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UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

December 6, 1994

NRC INFORMATION NOTICE 94-83: REACTOR TRIP FOLLOWED BY UNEXPECTED EVENTS

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to a recent reactor trip followed by a series of unexpected events and equipment failures. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On September 8, 1994, the River Bend Station experienced an automatic reactor trip on a reactor water level high (Level 8) trip signal. A Level 8 trip occurs at 51 inches, but the operators verified that the level was and had been stable at 36 inches. After implementing the appropriate scram recovery procedures, the operators observed that the expected turbine trip had not occurred; therefore, they tripped the turbine manually about 10 minutes into the event. The operators also opened the generator output breakers which had failed to open. After the output breakers were opened, electric power was unexpectedly lost to the following systems and components: safety parameter display system, emergency response information system, reactor protection system (RPS), feedwater pumps, condensate pumps, reactor recirculation pumps, a normal service water pump, and two circulating water pumps. In addition, due to the loss of the RPS, a containment isolation occurred which isolated both main steam and feedwater systems. In spite of these problems, the operators determined that no emergency level had been reached.

During the recovery period, the operators manually opened one safety/relief valve for pressure control and initiated operation of the reactor core isolation cooling (RCIC) system; however, the RCIC pump turbine tripped on overspeed. The operators then initiated the high pressure core spray (HPCS) system to provide condensate makeup to the reactor vessel. Because the reactor vessel level was maintained above the emergency core cooling system (ECCS) actuation setpoints, no automatic initiation of the ECCS occurred. In addition, because no power was lost to the safety-related busses, no emergency diesel generators started.

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updated on 12/17/94
PDR IEE

Notice 94-083

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Discussion

The anomalous occurrences began with a high water level signal, which was subsequently determined to be a spurious signal received by RPS channels C and D. The reactor scram initiated on a 1-out-of-2-taken-twice logic. The licensee root cause determination concluded that Rosemount Model 1153 level transmitters with no or minimal damping are susceptible to providing spurious trips as a result of signal noise in process variables. The licensee replaced these model transmitters due to incompatibilities between damping and instrument response time.

General Electric Nuclear Energy (GENE) addressed the concern about signal noise in process variables in SIL No 463, R1 dated July 9, 1991 and presented recommended actions. Since the transmitters are not the source of the noise, GENE recommends that a root cause evaluation be performed to determine the source of the noise and that, if there are differences between the required instrument response time and the measured response time, an evaluation be performed and appropriate adjustments made.

The anticipated turbine trip, which normally follows a valid high water level scram, did not occur because this actuation is based on a 2-out-of-3 logic and only channel C of channels A, B, and C had received a trip signal.

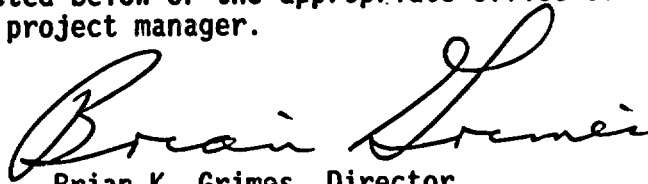
Usually, an automatic reactor trip will lead to motoring of the main generator and an automatic trip of the generator on reverse power when the reverse power exceeds the set point of approximately 3 MW (million Watts) on either one of two reverse power relays. However, because of an abnormally high inductive load (about 200 MVAR [million volt amperes reactive]) on the generator prior to the reactor scram, the reverse power trip set point of both relays had been effectively shifted to about 10 MW on one relay and 20 MW on the other relay. Because the highest reverse power attained was about 10 MW, the automatic turbine and main generator trip did not occur.

The anticipated automatic trip of the turbine and main generator would have led to a fast transfer (within 6 to 10 cycles) of power from the normal station service (main generator) to the preferred station service (grid). The manual trip, however, resulted in the plant load being carried by the main generator while it was losing voltage and frequency which, in turn, led to a slow transfer on undervoltage about 1.3 minutes later. This series of events led to a loss of power to certain non-safety equipment and the RPS motor generator sets. The loss of power to the RPS led to containment isolation. Plant response during a slow transfer had not been addressed in operator training nor was it modeled on the control room simulator.

The RCIC turbine tripped on overspeed because the governor valve had failed in the open position. Attempts to manually stroke the valve were unsuccessful. After the reactor was shut down, the valve bonnet was disassembled and the valve stem was found to be stuck. This event and others are described in Information Notice 94-66, "Overspeed of Turbine-Driven Pumps Caused by Governor Valve Stem Binding," issued on September 19, 1994. One potential cause for the stuck valve stem is galvanic corrosion of the valve stem material while the system is in its standby condition.

Other failures that occurred after the reactor scram involved operational failures of one safety-related motor operated valve (MOV) and four non-safety related MOVs. These failures, in this sequence, did not cause other event consequences. The failure of the safety related valve was determined to have been caused by an electrical lead within Limitorque actuator, Model SMB-00, which had been sharply bent with the bend adjacent to the cover. Vibration associated with valve operation caused a chafing action which over time permitted arcing and a fuse to blow. Contact positions LS-1 and LS-9 were determined to be the only positions with insufficient clearance and thus susceptible to this type of failure.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.



Brian K. Grimes, Director
Division of Project Support
Office of Nuclear Reactor Regulation

Technical contacts: T. Stetka, RIV
(817) 860-8247

J. Carter, NRR
(301) 504-1153

Attachment:
List of Recently Issued NRC Information Notices

Attachment filed in Jacket

LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-82	Concerns Regarding Essential Chiller Reliability during Periods of Abnormal Cooling Water Temperature	12/05/94	All holders of OLs or CPs for nuclear power reactors.
94-81	Accuracy of Bioassay and Environmental Sampling Results	11/25/94	All U.S. Nuclear Regulatory Commission licensees.
94-80	Inadequate DC Ground Detection in Direct Current Current Distribution Systems	11/25/94	All holders of OLs or CPs for nuclear power reactors.
94-79	Microbiologically Influenced Corrosion of Emergency Diesel Generator Service Water Piping	11/23/94	All holders of OLs or CPs for nuclear power reactors.
94-78	Electrical Component Failure due to Degradation of Polyvinyl Chloride Wire Insulation	11/21/94	All holders of OLs or CPs for nuclear power reactors.
94-77	Malfunction in Main Generator Voltage Regulator Causing Overvoltage at Safety-Related Electrical Equipment	11/17/94	All holders of OLs or CPs for nuclear power reactors.
94-76	Recent Failures of Charging/Safety Injection Pump Shafts	10/26/94	All holders of OLs or CPs for pressurized water reactors.
93-60, Supp. 1	Reporting Fuel Cycle and Materials Events to the NRC Operations Center	10/20/94	All 10 CFR Part 70 fuel cycle licensees.

OL = Operating License
 CP = Construction Permit

Other failures that occurred after the reactor scram involved operational failures of one safety-related motor operated valve (MOV) and four non-safety related MOVs. These failures, in this sequence, did not cause other event consequences. The failure of the safety related valve was determined to have been caused by an electrical lead within Limitorque actuator, Model SMB-00, which had been sharply bent with the bend adjacent to the cover. Vibration associated with valve operation caused a chafing action which over time permitted arcing and a fuse to blow. Contact positions LS-1 and LS-9 were determined to be the only positions with insufficient clearance and thus susceptible to this type of failure.

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Original signed by
 Brian K. Grimes

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 Office of Nuclear Reactor Regulation

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DOCUMENT NAME: 94-83.IN
 *See previous concurrence

OFFICE	OECB	C	RIV	C	SC:OECB	C	C:OECB	D:DOPS
NAME	TJCarter*		TStetka*		RLDennig*		AEChaffee*	BKGrimes
DATE	10/04/94		10/04/94		10/04 /94		10/04/94	10/ /94

OFFICE	C:EELB	E	C:HICB	C	D:DOPS,NRR			
NAME	CBerlinger*		JWermiel*		BKGrimes			
DATE	10/06/94		10/06/94		11/3/94			

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DOCUMENT NAME: G:\TJC\RB-IN.IN2

*See previous concurrence

OFFICE	OECB	C	RIV	C	SC:OECB	C	C:OECB		D:DOPS	
NAME	TJCarter*		TStetka*		RLDennig*		AEChaffee*		BKGrimes	
DATE	10/04/94		10/04/94		10/04 /94		10/04/94		10/ /94	

OFFICE	C:EELB	E	C:HICB	C						
NAME	CBerlinger*		JWermiel*							
DATE	10/06/94		10/06/94							

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Brian K. Grimes, Director
 Division of Operating Reactor Support
 Office of Nuclear Reactor Regulation

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 817-860-8247

Attachment:
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*See previous concurrence

DOCUMENT NAME: G:\TJC\RB-IN.IN1

*See previous concurrence

OFFICE	OECB	C	RIV	C	SC:OECB	C	C:OECB	D:DOPS
NAME	TJCarter*		TStetka*		RLDennig*		AEChaffee*	BKGrimes*
DATE	10/04/94		10/04/94		10/04/94		10/04/94	10/ /94

OFFICE	C:EELB	E	C:HICB	C				
NAME	CBerlinger*		JWermiel*					
DATE	10/06/94		10/06/94					

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Comments from Editor
Comments incorporated

OFFICE	OECEB C	RIV	SC:OECEB	C:OECEB C	D:DOPS
NAME	TCarter	TStetka	RLDennig	AEOHaffee	BKGrimes
DATE	10/4/94	10/ /94	10/4 /94	10/4/94	10/ /94

DOCUMENT NAME: G:\tjc\rb-in.in1

With no charge comments included.

OFFICE	C:EEK/E	C:HICB				
NAME	CBerlinger	JWermielke				
DATE	10/6 /94	10/6 /94				

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