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

December 7, 1990

NRC INFORMATION NOTICE NO. 90-76: FAILURE OF TURBINE OVERSPEED TRIP MECHANISM BECAUSE OF INADEQUATE SPRING TENSION

Addressees:

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

Purpose:

This information notice is intended to alert addressees to the potential failure of the overspeed trip mechanism on turbine-driven pumps as the result of inadequate tension in the emergency trip spring. 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:

On March 17, 1990, and on August 14, 1990, during two separate monthly surveillance tests of the Terry turbine-driven auxiliary feedwater pump at Arkansas Nuclear One, actuation of the local manual trip lever on the overspeed trip mechanism failed to close the turbine trip and throttle valve. If a malfunction causes the turbine to overspeed, the overspeed trip mechanism (shown in Figure 1) normally will rapidly close the turbine trip and throttle valve, stopping steam flow to the turbine. Excessive turbine speeds could damage the turbine and pump and overpressurize the auxiliary feedwater system.

In response to an overspeed, a weight in the turbine shaft is forced outward by the excessive centrifugal force, striking a tappet, which moves upward, releasing the emergency head lever (see Figure 1). This lever normally allows the emergency trip spring to move a rod connected to the turbine trip and throttle valve trip mechanism. The movement of the connecting rod should then disengage a trip hook lever on the trip and throttle valve allowing the valve to close. However, during the two failed tests, the emergency trip spring failed to move the connecting rod. During the first of these tests, the plant personnel were able to actuate the trip mechanism by tapping on the emergency trip spring holder, which produced an erratic response, indicating that the spring force and the frictional forces were evenly matched. Arkansas Nuclear One personnel lubricated the critical mating surfaces and achieved good trip response.

However, the second failure clearly indicated that insufficient spring force was the root cause of the problem. The original emergency trip spring, which had been in service approximately nine years, had stretched 1/8 inch beyond its normal at rest position. This spring was replaced with a new one of identical design. After this change, plant personnel successfully completed a number of trip tests.

Discussion:

Inspection of the original emergency trip spring provided neither evidence of a manufacturing defect nor that the spring had ever been stretched beyond its elastic limit. The observed elongation was apparently the result of a long-term relaxation process, which could develop on this or any other similar trip mechanism. The tension in the spring, and thus the force applied to the connecting rod, can be controlled by adjusting the position of the trip spring holder on a threaded portion of the connecting rod. This adjustment is made during turbine installation and normally is not changed or checked thereafter. The Arkansas Nuclear One staff intends to revise the maintenance procedures to specify adjustment of the trip spring holder position in the event of any future problems attributable to insufficient spring force.

The failure of overspeed trip mechanisms could result in severe damage to turbines and pumps in boiling water reactor high-pressure coolant injection and reactor core isolation cooling systems and in pressurized water reactor auxiliary feedwater systems. The resulting overpressurization can also damage other components. NRC Information Notice 90-45 discussed two overspeed events involving turbine-driven auxiliary feedwater pumps. One occurred at Rancho Seco, where the turbine, rated at 3600 rpm, reached 6020 rpm a few seconds after start. According to calculations, the auxiliary feedwater system pressure reached 3850 psig, significantly exceeding the system design pressure of 1325 psig. This overpressurization also affected the motor-driven auxiliary feedwater train because the two trains were tied together. The other overspeed event occurred at San Onofre, where the turbine-driven auxiliary feedwater pump reached 5000 rpm and the auxiliary feedwater system pressure was calculated to have reached 2420 psig.

The event at Arkansas Nuclear One revealed an additional failure process for overspeed trip mechanisms. It serves as a reminder that the characteristics of mechanical components, such as springs, are subject to change. Such variability highlights the importance of periodic checking and adjustment, inherent to adequate maintenance and testing practices.

Related Generic Communications:

1. NRC Information Notice 90-45, "Overspeed of the Turbine-Driven Auxiliary Feedwater Pumps and Overpressurization of the Associated Piping Systems", dated July 6, 1990.

2. NRC Information Notice 88-67, "PWR Auxiliary Feedwater Pump Turbine Overspeed Trip Failure", dated August 22, 1988.

3. NRC Information Notice 88-09, "Reduced Reliability of Steam-Driven Auxiliary Feedwater Pumps Caused by Instability of Woodward PG-PL Type Governors", dated March 18, 1988.

4. IE Information Notice 86-14, "PWR Auxiliary Feedwater Pump Turbine Control Problems", dated March 10, 1986.

5. IE Information Notice 86-14, Supplement 1, "Overspeed Trips of AFW, HPCI, and RCIC Turbines", dated December 17, 1986.

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

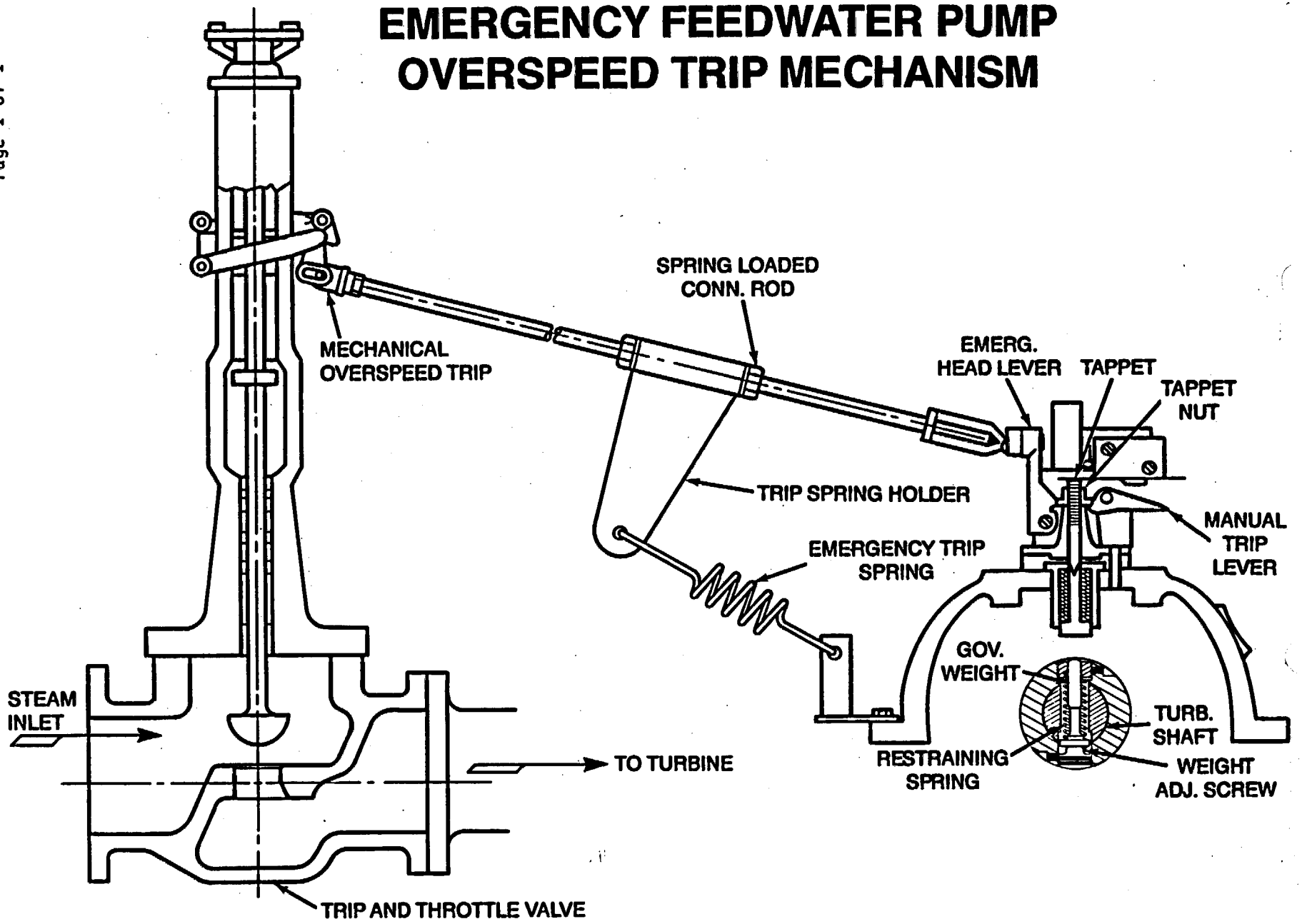
Technical Contacts: Thomas F. Stetka, Region IV
(817) 860-8247

Michael F. Runyan, Region IV
(817) 860-8142

Attachments:
1. Figure 1. Emergency Feedwater Pump Overspeed Trip Mechanism
2. List of Recently Issued NRC Information Notices

Figure 1

EMERGENCY FEEDWATER PUMP OVERSPEED TRIP MECHANISM



LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
90-75	Denial of Access to Current Low-Level Radioactive Waste Disposal Facilities	12/5/90	All Michigan holders of NRC licenses.
90-74	Information on Precursors to Severe Accidents	12/4/90	All holders of OLs or CPs for nuclear power reactors.
90-73	Corrosion Of Valve-To-Torque Tube Keys In Spray Pond Cross Connect Valves	11/29/90	All holders of OLs or CPs for nuclear power reactors.
90-72	Testing of Parallel Disc Gate Valves In Europe	11/28/90	All holders of OLs or CPs for nuclear power reactors.
90-71	Effective Use of Radiation Safety Committees to Exercise Control Over Medical Use Programs	11/6/90	All NRC licensees authorized to use by-product material for medical purposes.
90-70	Pump Explosions Involving Ammonium Nitrate	11/6/90	All uranium fuel fabrication and conversion facilities.
90-38, Supp. 1	License and Fee Requirements for Processing Financial Assurance Submittals for Decommissioning	11/6/90	All fuel facility and materials licensees.
89-30, Supp. 1	High Temperature Environments At Nuclear Power Plants	11/1/90	All holders of OLs or CPs for nuclear power reactors.
90-69	Adequacy of Emergency and Essential Lighting	10/31/90	All holders of OLs or CPs for nuclear power reactors.
90-68	Stress Corrosion Cracking of Reactor Coolant Pump Bolts	10/30/90	All holders of OLs or CPs for pressurized water reactors (PWRs).

OL = Operating License
CP = Construction Permit

3. NRC Information Notice 88-09, "Reduced Reliability of Steam-Driven Auxiliary Feedwater Pumps Caused by Instability of Woodward PG-PL Type Governors", dated March 18, 1988.

4. IE Information Notice 86-14, "PWR Auxiliary Feedwater Pump Turbine Control Problems", dated March 10, 1986.

5. IE Information Notice 86-14, Supplement 1, "Overspeed Trips of AFW, HPCI, and RCIC Turbines", dated December 17, 1986.

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Attachments:
1. Figure 1. Emergency Feedwater Pump Overspeed Trip Mechanism
2. List of Recently Issued NRC Information Notices

*SEE PREVIOUS CONCURRENCES

*OGCB:DOEA:NRR	*RIV	*RIV	*RPB:ADM	D/DOEA:NRR	*C/OGCB:DOEA:NRR
DCKirkpatrick	TStetka	MRunyan	TechEd	CERossi	CHBerlinger
09/15/90	11/ /90	11/ /90	10/05/90	12/3 /90	11/29/90

DOCUMENT NAME: IN 90-76

4. IE Information Notice 86-14, "PWR Auxiliary Feedwater Pump Turbine Control Problems."

5. IE Information Notice 86-14, Supplement 1, "Overspeed Trips of AFW, HPCI, and RCIC Turbines."

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Document Name: OSTRIPIN

*SEE PREVIOUS CONCURRENCES

				D/DOEA:NRR CERossi 11/ /90
*OGCB:DOEA:NRR DCKirkpatrick 09/15/90	RIV TStetka 11/21/90 By Phone DCK	RIV MRunyan 11/21/90 By Phone DCK	*RPB:ADM TechEd 10/05/90	C/OGCB:DOEA:NRR CHBerlinger for 11/29/90

5. IE Information Notice 86-14, Supplement 1, "Overspeed Trips of AFW, HPCI, and RCIC Turbines."

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Attachments:
1. Figure 1
2. List of Recently Issued NRC Information Notices

Document Name: IN ON TURBINE OS TRIP FAILURE

				D/DOEA:NRR CERossi 09/ /90
OGCB:DOEA:NRR DCKirkpatrick 09/15/90 DCK	RIV TStetka 09/ /90	RIV MRunyan 09/ /90	RPB:ADM TechEd JMain 10/5/90 JM	C/OGCB:DOEA:NRR CHBerlinger 09/ /90