UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

December 5, 2011

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Subject: Report of NCNR Violation of Limiting Conditions of Operation (11/22/11)

Reference: Facility License TR-5
Docket No. 50-184
Event No. 47466

Dear Sir,

Attached is the written report of the circumstances, root cause, and corrective actions for the reported violation of TR-5 technical specification 3.4.1(2). This violation was initially reported verbally to the NRC Operations Center, Project Manager and assigned Inspector on November 22. The Chairman of the license Safety Evaluation Committee (SEC) was notified after the violation occurred and has reviewed this report. The full SEC will review the circumstances and the corrective action implementation at the next scheduled meeting.

We understand that our Inspector, Mr. Craig Bassett, will also review the circumstances of the violation during his next inspection. Please contact Dr. Sean O'Kelly, NCNR Deputy Director, at 301-975-6260 if you have questions or require additional information.

Sincerely,

Robert M. Dimeo

Robert M. Dimeo
Director, NIST Center for Neutron Research

cc: Xiaosong Yin, NRR/DPR/PRLB (12D20)
Craig Bassett, NRR/DPR/PROB (RGN II)
NCNR Docket File

Attachment: Report of Violation

A020
NRR

NIST

On November 21, at approximately 4:45 PM, the NCNR facility violated a Limiting Condition of Operation (LCO) of the TR-5 Technical Specifications (TS). An initial report was made to the NRC Operations Center at 2:43 PM on November 22. The initial written report of the incident was emailed to the TR-5 Project Manager and Inspector to confirm as required by TS 6.7.2 that the event as described under Event Number 47466 was correct as written. The initial report was made in accordance with 10CFR50.36 and TR-5 TS 6.7.2.

Circumstances of Violation

The four individual shim arm control switches on the reactor console were replaced with new switches during the week of November 14. The new switches had additional contacts that provided switch position information to the reactor console data acquisition system. When received, the replacement switches appeared to be incorrect because the switch cover plate was opposite the current switches (i.e. "withdraw" and "insert" were reversed in position). Continuity checks verifying this condition were not performed but technicians modified the internal components of the new switches to electrically correct the perceived condition and reverse the switch. The switches were installed by electronics technicians by moving individual wires from the old switches to the new switches directly without an intermediate full switch removal.

During a control room upgrade status meeting on November 21, it was noted that the change of the four shim arm switches had been completed, but that functional testing had not yet been completed. The Chief of Reactor Operations was informed of the need for retesting of the shim control switches and he directed the on-coming swing (3 to 11 PM) shift supervisor to "exercise" #1 shim control arm that evening and individually exercise each of the other three shim control arms each night for the next three swing shifts. "Exercise" as understood by the Shift Supervisor meant withdrawing the shim control arm to a full withdrawn position and then fully inserting the shim control arm with the reactor in "Rod Drop Test" mode. This particular operation was performed following the replacement of a shim control arm shaft seal (primary boundary) during the period of the current outage in which the core was fully unloaded.

For reactor maintenance, in order to withdraw a single shim control arm with active scram and rundown signals it is necessary to operate in the "Rod Drop Test" mode. Rod Drop Mode is defined in TS 1.3.24 as any combination of control systems and mechanical systems that allows for the movement of only a single shim arm and ensures the reactor remains shutdown, when sufficient fissile material for criticality is present. Operation of shim control arms in Rod Drop Test mode is an instance in which normal confinement requirements are not required. The Rod Drop Test is enabled by using two separate key switches (switches are in series) to energize an electrical bypass around the scram and rundown contacts. Separate contacts prohibit the movement of more than one shim control arm in Rod Drop Test mode. A rundown (insertion) of all shim control arms will occur if a shim control arm other than the one selected for testing is withdrawn in this mode.

When the operators turned both Rod Drop Test switches they received an immediate Rod Test On alarm on the console. This is not an expected indication. This indicated that the Rod

Withdrawal Prohibit and Rundown relays were not energized and no shim control arm could be withdrawn. In order to complete the requested evolution, the operators returned the Rod Test Mode switches to off. They then proceeded to clear all scrams and rundowns by running the primary coolant system (clears low flow scram) and simulating signals for thermal column flow, thermal shield flow, cold source pressure, and cold source flow using the reactor test panel. At this point the Startup Prohibit Relay was energized allowing all four shim control arms to be withdrawn.

The operators proceed to test #1 shim control arm switch but found that the rod did not move. The operators then proceeded to test all shim control arm switches individually. While testing #4 shim control arm switch in the insert position the shim arm was noted to move outward. The operator immediately stopped testing before the shim arm full inserted light cleared. The Shift Supervisor directed the reactor be manually scrammed and the testing was suspended.

It was noted the next day that reactor building did not have confinement during the time period that the shim control switches were being tested. Confinement as defined in the TR-5 Technical Specifications is

> an enclosure of the C wing of the NCNR that is designed to limit the release of effluents between the enclosure and its external environment through controlled or defined pathways.

Technical Specification 3.4.1 states:

> Confinement shall be maintained when:
>
> (1) The reactor is operating
> (2) Changes of components or equipment within the confines of the thermal shield, other than rod drop tests or movement of experiments, are being made which could cause a significant change in reactivity.
> (3) There is movement of irradiated fuel outside a sealed container or system.
> (4) The reactor has been shutdown for shorter than the time specified in the specification of Section 3.9.2.2.

With regard to 3.4.1(1), the definition of reactor operating is when it is not secured or shutdown. During the testing of the shim arm control switches the reactor was subcritical by at least one dollar and the reactor was in a shutdown condition as defined in the reactor license. The definition of Reactor Secured (TS 1.2.18(a)(1)) states the reactor is secured when:

> The Control Power key switch or the Rod Drive Power key switch is in the off position with the key removed and under the control of a licensed operator.

In order to perform the functional test of the shim control switches, the reactor operators placed the reactor in a condition that would allow more than one shim to be withdrawn. It was never the intention of the reactor operators to withdraw more than one shim control arm at a time for testing but the potential existed to add a significant amount of positive reactivity. This change of reactivity could have occurred by operator error or due to the rewiring of all four shim control switches. TS 3.4.2 *Equipment to Achieve Confinement* Section 3.4.2(5) requires that the reactor

building truck door remain closed and sealed for reactor confinement but it had been used frequently and was left open to allow passage of large items of equipment in the current extended maintenance outage. In addition, during this time, several confinement penetrations had been made due to on-going facility upgrades or maintenance and were not sealed or tested. Due to maintenance activities and contrary to TS 3.4.2, the building confinement was not established when the reactor was not secured with both the Rod Drive Power and Control Power key switches on, the reactor not in the Rod Drop Test mode and the potential for a significant change in reactor reactivity caused by maintenance and testing of the reactor control system.

The reactor ventilation system was operational at all times during the period that the maintenance on the rod control system occurred and the confinement building was maintained at a negative pressure relative to the building exterior. Testing in 2010 showed that the roll-up exterior truck door is sufficient to maintain a negative building pressure with the normal truck door fully open.

The on-shift operating crew and two other supervisory senior reactor operators had discussed the improper indications when the Rod Drop Test Mode was activated and, after approximately one-half hour, chose to enable the rod drive motors and magnets for further troubleshooting and to operate the shim switches. The operators had discussed not withdrawing the shim rods beyond the point of clearing the rod bottom indication lights and were prepared to scram the reactor if unusual reactor response was noted. Some operators felt that the reactor had been shutdown by sufficient margin to allow the testing and that TS 3.4.1 permitted the test because they did not intend to introduce significant reactivity into the reactor.

An evaluation of the control shim arm switches after the test failure found that the switches were correct as received and the modification by the electronics technicians reversed the switches incorrectly. Further, while connecting the wiring for the Shim #4 replacement switch, a wire was not connected to a terminal and this caused the Rod Test On alarm and prevented normal Rod Drop Test Mode (see attached schematic).

Root Cause of Violation

The root cause of the violation has been attributed to a failure to follow written procedures. Approved reactor operating procedures include a specific category of procedures related to requirements of the TR-5 Technical Specifications and these are called Technical Specification Procedures (T.S.P.). Two approved procedures apply to the use of the Rod Drop Test Mode:

1. T.S.P. 4.2.1(1) Withdrawal and Insertion Speed of Each Shim Arm
2. T.S.P. 4.2.1(2) Scram Time of Each Shim Arm's First 5 Degrees Drop

The initial conditions of the two procedures are identical:

A. The reactor secured, in the rod drop test mode (Rod Drive, Control Power and Rod Drop test keys in console), and a senior licensed operator in direct charge of the operation.
B. All rods at their lower limits.

The limitations and precautions sections of the two procedures are nearly identical but the applicable precautions are

- Withdraw only one shim at a time and observe nuclear instruments.
- Confinement integrity requirements of Technical Specifications 3.4 are satisfied.

During interviews of the operators in the control room at the time they noted that neither procedure was referenced during the evolution.

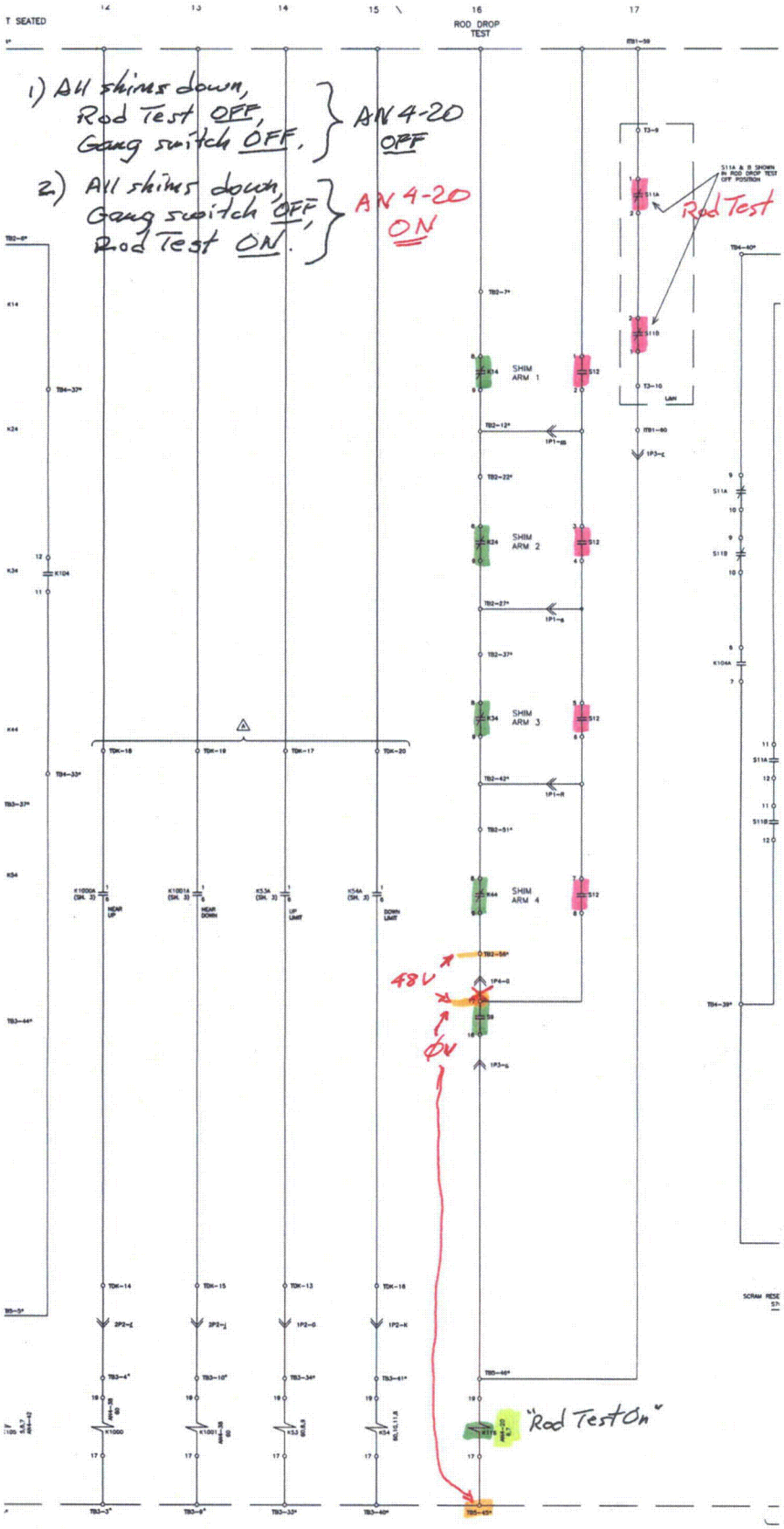
Corrective Actions

1. The ability of operators to bypass several rundowns simultaneously using the test panel will be permitted only using an approved procedure under circumstances in which the procedure applies unless direct authorization on a case-by-case basis is given by the Chief of Reactor Operations or the Chief of Reactor Operations and Engineering.

2. The Chief of Reactor Operations will immediately prepare a one-hour training seminar for all operators to discuss the circumstances of the violation, decision errors that occurred, maintaining a questioning attitude when performing any task or operation, and the requirement for all operators to follow approved procedures.

3. Technical Specification 3.4.1 and the basis for that specification will be evaluated for clarity and modified as necessary to correct any confusing language that may have led to the violation. In addition, during operator requalification training in January 2012, a review of the existing specifications (license reissued July 2009) to assure that all individuals fully understand the specifications as written. Any specification that is not absolutely clear to operators will be evaluated for possible changes.

4. A review of the use of the Rod Drop Test switch for testing other than rod tests will be performed.


1) All shims down, Rod Test OFF, Gang switch OFF. } AN 4-20 OFF
2) All shims down, Gang switch OFF, Rod Test ON. } AN 4-20 ON
Rod Test
48V
0V
"Rod Test On"
SHIM ARM 1
SHIM ARM 2
SHIM ARM 3
SHIM ARM 4
ROD DROP TEST