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

May 13, 1992

NRC INFORMATION NOTICE 92-39: UNPLANNED RETURN TO CRITICALITY DURING REACTOR SHUTDOWN

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 events involving unplanned returns to criticality caused by the cooldown of the reactor coolant system during reactor shutdowns. 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

The licensees for the following plants recently experienced unplanned criticalities during reactor shutdowns: the Monticello Nuclear Generating Plant, the Big Rock Point Nuclear Plant, and the Grand Gulf Nuclear Station.

Monticello

On June 6, 1991, an unplanned criticality occurred at the Monticello Nuclear Generating Plant during a reactor shutdown when an unanticipated cooldown occurred in conjunction with rod insertion. The licensee initiated this shutdown to repair a leaking safety-relief valve shortly after the plant was returning to power following a refueling outage.

Since this shutdown occurred shortly after the cycle startup, the reactor did not generate sufficient decay heat to produce the steam needed to supply the normal steam system loads and still maintain pressure in the reactor. As control rods were being inserted using notch insertion, the reactor coolant system pressure and temperature began to decrease. As long as the operator continued to insert control rods, the reactor remained subcritical. However, when the operator stopped inserting control rods to review and evaluate plant conditions, the cooldown continued, adding sufficient reactivity to overcome the negative reactivity from the insertion of control rods and causing the reactor power to increase. The reactor power continued to

increase until an intermediate-range monitor (IRM) tripped on a high-high flux setpoint, causing a reactor scram.

Further details of the event may be found in Licensee Event Report 50-263/91-15 or NRC Inspection Report 50-263/91-13.

Big Rock Point

On November 30, 1991, an unplanned criticality occurred at the Big Rock Point Nuclear Plant during a reactor shutdown when a cooldown occurred in conjunction with a rod insertion. The event occurred during a scheduled shutdown for a refueling outage.

After taking the main turbine off line and bringing the reactor to a subcritical condition, the licensee delayed actions to continue inserting control rods while changing shifts. However, the reactor coolant system continued to cool down because the normal steam system loads were removing heat. The cooldown added sufficient reactivity to eventually overcome the effects of the control rods, and the reactor returned critical. The operators noticed the condition in approximately 2 minutes and took the appropriate actions to return the reactor subcritical.

Further details of the event may be found in Licensee Event Report 50-155/91-009 or NRC Inspection Report 50-155/91-25.

Grand Gulf

On December 30, 1991, an unplanned criticality occurred at the Grand Gulf Nuclear Station during a reactor shutdown when a cooldown occurred in conjunction with a rod insertion. The event occurred during a scheduled shutdown for a maintenance outage to replace a recirculation pump shaft. To minimize the release of plated-out radioactive material from the fuel cladding and channels to the reactor coolant system, a slow power reduction and a slow cooldown were prescribed for this shutdown.

The slow power reduction and the effects of an earlier outage minimized reactor decay heat and xenon peaking. The operators were driving rods into the core individually because gang drive for the control rods was unavailable. This made the reactivity insertion slower than normal. The operators inserted rods to reduce flux to range 3 on the IRMs and stopped rod insertion in order to perform a source range monitor surveillance. Indicated power reached IRM range 1. However, the reactor coolant system continued to cool down because the normal steam system loads were removing heat. In order not to affect the source range monitor surveillance, the shift supervisor elected to not insert control rods and alerted the operators to the possibility of a return to criticality as the cooldown continued. The reactivity added by the cooldown eventually overcame the effects of the control rods. The reactor returned to a critical condition, and reactor power increased on a reactor period between 300 to 800 seconds. The operators, having been trained on a similar event at another BWR, were monitoring the condition and expected the power to increase to the point of adding heat, where the fuel and moderator temperature coefficients would halt the reactor power increase. As the power increased, the

reactor operator ranged the IRMs to prevent a reactor scram. Power level remained on scale. The power increase was terminated with the IRMs reading on range 7 and 8. The operators completed the source range monitor surveillance, then resumed inserting rods and successfully completed the shutdown.

Further details of the event may be found in NRC Inspection Report 50-416/92-04 and Licensee Event Report 50-416/91-16.

Discussion

The underlying principle of reactivity management is to maintain the reactor in the desired condition by properly anticipating, controlling, and responding to the plant's changing parameters. The experience at Monticello, Big Rock Point, and Grand Gulf indicates that shutdowns in situations with low decay heat present a unique challenge to reactivity control if inadvertent recriticality is to be prevented. These events emphasize the importance of the operator giving continuous attention to plant parameters during a shutdown. Further, accepting recriticality without prior management approval and procedures, i.e., an ad-hoc approach, raises concerns due to the lack of opportunity for contingency planning.

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.

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

Technical contacts: Melvyn Leach, RIII
(708) 790-5559

Geoffrey Wright, RIII
(708) 790-5695

Paul O'Connor, NRR
(301) 504-1307

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
92-38	Implementation Date for the Revision to the EPA Manual of Protective Action Guides and Protective Actions for Nuclear Incidents	05/12/92	All holders of OLs or CPs for nuclear power reactors, non-power reactors and materials licensees authorized to possess large quantities of radioactive material.
92-37	Implementation of the Deliberate Misconduct Rule	05/08/92	All Nuclear Regulatory Commission Licensees.
92-16, Supp. 1	Loss of Flow from the Residual Heat Removal Pump during Refueling Cavity Draindown	05/07/92	All holders of OLs or CPs for nuclear power reactors.
92-36	Intersystem LOCA Outside Containment	05/07/92	All holders of OLs or CPs for nuclear power reactors.
92-35	Higher Than Predicted Erosion/Corrosion in Unisolable Reactor Coolant Pressure Boundary Piping Inside Containment at A Boiling Water Reactor	05/06/92	All holders of OLs or CPs for nuclear power reactors.
92-34	New Exposure Limits for Airborne Uranium and Thorium	05/06/92	All licensees whose operations can cause airborne concentrations of uranium and thorium.
92-33	Increased Instrument Response Time When Pressure Dampening Devices are Installed	04/30/92	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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Original Signed by
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*SEE PREVIOUS CONCURRENCE

OFC	RIII	ADR4-5:PD4-1	SC:DOEA:OEAB	ADM:RPB	C:DST:SRXB	C:DOEA:OEAB
NAME	GWright*	PO'Connor*	RDennig*	JMain*	RJones*	AChaffee*
DATE	03/11/92	03/17/92	03/11/92	03/11/92	03/13/92	04/13/92

OFC	C:DOEA:OGCB	D:DOEA
NAME	CBerlinger*	CRossi
DATE	04/21/92	05/7/92

DOCUMENT NAME: IN 92-39

Further details of the event may be found in NRC Inspection Report 50-416/92-04 and Licensee Event Report 50-416/91-16.

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The underlying principle of reactivity management is to maintain the reactor in the desired condition by properly anticipating, controlling, and responding to the plant's changing parameters. Once a reactor has been placed in a subcritical condition during a plant shutdown, it is of primary importance that the reactor be maintained in that subcritical condition. Raising the range of the IRMs in the event of recriticality can be inappropriate if the licensed operators do not have management's oversight, training, and specific procedures for this.

The experience at Grand Gulf and Monticello indicate that slow shutdowns in situations with low decay heat present a unique challenge to reactivity control and require the operator and management to give careful attention to avoid recriticality. The events at Monticello and Big Rock Point also highlight the importance of the operator giving continuous attention to plant parameters during a shutdown.

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E. Rossi obtained comments from Jon Johnson in RII on 4/16/92

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The experience at Grand Gulf and Monticello indicate that slow shutdowns in situations with low decay heat present a particular challenge to reactivity

control, and require heightened operator and management awareness to avoid recriticality. In addition, the events at Monticello and Big Rock Point highlight the importance of continuous operator attention to plant parameters in the course of a shutdown.

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