

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

February 8, 1994

NRC INFORMATION NOTICE 94-11: TURBINE OVERSPEED AND REACTOR COOLDOWN
DURING SHUTDOWN EVOLUTION

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 event involving the spurious opening of turbine governor and stop valves and resultant turbine overspeed and reactor coolant system cooldown due to a malfunctioning control system during a shutdown evolution. 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 12, 1992, the Diablo Canyon Power Plant, Unit 1, was in Mode 2 at 0 percent power. The Pacific Gas and Electric Company (the licensee) was shutting down the reactor for a refueling outage. The main turbine had been manually tripped and removed from service. The unit was subcritical, with bank "D" control rods fully inserted and bank "C" rods at approximately 50 steps. To prevent excessive reactor coolant system cooldown, an operator was dispatched to re-latch the main turbine. This causes the stop valve trip pilot valves to close which isolates a main steam leakage path to the condenser. However with the re-latching of the main turbine, the turbine speed rapidly increased from about 1100 rpm to 1870 rpm; reactor coolant temperature decreased from 284°C [543°F] to 279°C [535°F]; and the intermediate range nuclear instrumentation indication increased from 1.9×10^{-9} amps to 2.2×10^{-9} amps. At the governor valve overspeed setpoint of 103 percent (1854 rpm), the governor valves began to close. In response to these indications, the operators again tripped the main turbine. The operators observed that reactor coolant system temperature continued to decrease and tripped the reactor to prevent an inadvertent return to criticality from the cooldown.

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Discussion

During reactor operations at Diablo Canyon, turbine speed is regulated by the positions of four governor valves (see Attachment 1) which are controlled by the P2000 computer. When the turbine is tripped, pressure switch PS-22B (Low Auto Stop Oil Pressure) is designed to provide a contact closure signal to the P2000 computer. This signal is used by the P2000 computer to reset the main turbine speed reference signal to 0 rpm. To prevent excessive cooldown following a plant shutdown, the licensee re-latches the main turbine while the stop valve equalizing valves are closed. Re-latching the turbine in this manner closes the stop valve trip pilot valves, which isolates a steam leakage path to the condenser.

During this event, PS-22B failed to close due to corrosion of internal switch components. The failure of PS-22B allowed the P2000 main turbine speed reference signal to remain at 1800 rpm. As the main turbine deviated from 1800 rpm during coastdown, the P2000 speed controller integrated the deviation which resulted in a maximum speed-increase demand signal. Upon re-latching the main turbine, governor valve FCV-141 responded to the P2000 demand signal and opened in an attempt to return main turbine speed to 1800 rpm. The main turbine accelerated rapidly to 103 percent (1854 rpm), at which point the governor valve overspeed system closed the governor valves. At approximately the same time that the governor valves began to close, the licensee tripped the turbine. The maximum speed attained of 1870 rpm was below the main turbine overspeed trip setpoint of 1980 rpm. The turbine trip system remained operable throughout the event.

The mechanical components of PS-22B include a plunger rod, a bushing, and a case. The plunger rod was fabricated of austenitic stainless steel, and the bushing and case were fabricated of aluminum. These two materials are far apart on the galvanic series. The resulting potential difference could result in the formation of a galvanic cell, creating aluminum oxide buildup between the plunger and the bushing. Corrosion product buildup, combined with a static pressure system, is believed to have caused PS-22B to stick.

A similar event occurred at the James A. Fitzpatrick Nuclear Power Plant. On December 28, 1992, during a refueling outage, the main turbine stop valves spuriously opened when the main turbine trip system was reset. Testing of the turbine electro-hydraulic control system revealed a failed Agastat time delay relay in the primary trip/reset logic circuitry. The time delay relay allows the turbine to be reset without opening the main turbine stop valves. This failure of the relay allowed the electro-hydraulic control system speed circuit to change from 0 rpm to 1800 rpm spontaneously, creating a demand signal to open the main turbine stop valves. In this event, the main steam isolation valves closed, which prevented an actual turbine overspeed.

The events discussed above are examples of how turbine control system failures can result in unanticipated challenges to turbine overspeed protection systems during all modes of operation.

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

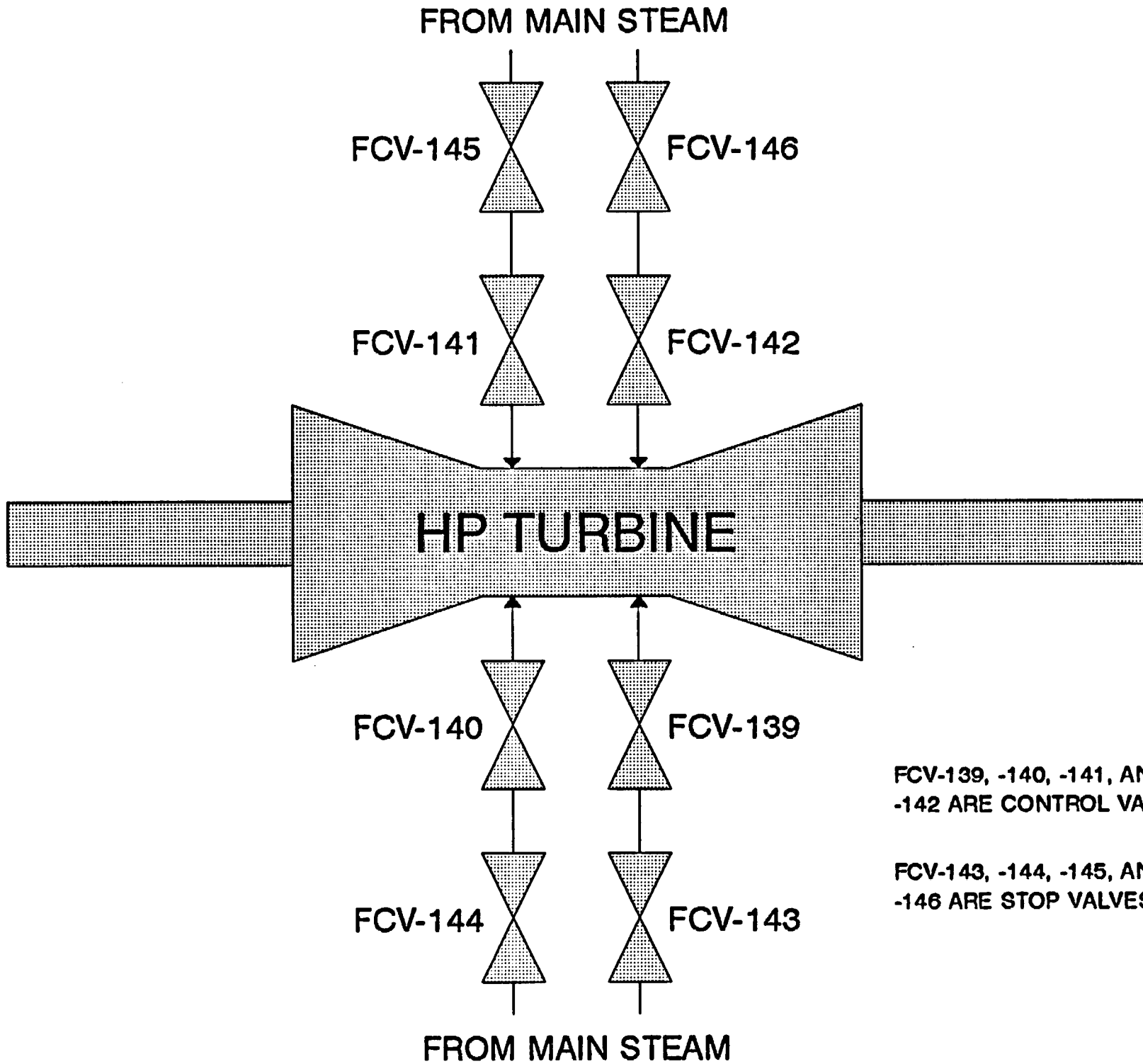


Brian K. Grimes, Director
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contact: Eric J. Benner, NRR
(301) 504-1171

Attachments:

1. Main Steam Stop and Governor Valves
2. List of Recently Issued NRC Information Notices



FCV-139, -140, -141, AND
-142 ARE CONTROL VALVES

FCV-143, -144, -145, AND
-146 ARE STOP VALVES

LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-10	Failure of Motor-Operated Valve Electric Power Train due to Sheared or Dislodged Motor Pinion Gear Key	02/04/94	All holders of OLs or CPs for nuclear power reactors.
94-09	Release of Patients with Residual Radioactivity from Medical Treatment and Control of Areas due to Presence of Patients Containing Radioactivity Following Implementation of Revised 10 CFR Part 20	02/03/94	All U.S. Nuclear Regulatory Commission medical licensees.
94-08	Potential for Surveillance Testing to Fail to Detect an Inoperable Main Steam Isolation Valve	01/01/94	All holders of OLs or CPs for nuclear power reactors.
93-26, Supp. 1	Grease Solidification Causes Molded-Case Circuit Breaker Failure to Close	01/31/94	All holders of OLs or CPs for nuclear power reactors.
94-07	Solubility Criteria for Liquid Effluent Releases to Sanitary Sewerage Under the Revised 10 CFR Part 20	01/28/94	All byproduct material and fuel cycle licensees with the exception of licensees authorized solely for sealed sources.
94-06	Potential Failure of Long-Term Emergency Nitrogen Supply for the Automatic Depressurization System Valves	01/28/94	All holders of OLs or CPs for boiling water reactors.
93-85, Rev. 1	Problems with X-Relays in DB- and DHP-Type Circuit Breakers Manufactured by Westinghouse	01/20/94	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
 CP = Construction Permit

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Original signed by
Brian K. Grimes

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Office of Nuclear Reactor Regulation

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*See previous concurrences

OFC	OEAB:DORS	SC/OEAB:DORS	PUB:ADM	C/OEAB:DORS
NAME	EBenner*	EGoodwin*	Tech Ed*	AChaffee*
DATE	03/01/93	03/05/93	03/02/93	03/31/93

OFC	OGCB:DORS	C/OGCB:DORS	D/DORS
NAME	DKirkpatrick*	GMarcus*	BGrimes
DATE	04/08/93	04/09/93	02/3/94

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OFC	C/OGCB:DORS	D/DORS
NAME	GMarcus <i>GMM</i>	BGrimes
DATE	4/9/93	1 / 93

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OEAB:DORS*
EBenner
3/1/93

RAB for
SC/OEAB:DORS
EGoodwin
3/5/93

PUB:ADM*
Tech Ed
3/2/93

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C/OEAB:DORS
AChaffee
3/31/93

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GMarcus
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D/DORS
BGrimes
/ /93

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Tech Ed *JM* AChaffee
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