

Main Feedwater Pump [EIIS:P] response was normal. Both Main Feedwater Pumps went into recirculation after isolation of Main Feedwater.

Auxiliary Feedwater System response was normal. The Turbine Driven Auxiliary Feedwater Pump and both Motor Driven Auxiliary Feedwater Pumps started automatically as designed. Auxiliary Feedwater System flow to all of the four Steam Generators was within the acceptable range.

Reactor Coolant Pump performance was normal. All seal water leak off flows remained within range.

Condensate System (CM) [EIIS:KA] response was normal.

The health and safety of the public were not affected by this event.