UNIVERSITY OF MISSOURI-COLUMBIA

Research Reactor Center

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

January 26, 1996

Director of Nuclear Reactor Regulation
ATTN: Document Control Desk
Mail Station P1-37
U.S. Nuclear Regulatory Commission
Washington, DC 20555

REFERENCE: Docket No. 50-186
University of Missouri Research Reactor
License R-103

SUBJECT: Report as required by T.S. 6.1.h.(2) regarding reactor operation with the regulating blade in a degraded condition

DESCRIPTION

On December 27, 1995, at 1748 a reactor shutdown was commenced by manual rod run-in to investigate a suspected problem with the regulating blade drive mechanism. A senior operator, performing a sample evolution on the reactor bridge, suspected a problem when he detected an audible difference in the sound of the regulating blade drive mechanism when it operated. The Channel 4 (WRM) chart recorder indicated the regulating blade was maintaining reactor power level within its normal range.

The reactor was shut down because Technical Specification 3.2.a. states, ". . . all control blades, including the regulating blade, shall be operable during reactor operation." The T.S. 1.12 definition of operable states a ". . . system or component is operable when it is capable of performing its intended function in a normal manner."

After the reactor was shut down, the regulating blade was exercised in the "manual" mode. The regulating blade appeared to drive in normally, but was noisy and slower than normal when driving out.

An electronics technician was called to investigate the problem with the regulating blade. After disassembly of the regulating blade drive motor and gearbox assembly, the electronics technician found that the dowel pin had failed in the gearbox coupling to the drive motor. This resulted in a friction fit between the gearbox input shaft and the gearbox coupling that allowed the shaft to slip in the coupling when the regulating blade was driven out.

The dowel pin was replaced in the gearbox coupling and the gearbox input shaft bearing was replaced. The regulating blade drive was installed and the compliance check (CP-14) was completed to demonstrate its operability. This check included drive speed in both "in" and "out" direction and assured that alarms and rod run-ins associated with the regulating blade were actuating at the expected rod height.

IE22
1/1

The reactor was refueled and returned to operation at 2331 the same day. We estimate that the reactor may have operated five minutes with the regulating blade drive in a degraded condition prior to commencing reactor shutdown.

ANALYSIS

The regulating blade system is used to automatically control reactor power at a desired power level (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, gearbox assembly, and a ball/lead screw arrangement to translate the rotary motion of the motor and gearbox to the linear motion of the regulating blade.

In the automatic mode, the regulating blade controls reactor power by comparing the output of the Wide Range Monitor (Channel 4) with the level on the power schedule potentiometer set by the reactor operator. 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.

The rod run-ins associated with the regulating blade (< 10% withdrawn and rod bottomed) were operable during the short time the reactor operated with the regulating blade drive in a degraded condition, because the regulating blade demonstrated it was capable of driving in without slipping. Any up power excursion would have resulted in the regulating blade driving in at the normal rate to compensate. This was further verified by reviewing the Channel 4 (Wide Range Monitor) charts which indicated that the regulating blade was maintaining reactor power within its normal range.

Even though the regulating blade drive in its degraded condition could not meet the strict definition of "operable" in T.S. 1.12 definition, it was capable of meeting the basis for T.S. 3.2.a. which is to ". . . ensure that the normal method of reactivity control is used during reactor operation." The regulating blade could drive in at normal speed, but had a slower positive reactivity insertion rate while driving out. When the regulating blade drive was suspected to have a problem the reactor was shut down to investigate.

Subsequent investigation by the Electronics Shop indicated that the dowel pin for the gearbox input coupling was missing and had presumably broken shortly before the operator detected an audible difference in the regulating blade drive. The dowel pin and input shaft bearing were replaced, the mechanism tested, and compliance checks relevant to the regulating blade rod run-ins were completed. Review of Electronics Shop maintenance logs indicate no previous failure of this coupling pin which was part of original design.

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. The total reactivity worth of the regulating blade is 0.0017 Δk and is not considered in any safety analysis to contribute to the reactor shutdown margin of at least 0.02 Δk with any one shim blade fully withdrawn(T.S. 3.1.e). 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 rod run-ins associated with the regulating blade is to ensure termination of a transient which, in automatic operation, is causing a rapid insertion of the regulating blade.

While evaluating the safety significance of this event, we recognized that our Limiting Conditions for Operation for regulating blade operability in MURR Technical Specifications do not include Action requirements (similar to Specification 3.0.2 of power plant Standard Technical Specifications) that would allow implementation of an Action requirement (in this case, a prompt shutdown) within a specified time interval as constituting compliance with the specification. Technically, the second the regulating blade drive is found to be in a degraded condition we are in non-compliance with Technical Specifications.

The University of Missouri Research Reactor management is developing a safety analysis to support a request for a Technical Specification revision that would allow a timely reactor shutdown as an action statement for a failure of the regulating blade. This is consistent with ANSI standards ANS-15.1, Development of Technical Specifications for Research Reactors and ANS-15.18, Administrative Control for Research Reactors where special reports would not be required when a research reactor momentarily operates outside the limiting conditions for operation if prompt remedial action is taken (e.g., a reactor shutdown). This would alleviate the generation of a Licensee Event Report for conditions which do not pose a safety concern for the reactor or the public.

CORRECTIVE ACTION

The control room operator commenced a reactor shutdown to investigate a suspected problem with the regulating blade drive within minutes of the report from an operator on the reactor bridge that the regulating blade drive sounded different.

A failure of this dowel pin in the gearbox coupling was the first in twenty-seven years of operation. The pin was replaced by an equivalent dowel pin. No additional long-term corrective action specific to this failure is planned. The regulating blade drive motor and gearbox are already on a six month preventive maintenance schedule which includes an inspection of all set screws and pins.

Sincerely,

Walt A. Meyer Jr.
Reactor Manager

ENDORSEMENT:
Reviewed and Approved

J. Charles McKibben
Associate Director

Attachment: Figure 1

xc: Mr. Alexander Adams, Jr., USNRC
Regional Administrator, NRC, Region III
Dr. John P. McCormick, Interim Vice Provost for Research
and Graduate School Dean, UMC
Reactor Advisory Committee
Reactor Safety Subcommittee

Christine M. Errante 1/26/96

CHRISTINE M. ERRANTE
Notary Public - Notary Seal
STATE OF MISSOURI
Boone County
My Commission Expires: April 14 1999

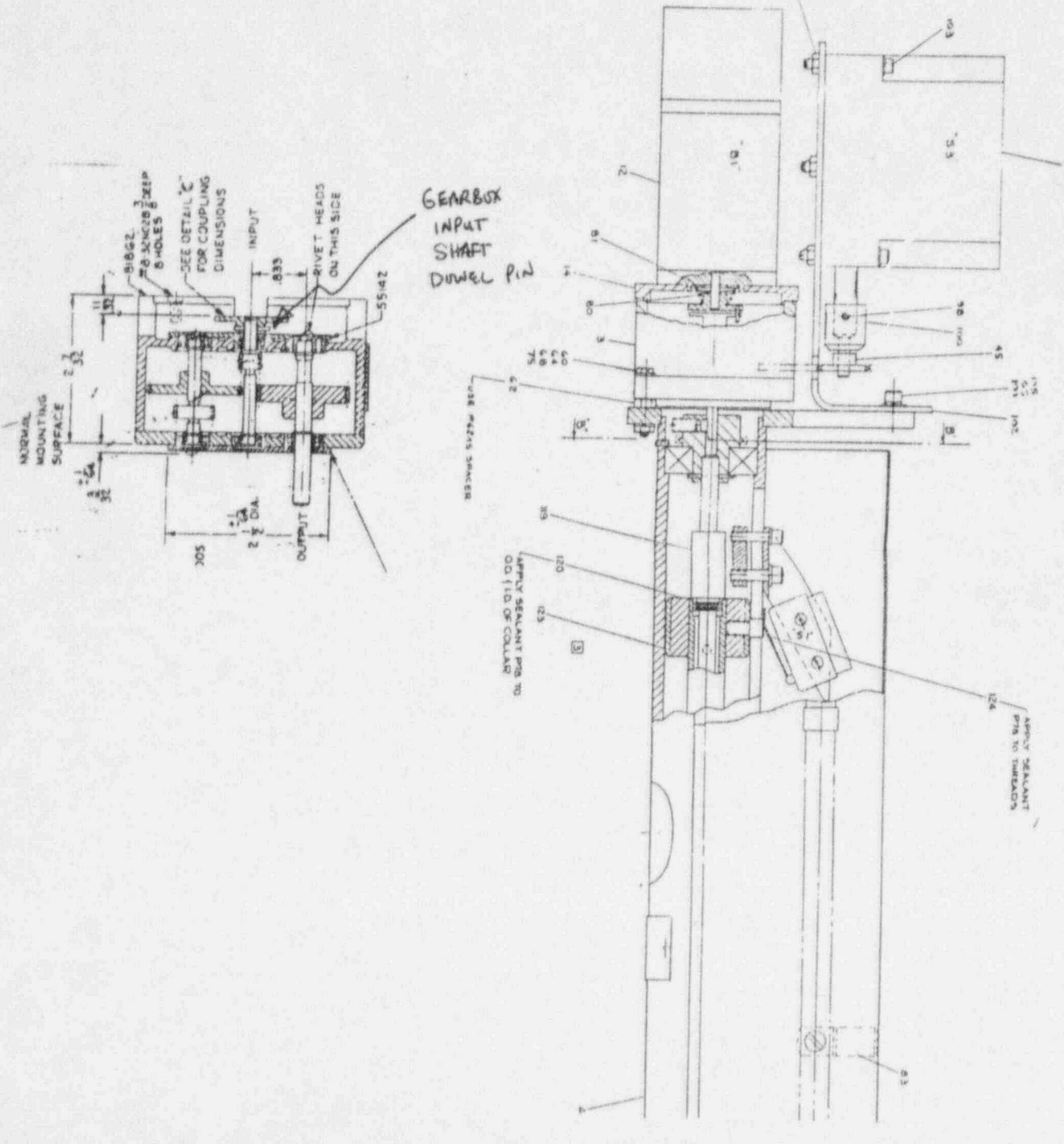
GEARBOX INPUT SHAFT DOWEL PIN
NORMAL MOUNTING SURFACE
SEE DETAIL "C" FOR COUPLING DIMENSIONS
INPUT
OUTPUT
RIVET HEADS ON THIS SIDE
APPLY SEALANT P78 TO O.D. & I.D. OF COLLAR
APPLY SEALANT P78 TO THREADS

FIGURE 1