



UNIVERSITY OF MISSOURI-COLUMBIA

Research Reactor Facility

Research Park
Columbia, Missouri 65211
Telephone (314) 882-4211
FAX (314) 882-3443

December 2, 1992

Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D.C. 20555

REFERENCE: Docket 50-186
University of Missouri Research Reactor
License R-103

SUBJECT: Report as required by Technical Specification 6.1.h(2) concerning
reactor operation with the regulating blade inoperative.

Description:

At 1316 on November 4, 1992, with the reactor operating at full power in the automatic mode, a CHANNEL 4, 5 or 6 (power ranges) 95% DOWNSCALE annunciator was received. The annunciation locked in and then cleared several times. Immediate investigation revealed the regulating blade drive was not operating properly. The reactor was shutdown by manual scram at 1320.

Preceding the failure, the reactor had been in continuous full power operation with the regulating blade properly maintaining power in automatic control for a period of 41 hours 51 minutes since the scheduled maintenance day on November 2, 1992. The operability prior to the failure was verified by review of Operations logs and the wide range and power range chart indications. The regulating blade drive was verified inoperable by the duty operator manually attempting to shim the regulating blade while the regulating blade drive was monitored by another operator and the duty electronics technician. The reactor was shutdown by manual scram to be in accordance with Technical Specification 3.2.a. which states, "all control blades, including the regulating blade, shall be operable during reactor operation."

Analysis:

The regulating blade controls reactor power at a desired level set by the duty operator (normally 10 MW). The blade is constructed of stainless steel and is driven at 40 inches per minute by the regulating drive mechanism. The regulating drive mechanism consists of a drive servomotor, gear box assembly, and a ball/lead screw arrangement to translate the rotary motion of the motor and gear box to the linear motion of the regulating blade.



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In the automatic mode, the regulating blade controls reactor power by comparing the output of the wide range monitor (channel 4) with the setting provided by the power schedule potentiometer. Any difference between the wide range monitor indication and the potentiometer setting creates a drive signal to the regulating blade drive mechanism. The blade frequently shims to make minor adjustments to maintain power at the desired level in automatic control.

At 1316, November 4, 1992, with the reactor operating at full power in automatic control a CHANNEL 4, 5 or 6 95% DOWNSCALE annunciator was received. The annunciation locked in and cleared several times. Immediate inspection of all 3 (three) power range charts indicated an actual power decrease for 3-4 minutes preceding the annunciation. The regulating blade was still in auto at this time. The duty operator then switched the regulating blade control to manual and attempted to shim the blade manually in, then out. Indication did not change. While the duty operator attempted to shim the regulating blade manually, the drive was being inspected by other operators. The regulating blade drive motor was responding but the drive itself did not appear to be operating. The reactor was shutdown by manual scram at 1320 to repair the regulating blade drive mechanism.

The electronics technicians who assisted in investigating the regulating blade drive mechanism failure determined that the set screw that engages the motor shaft to the gearbox had come loose such that the motor was operating, but was not driving the gearbox. They then attempted to tighten the screws with the drive motor in place, but were unable to do so satisfactorily.

The regulating blade drive was removed and the drive repaired by filing a flat on the motor shaft to provide a better seating surface for the set screw, and the set screw was reinstalled with Loctite. The drive was reinstalled and tested satisfactorily over its full range of travel.

Subsequent review of the wide range and power range charts indicated that the reactor operated for a total of 7 to 8 minutes with the regulating blade mechanism inoperable. Reactor operation during this time deviates from Technical Specification 3.2.a. which states, "all control blades, including the regulating blade, shall be operable during reactor operation."

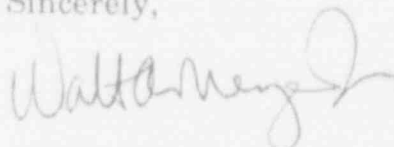
With the regulating blade mechanism inoperable, the rod run-ins associated with the regulating blade (REG ROD < 10% or BOTTOMED) would have been inoperable. This deviates from Technical Specification 3.4.c. which states, "The reactor shall not be operated unless the following rod run-in functions are operable...Regulating Blade Position < 10% withdrawn and bottomed."

The regulating blade and its associated rod run-in features are not part of the reactor safety system as defined in Technical Specification 1.18. When a reactor scram or rod run-in occurs, the regulating blade is automatically shifted to manual control to prevent it from trying to maintain power by shimming. The basis for the rod run-ins associated with the regulating blade is to assure termination of a transient which, in automatic operation, is causing a rapid insertion of the regulating blade.

Corrective Action:

The reactor was shutdown by manual scram when it was determined that the regulating blade drive mechanism was not operable. The motor shaft, which had no flat for positive set screw engagement, was modified to add a flat surface. The set screw was reinstalled with Loctite to reduce the potential for the set screw to become loose. After reassembly, the operability of the regulating blade and associated rod run-ins and indication was verified.

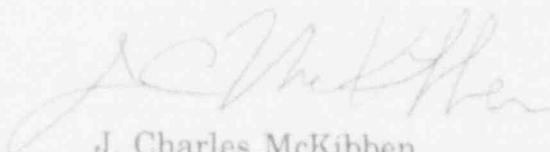
Sincerely,



Walter A. Meyer, Jr.
Reactor Manager

ENDORSEMENT:

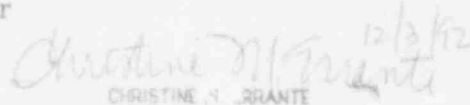
Reviewed and Approved



J. Charles McKibben
Associate Director

WAM:bjb

xc: Regional Administrator, NRC, Region III
Reactor Advisory Committee
Reactor Safety Subcommittee


CHRISTINE M. BRANTE
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