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

March 23, 1990

NRC INFORMATION NOTICE NO. 90-22: UNANTICIPATED EQUIPMENT ACTUATIONS FOLLOWING RESTORATION OF POWER TO ROSEMOUNT TRANSMITTER TRIP UNITS

Addressees:

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

Purpose:

This information notice is intended to alert addressees to potential problems resulting from the reenergization of Rosemount transmitter trip units. 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 do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

The River Bend Station was operating at 100-percent power on February 11, 1990. While maintenance was being performed on a division 2 battery charger, a sudden increase in dc bus voltage occurred when the battery charger was placed in the equalize mode of operation. The voltage increase had a magnitude of less than 10-percent above the nominal voltage while in the equalize mode. However, this voltage was sufficient to cause the automatic shutdown of a Topaz inverter connected to the battery bus that was being energized by the charger. In turn, the Topaz inverter deenergized a number of Rosemount transmitter trip units. The licensee was aware of the potential for unwanted equipment actuations upon restoration of power to the transmitter trip units and removed what was believed to be the affected equipment from service. The battery charger voltage was then lowered to allow the inverter to reset. Upon resetting the inverter, unexpected trip signals occurred that resulted in a number of unanticipated equipment actuations. The most notable of these actuations was the opening of the low-pressure coolant injection (LPCI) valves while the plant was at full power. The unanticipated trip signals and actuations occurred because the operators did not have procedures and/or a load list available and could not predict all components that were affected.

Topaz inverters have an automatic reset feature that operates when the supply voltage returns to normal. When the battery charger voltage was lowered, the

IDAR-11C

Rosemount trip units powered by the inverter were immediately reenergized. The transmitters required several additional milliseconds to completely reenergize. The transmitter inputs to the trip units decrease to zero on loss of power, and therefore the inputs were equal to zero when power was restored.

Those trip units that actuate on a decreasing input (i.e., a trip occurs when the input goes below the setpoint value) reenergized in the tripped condition, even though the actual value of the monitored variable was above the trip setpoint. In the first few milliseconds after the inverter reset, the trip units detected "low" reactor vessel water level which satisfied the LPCI initiation logic, and "low" reactor pressure which satisfied the low pressure permissive required to open the LPCI valves. These signals caused the division 2 (trains B and C) LPCI valves to automatically open as well as numerous other actuations. This resulted in a single check valve isolation of the high-pressure reactor coolant system from the low-pressure residual heat removal (RHR) system. Failure of the single check valve would have overpressurized the RHR piping and could have resulted in loss of reactor coolant, for example, through the failure of RHR pump seals or other components.

On January 3, 1984, and February 23, 1985, Grand Gulf experienced nearly identical events. In both instances, the plant was at cold shutdown and low-pressure coolant injection occurred. As in the event at River Bend, a higher than expected voltage occurred when the battery charger was placed in equalize, causing the Topaz inverters to trip. When the bus voltage was lowered, the inverters reset and reenergized the Rosemount transmitter trip units.

A similar event occurred at Hope Creek on April 14, 1989. The licensee reported that while attempting to restore the Topaz inverter, a voltage transient caused a loss-of-coolant accident initiation signal. The high-pressure coolant injection system was secured before water was injected into the reactor vessel; at the time, the plant was at 100-percent power.

Discussion:

The effects of restoration of power to safety-related equipment that is normally energized are typically not as thoroughly analyzed as the effects of losses of power. Since the potential for serious consequences exists from unanticipated component actuations, careful consideration of the effects of restoration of power to Rosemount transmitter trip units is warranted. The potential may also exist for unanticipated plant response to restoration of power to similar equipment from other manufacturers. Awareness of the potential consequences of rendering numerous safety-related components inoperable during power operation to prevent equipment from actuating upon restoration of power is also important. Degraded transient and accident response capability and the potential for human errors during these operations are of particular concern.

The NRC-approved design described in NEDO 21617, "Analog Transmitter Trip Unit System for Engineered Safeguard Sensor Trip Inputs", includes a redundant voltage converter leading to the trip units. The voltage converters are auctioneered so if one is lost, the other voltage converter supplies power. The use of the redundant voltage converter would decrease the probability of de-energizing the transmitter trip units. However, other power supply failures upstream of the voltage converters may also produce events similar to those described above.

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 NRR project manager.

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: P. C. Wagner, RIV
(817) 860-8127

A. Mattson, NRR
(301) 492-1177

R. Kendall, NRR
(301) 492-1192

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
90-21	Potential Failure of Motor-Operated Butterfly Valves to Operate Because Valve Seat Friction was Under-estimated	3/22/90	All holders of OLs or CPs for nuclear power reactors.
90-20	Personnel Injuries Resulting from Improper Operation of Radwaste Incinerators	3/22/90	All NRC licensees who process or incinerate radio-active waste.
90-19	Potential Loss of Effective Volume for Containment Recirculation Spray at PWR Facilities	3/14/90	All holders of OLs or CPs for PWRs.
90-18	Potential Problems with Crosby Safety Relief Valves Used on Diesel Generator Air Start Receiver Tanks	3/9/90	All holders of OLs or CPs for nuclear power reactors.
90-17	Weight and Center of Gravity Discrepancies for Copes-Vulcan Valves	3/8/90	All holders of OLs or CPs for nuclear power reactors.
89-59, Supp. 2	Suppliers of Potentially Misrepresented Fasteners	3/7/90	All holders of OLs or CPs for nuclear power reactors.
90-16	Compliance with New Decommissioning Rule	3/7/90	All materials licensees.
90-15	Reciprocity: Notification of Agreement State Radiation Control Directors Before Beginning Work in Agreement States	3/7/90	All holders of NRC materials licenses which authorize use of radioactive material at temporary job sites.
90-14	Accidental Disposal of Radioactive Materials	3/6/90	All U.S. NRC byproduct material licensees.

OL = Operating License
CP = Construction Permit

The NRC-approved design described in NEDO 21617, "Analog Transmitter Trip Unit System for Engineered Safeguard Sensor Trip Inputs", includes a redundant voltage converter leading to the trip units. The voltage converters are auctioneered so if one is lost, the other voltage converter supplies power. The use of the redundant voltage converter would decrease the probability of de-energizing the transmitter trip units. However, other power supply failures upstream of the voltage converters may also produce events similar to those described above.

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 NRR project manager.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: P. C. Wagner, RIV
(817) 860-8127

A. Mattson, NRR
(301) 492-1177

R. Kendall, NRR
(301) 492-1192

Attachment: List of Recently Issued NRC Information Notices

*See previous concurrence.

*RIV	*EAB:NRR	*EAB:NRR	*EAB:NRR	*AC:OEAB:NRR	*RPB:ADM	*C:OGCB:NRR
TStetke	AMattson	RKendall	PBaranowsky	PBaranowsky	TechEd	CHBerlinger
3/15/90	3/15/90	3/16/90	3/16/90	3/16/90	3/5/90	3/16/90

D:~~DOEA:NRR~~
~~CERossi~~
3/19/90

Region IV concurrence 3/15/90 per telcon PWB with TStetke.

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 NRR project manager.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: P. C. Wagner, RIV
(817) 860-8127

A. Mattson, NRR
(301) 492-1177

R. Kendall, NRR
(301) 492-1192

Attachment: List of Recently Issued NRC Information Notices

*See previous concurrence.

RIV	EAB:NRR	EAB:NRR	EAB:NRR	AC:OEAB:NRR	*RPB:ADM	*C:OGCB:NRR
TStetke	AMattson	RKendall	PBaranowsky		TechEd	CHBerlinger
3/15/90	3/15/90	03/16/90	3/16/1	3/16/1	/ /	3/16/90

D:DOEA:NRR
CERossi
/ /

Region IV concurrence 3/15/90 per telcon PWB with TStetke.

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 NRR project manager.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: P. C. Wagner, RIV
(817) 860-8127

A. Mattson, NRR
(301) 492-1177

R. Kendall, NRR
(301) 492-1192

Attachment: List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCES

OFC	:EAB:NRR	:EAB:NRR	:AC:OEAB:NRR	:*RPB:ADM	:C:OGCB:NRR	:D:DOEA:NRR	:
NAME	:AMattson	:PBaranowsky	:DCFischer	:TechEd	:CHBerlinger	:CERossi	:
DATE	:3/ 7/90	:3/7/90	:3/07/90	:3/ /90	:3/8/90	:3/ /90	:

The licensee was aware of the potential for unwanted equipment actuation upon restoration of power to the trip units and had attempted to remove the affected equipment from service before restoration. Actions taken to deliberately render safety-related equipment inoperable during power operation are undesirable because of the degraded transient and accident response capability and because of the potential for human errors.

Similar Events:

On January 3, 1984 and February 23, 1985, Grand Gulf experienced nearly identical events. In both instances, the plant was at cold shutdown and LPCI injection occurred. As in the events at River Bend a higher than expected voltage occurred when the battery charger was placed into the equalize mode, causing the Topaz inverters to trip. When the bus voltage was lowered, the inverters reset and reenergized the Rosemount transmitter trip units.

A similar event occurred at Hope Creek on April 14, 1989. The licensee reported that while attempting to restore the Topaz inverter, a voltage transient caused a LOCA initation signal. The high pressure coolant injection system was secured before water was injected into the reactor vessel; at the time, the plant was at 100 percent power.

Discussion:

The NRC-approved design described in NEDO 21617 includes a redundant voltage converter leading to the trip units. These voltage converters are auctioneered so that in the loss of one, the other voltage converter supplies power. The use of the redundant voltage converter would decrease the probability of deenergizing the transmitter trip units, and would avoid the problems encountered with reenergization of the transmitter trip units.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact one of the technical contacts listed below or the Regional Administrator of the appropriate regional office.

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: P. C. Wagner, RIV
(817) 860-8127

A. Mattson, NRR
(301) 492-1177

R. Kendall, NRR
(301) 492-1192

Attachment: List of Recently Issued NRC Information Notices

OFC	:EAB:NRR	:EAB:NRR	:TECH:ED	:C:OGCB:NRR	:D:DOEA:NRR	:	:
NAME	:AMattson	:PBaranowsky	:BCalure	:CHBerlinger	:CERossi	:	:
DATE	:3/5/90	:	:3/12/90	:	:	:	: