

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

September 19, 1994

NRC INFORMATION NOTICE 94-66: OVERSPEED OF TURBINE-DRIVEN PUMPS CAUSED BY GOVERNOR VALVE STEM BINDING

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 recent problems regarding binding of governor valves for turbine-driven pumps that have resulted in overspeed trips. 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

River Bend

On September 8, 1994, the River Bend Station experienced an automatic reactor trip on a reactor water level high (Level 8) trip signal. In the course of the recovery, the operators initiated the reactor core isolation cooling (RCIC) system, but 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. The reactor vessel level was maintained above the emergency core cooling system (ECCS) actuation setpoints, and no ECCS initiations occurred.

The RCIC turbine tripped on overspeed due to the governor valve failing in the open position. Attempts to manually stroke the valve were unsuccessful. The valve bonnet was disassembled. The valve stem was found to be stuck and had to be forcibly removed. Close inspection indicated that the apparent failure mechanism was galvanic corrosion between the valve stem and spacers in the packing assembly. The licensee reviewed the maintenance history of the valve and found that the stem and spacers had been recently replaced during the refueling outage that ended in July 1994. The valve, which is on a quarterly test schedule, had not been tested since the outage. The licensee has contacted the valve manufacturer, Dresser-Rand Steam Turbines, for information on the material specifications for the valve stem and spacers. In addition, the licensee has submitted the spacers for chemical analysis and is presently awaiting the results.

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updated on 10/4/94

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North Anna

On July 29, 1994, the North Anna Power Station Unit 2 turbine-driven auxiliary feedwater pump (AFW) pump tripped on overspeed during an initial startup following maintenance. During valve cycling by hand, the licensee noted that the valve appeared to stick and the stem would only move approximately one-half inch. After several more attempts, the valve was freed and traveled an additional one-half inch. The valve was disassembled, and the licensee noted pitting and corrosion on the valve stem. The licensee replaced the stem and packing assembly. The post-maintenance test was successfully completed.

Surry

On January 11, 1992, the Surry Power Station Unit 1 turbine-driven AFW pump tripped on overspeed during shutdown of the pump; it was noted that the valve stem was sticking. On December 2, 1993, the Surry Power Station Unit 1 turbine-driven AFW pump tripped on overspeed after being started for a monthly surveillance test. The pump was started a second time and again tripped on overspeed. The governor valve linkage was disconnected from the turbine governor and the governor valve stem was checked for freedom of movement. The valve stem was found stuck in the open position. In this condition, the turbine governor was unable to reposition the governor valve and the turbine tripped at the overspeed trip setpoint. The governor valve bonnet, stem and packing were replaced and the turbine-driven AFW pump operated satisfactorily.

On June 15, 1994, the Unit 1 turbine-driven AFW pump again tripped on overspeed after being started for a monthly surveillance test. The pump was started a second time and operated satisfactorily. Corrective maintenance was not performed between the first and second starts. The governor valve linkage was disconnected from the turbine governor and the governor valve stem was checked for freedom of movement. The valve stem was difficult to move and it was concluded that governor valve stem binding caused the turbine-driven AFW pump to trip on overspeed during the initial start. The governor valve bonnet, stem and packing, which were previously replaced in December 1993, were again replaced and the turbine-driven AFW pump operated satisfactorily.

To evaluate whether a similar condition existed in Unit 2, the Unit 2 turbine-driven AFW pump governor valve linkage was disconnected from the turbine governor and the governor valve stem was checked for freedom of movement on June 25, 1994. It also had been checked on January 17, 1994. In both instances governor valve stem binding was noted. The Unit 2 turbine-driven AFW pump had satisfactorily passed its monthly surveillance in this condition. The governor valve stem and packing were replaced each time stem binding was identified.

Based on metallurgical analysis, the licensee determined that the corrosion products are formed due to galvanic corrosion, crevice corrosion, and pitting corrosion. Dresser-Rand stated that the packing binder material has approximately 1.29% sulfur and traces of other chemicals. The licensee and the vendor are currently investigating to determine what effect the sulfur and other chemicals have in accelerating the corrosion process.

Arkansas Nuclear One

On May 9, 1991, an event occurred at Arkansas Nuclear One where a turbine-driven emergency feedwater pump tripped on overspeed. The cause of the overspeed trip was determined to be corrosion of the governor valve stem. The buildup of corrosion products on the stem caused binding which prevented the valve from closing as the turbine accelerated on startup. In this instance, the valve stem had been in service for one month prior to the failure.

Discussion

Turbine driven pumps used in both RCIC and the auxiliary feedwater systems are classified as engineered safety features which are designed for removing decay heat and for providing a redundant means of supplying water to either the reactor vessel or the steam generators.

The turbine-driven pumps at River Bend, North Anna, Surry, and Arkansas Nuclear One were manufactured by Terry Steam Turbine Company. Dresser-Rand Steam Turbines is the current vendor for the equipment. The governor valve for the turbines is designed such that the valve stem travels through a packing assembly made up of carbon spacers and stainless steel washers with very tight clearances. The governor valve stem material is 410 stainless steel that is nitrided for hardness. The packing space is composed of carbon discs and stainless steel washers. A gland packing leakoff is located in the outer portion of the packing/stem assembly. In one case, the licensee has determined that there was corrosion and a buildup of mineral deposits on the governor valve stem in the area adjacent to the packing leakoff. The deposits were extremely hard and adherent to the stem. The corrosion and deposits interfered with the movement of the stem through the packing causing the stem to bind. The clearance between a new stem and packing assembly is approximately 0.005 cm [0.002 inches]; therefore, only a small buildup of deposits on the stem will result in interference between the stem and packing. One licensee reported that the ambient temperature of the governor valve is significantly warmer, which may affect the corrosion rate. (The steam supply valve is in close proximity to the governor valve.)

In a letter dated March 24, 1993, to Surry Nuclear Power Station from Dresser-Rand Steam Turbines, nuclear plant experience with corrosion-related valve stem binding was discussed. The letter stated that eight plants had reported governor valve stem binding problems. Dresser-Rand stated that Terry model ZS and GS turbines using two and one half-inch veeport and three-inch venturi governor valves with 410 stainless steel stems and carbon packing rings were subject to this phenomena. The letter also stated that the environment of the governor valve was critical and that a dry environment for stem and packing assembly was desired when the equipment was not operating. When unable to assure a dry environment the letter recommended using a chrome plated stem. However, in conversation with the staff, the Dresser-Rand Steam Turbines representative indicated that the new stems may also be subject to binding.

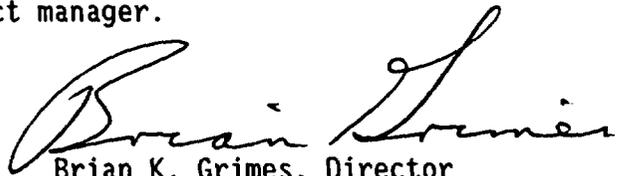
The root cause for the formation of deposits and corrosion on the governor valve stems is under review by several licensees, Dresser-Rand Steam Turbines, and the EPRI Terry Turbine Users Group. Until a root cause is determined, some licensees have elected to perform more frequent operational checks or inspections of the stem and packing. At Surry Power Station, a maintenance procedure to stroke the governor valve stem is performed weekly at Unit 2 and every few days at Unit 1. In addition, the speed of the turbine and the initial movement of the governor valve stem are correlated during monthly surveillance testing. Trending has identified that turbine speed at initial governor valve stem movement increases as the deposits on the stem are formed. Also, the governor valve packing drain line at Surry is periodically removed and the area of the stem inside the governor valve bonnet is inspected for corrosion and deposit buildup with mirror/flashlight and mini-camera.

Related Generic Communications

Turbine-driven pump overspeed trip events attributed to various causes are described in the following information notices:

- ° NRC Information Notice 93-51, Repetitive Overspeed Tripping of Turbine-Driven Auxiliary Feedwater Pumps.
- ° NRC Information Notice 90-45, Overspeed of the Turbine-Driven Auxiliary Feedwater Pumps and Overpressurization of the Associated Piping Systems.
- ° NRC Information Notice 88-67, PWR Auxiliary Feedwater Pump Turbine Overspeed Trip Failure.
- ° IE Information Notice 86-14, Supplement 1, Overspeed Trips of AFW, HPCI, and RCIC Turbines.

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 project manager.



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

Technical contacts:	M. Branch, RII (804) 357-2101	G. Hornseth, NRR (301) 504-2756
	S. Tingen, RII (804) 357-2101	F. Grubelich, NRR (301) 504-2784

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
94-65	Potential Errors in Manual Brachytherapy Dose Calculations Generated Using a Computerized Treatment Planning System	09/12/94	All U.S. Nuclear Regulatory Commission medical licensees.
94-64	Reactivity Insertion Transient and Accident Limits for High Burnup Fuel	08/31/94	All holders of OLs or CPs for nuclear power reactors and all fuel fabrication licensees.
94-63	Boric Acid Corrosion of Charging Pump Casing Caused by Cladding Cracks	08/30/94	All holders of OLs or CPs for pressurized water reactors.
94-62	Operational Experience on Steam Generator Tube Leaks and Tube Ruptures	08/30/94	All holders of OLs or CPs for pressurized water reactors.
94-61	Corrosion of William Powell Gate Valve Disc Holders	08/25/94	All holders of OLs or CPs for nuclear power reactors.
94-60	Potential Overpressurization of Main Steam System	08/22/94	All holders of OLs or CPs for pressurized-water reactors.
94-30, Supp. 1	Leaking Shutdown Cooling Isolation Valves at Cooper Nuclear Station	08/19/94	All holders of OLs or CPs for nuclear power reactors.
94-59	Accelerated Dealloying of Cast Aluminum-Bronze Valves Caused by Microbiologically Induced Corrosion	08/17/94	All holders of OLs or CPs for nuclear power reactors.
94-58	Reactor Coolant Pump Lube Oil Fire	08/16/94	All holders of OLs or CPs for pressurized water reactors.

OL = Operating License
 CP = Construction Permit

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Original signed by
 Brian K. Grimes
 Brian K. Grimes
 Director
 Division of Operating Reactor Support
 Office of Nuclear Reactor Regulation

Technical contacts: M. Branch, RII (804) 357-2101 G. Hornseth, NRR (301) 504-2756
 S. Tingen, RII (804) 357-2101 F. Grubelich, NRR (301) 504-2784

Attachment:
 List of Recently Issued NRC Information Notices
 DOC NAME: 94-66.IN

OFFICE	EMEB:DE*	EMCB:DE*	EMEB:DE*	EMCB:DE*	DE:NRR*
NAME	FGrubelich	GHornseth	RWessman	JStrosnider	BSheron
DATE	09/16/94	09/16/94	09/16/94	09/16/94	09/16/94
OFFICE	TECH ED*	OEAB:DORS	OGCB:DORS	OSCB:DORS	DORS:NRR
NAME		AChafee	TJKim	EDoorittle	BGrimes
DATE	09/15/94	09/ /94	09/ /94	09/ /94	09/19/94

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NAME	FGrubelich	GHornseth	RWessman	JStrosnider	BShelton
DATE	09/16/94	09/16/94	09/16/94	09/16/94	09/16/94

OFFICE	TECH ED*	OEAB:DORS	OGCB:DORS	OGCB:DORS	DORS:NRR
NAME		AChaffee	TJKim	EDoolittle	BGrimes
DATE	09/15/94	09/ /94	09/ /94	09/ /94	09/ /94