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A Duke Energy Company

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March 14, 2000

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

SUBJECT: Duke Energy Corporation
Catawba Nuclear Station Unit 1
Docket No. 50-413
Licensee Event Report 413/2000-001 Revision 0

Attached please find Licensee Event Report 413/2000-001 Revision 0, entitled "Reactor Trip Caused by a Pin to Pin Short Circuit within an Electrical Connector on the Turbine Electrical Trip Solenoid Valve.". 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.

LER 414/1999-006 concerning a similar event on Catawba Unit 2 will be revised to include information from the failure analysis performed on the connector.

Sincerely,

G. R. Peterson

Attachment

IE22

xc:

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U. S. Nuclear Regulatory Commission
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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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Catawba Nuclear Station Unit 1	05000413	1 OF 6

TITLE (4)

Reactor Trip Caused by a Pin to Pin Short Circuit within 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
02	13	2000	2000	001	00	03	14	2000	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 February 13, 2000 at 1831 hours with Catawba Unit 1 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 short 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. Corrective Actions included replacing the failed connector. 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.

FACILITY NAME (1)	DOCKET (2) NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Catawba Nuclear Station Unit 1	05000413	00	001	00	2 OF 6

Background

Catawba Nuclear Station Unit 1 is a Westinghouse Pressurized Water Reactor [EIIS:RCT]. Unit 1 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:RCT]).

The Turbine Emergency Trip System (ETS) is a part of the Main Turbine Hydraulic Oil System [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 [EIIS:TRB] Electro-Hydraulic pressure switches sense pressure dropping below 550 psig when above the P-9 (Power Range Neutron Flux) interlock [EIIS:IEL], or upon 4 of 4 Turbine Stop Valves [EIIS:V] closing 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 584.5 degrees F., Reactor Coolant System Pressure 2233 psig, Reactor Coolant System Boron Concentration 726 ppm, Fuel Cycle Burnup 261.1 Effective Full Power Days.

No systems, structures, or components were out of service at the time of this event that contributed to the event. The 1A Diesel Generator was out of service at the time of the event.

Event Description (dates and approximate times)

2-13-2000 1831 — The Unit 1 Reactor tripped. First out indication was "Turbine Trip causes Reactor Trip". Operations entered Procedure EP/1/A/5000/E-0 "Reactor Trip or Safety Injection", performed immediate actions and then transferred to EP/1/A/5000/ES-01 "Reactor Trip Response". Post trip conditions were normal.

2-13-2000 1832 — Main Feedwater (CF) [EIIS:SJ] isolation upon reactor trip with low T avg occurred as designed and Main Feedwater Isolation Valves [EIIS:ISV] closed as designed.

FACILITY NAME (1)	DOCKET (2) NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Catawba Nuclear Station Unit 1	05000413	00	001	00	3 OF 6

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

2-13-2000 1832	An Auxiliary Feedwater System (CA)[EIIS:BA] automatic start signal was generated on an ATWS Mitigation System Actuation Circuitry (AMSAC) signal and both Motor [EIIS:MO] Driven Auxiliary Feedwater Pumps [EIIS:P] started as designed. There was no Turbine Driven Auxiliary Feedwater automatic start signal.
2-13-2000 2100	A Plant Recovery Team was formed to investigate the reactor trip.
2-14-2000 0400	Engineering and Maintenance determined that the trip was caused by a faulty connector [EIIS:CON] on the Turbine Electrical Trip Solenoid Valve.
2-14-2000 0915	A Plant Operations Review Committee Meeting approved the restart of Unit 1. The connector, a fuse, and four relays in the electrical trip solenoid [EIIS:SOL] valve circuit were to be replaced before restart.
2-14-2000 1215	Reactor Trip Breakers [EIIS:BRK] were closed in preparation for reactor startup.
2-14-2000 1517	Unit 1 entered Mode 2 (Startup).
2-14-2000 1659	Unit 1 entered Mode 1 (Power Operation).
2-14-2000 0400	Repairs to the Turbine Electrical Trip Solenoid Valve circuitry were completed.
2-15-2000 0612	Unit 1 Turbine was placed on line.

Causal Factors

It was determined that an electrical short circuit between two pins in an electrical connector on the normally energized Electrical Trip Solenoid Valve caused the valve to de-energize and dump ETS pressure. The pressure

FACILITY NAME (1)	DOCKET (2) NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Catawba Nuclear Station Unit 1	05000413	00	001	00	4 OF 6

switches on the ETS header sensed pressure dropping below the set point of 550 psig (on 2 of 4 channels) and provided a turbine trip signal to the SSPS. The SSPS then initiated a reactor trip. There was a subsequent turbine trip on reactor trip. The pins of the connector exhibited the following resistance readings: Pin A to Pin B - 0 ohms, Pin B to Pin C - 19 ohms, Pin A to Pin C - 19 ohms.

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.

Automatic actuations of the Reactor Protection System due to equipment failures are a recurring problem. In the past twenty four months there has been one other automatic reactor trip. The cause of this reactor trip is very similar to the reactor trip which occurred on Catawba Unit 2 on December 30, 1999 (LER 414/99-006). During the investigation of that event, this (Unit 1) connector was externally inspected and no visible indications of problems were noted. Station Management opted not to change the connector at that time because there was no persuasive evidence that a failure was imminent.

Corrective Actions

Subsequent

1. The failed connector, a fuse [EIIS:FU], and four relays [EIIS:RLY] 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 given 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 following the trip.

The SSPS functioned as designed by tripping the Reactor. Reactor Trip breakers 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 as designed.

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 PORVs or Safety Valves lifted. Condenser [EIIS:COND] Steam Dump Valves functioned as designed.

Main Feedwater Pump response was normal.

Auxiliary Feedwater System response was normal. 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.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Catawba Nuclear Station Unit 1	05000413	00	001	00	6 OF 6

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.