Unintentional high power scram event, 11/23/2022, at the University of New Mexico AGN-201M reactor (License 50-252)

Event Number EN56313

Description, Analysis, and Proposed Corrective Actions

Carl Willis (Chief Reactor Supervisor), Rowdy Davis (Reactor Supervisor)

1/18/2023

1. Event, and facility response

An unscheduled high power scram occurred at the UNM AGN-201M reactor on 11/23/2022 when a sample of iodized table salt, under irradiation as part of a standard experiment, was withdrawn from the reactor Glory Hole, causing an increase in power to the safety channel high power trip point of 6 W. Further details of this event were recorded in the reactor log at the time (Appendix A). The Senior Operator on duty called the Chief Reactor Supervisor immediately after the event and a memo was prepared by the Senior Operator on duty that was communicated to the Chief Reactor Supervisor on the same day (Appendix B). Times referenced in these documents are in Mountain Time.

The Chief Reactor Supervisor determined the event was a Reportable Event on 1/17/2023 and notified the NRC Project Manager and the NRC Operations Center on 1/18/2023 (notification time: 15:24 Eastern Time). The memo in Appendix B was transmitted to the NRC Operations Center (acknowledged received at 15:43 Eastern Time.

2. Analysis of event (per TS 6.9.2)

a. Background

The activity underway at the time of the event involved irradiation of one of a set of samples used annually for gamma spectrometric analysis by a laboratory class (NE-323L, “Radiation Detection and Measurement”). The operation was approved on a facility Request For Use and followed a standard experiment procedure. The facility was staffed appropriately for conduct of the experiment (one licensed RO, operating, assisted by one licensed SRO). The experiment is routine at the UNM AGN-201M facility, typically repeated a dozen or more times on an annual basis with various samples. Sections 2.b-2.d discuss the causes, consequences, corrective actions, and measures to prevent recurrence of the unscheduled scram as required by TS 6.9.2.

b. Causes

The proximate cause of the unscheduled high power scram was the removal of a sample with high negative reactivity from the reactor without adequate coordination between the Reactor Operator and the assisting Senior Operator. The Reactor Operator was unable to withdraw control rods rapidly enough to offset rising power when the sample was removed, and the 6 W setpoint was reached, causing the scram.

Facility staff did not report the unscheduled event promptly to the NRC due to confusion about the reportability of the high-power scram. Significant prior staff experience and the bulk of documentation in the Training and Operation Manual relate to high-power scrams that are not considered reportable.

c. Probable consequences

No significant consequences were observed or are anticipated. The reactor safety channels performed according to specification.

d. Corrective actions and measures to prevent recurrence

High-power safety channel scrams are avoidable if proper experimental technique is observed and the operator and assistant work in coordination. The operator is expected to anticipate the reactivity addition from removal of strongly absorbing samples by driving rods out toward the previously-logged empty critical position *before* the assistant withdraws the sample, or *while* the assistant *slowly* withdraws the sample. The assistant must communicate with the operator about the intent to withdraw the sample, and the operator is ultimately responsible for communicating permission to the assistant when ready—i.e., when the reactor control rods have been positioned to counteract the anticipated reactivity of the sample movement.

The staff will drill appropriate technique (see below for example) and distribute this document to cultivate awareness about the circumstances of the unscheduled high-power scram.

Below is an example of good technique and coordination, where operator verbalizes the expected rod movement to compensate for the sample movement, and where operator gives permission to the assistant to move the sample after making rod movements to compensate:

> *Assistant takes position at the Glory Hole to withdraw sample carrier.*
>
> *ASSISTANT: "Permission to withdraw the sample?"*
>
> *OPERATOR: "WAIT for my permission. FCR will be moved down 10 cm to compensate."*
>
> *ASSISTANT: "Standing by."*
>
> *Operator drives rod out toward previously-logged empty critical position.*
>
> OPERATOR: *"GO to withdraw."*
>
> *Assistant withdraws sample.*

Emphasis will be placed on the operator's responsibility to coordinate all actions that influence reactivity, by giving the orders to stand by or to withdraw the sample according to his/her readiness.

Licensed facility staff need to establish better delineation between unscheduled conditions that are Reportable Occurrences (TS 6.9.2.a.7) and the specific scenario discussed at some length in the Training and Operations Manual (D.5.b) in which a situationally-aware licensed operator allows a student authorized operator to let power rise to the safety channel high level limit, which is not considered reportable. Two conditions appear to be required to satisfy the non-reportable scenario identified in D.5.b of the Manual: (A) specific awareness of the licensed operator on duty of an impending high-level scram, and (B) a planned instructional purpose. These elements comprise a "scheduling" of the

condition in the sense applicable to TS 6.9.2.a.7. It is clear that the event under consideration here occurred without operator awareness and was part of a standard operation to support a laboratory course unrelated to reactor operations instruction. Clarifying language will be added to the Training and Operations Manual, at the beginning of Section D.5.b: *"Unscheduled high-power scrams are Reportable Occurrences and must be promptly reported to the NRC (TS 6.9.2.a.7). The only exception is discussed below."* This document will be circulated to all facility administrative and operating staff.

3. Facility documentation references

The Technical Specifications language (6.9.2.a.7) pertinent to the reportability of unscheduled safety channel scrams reads:

> *7. Unscheduled conditions arising from natural or manmade events that, as a direct result of the event, require reactor shutdown, operation of safety systems, or other protective measures required by Technical Specifications.*

The Training and Operations Manual context for unintentional safety channel scrams reads (D.5.b):

> *Sometime, during the course of an experiment or training, a student will let the power drift up to the 6 Watt limit, whereupon a reactor scram occurs. The RSAC decided that such an observed (by the reactor supervisor, but not by the student) unintentional Safety Channel scram is not a reportable event. It was pointed out that in these cases, the reactor supervisor could have kept the scram from occurring but allowed it to happen as part of the educational process for the student(s). In this sense, the scram becomes part of the learning process. Clearly, no Technical Specification is violated under such circumstances as long as a Safety Channel scram does occur and the Reactor Supervisor is aware of the situation, yet permits the scram to occur as part of the educational process. The student invariably gets the message "loud and clear." The RSAC agreed (May 2006) that such events during student training should be treated as observed unintentional scrams, permitted for education/training; thus, not reportable events.*

Appendix A. Reactor logbook entry.

Appendix III B

THE UNIVERSITY OF NEW MEXICO
AGN-201M REACTOR OPERATIONS LOG

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OPERATIONAL INFORMATION: Date 11/23/2022

OPERATOR Erik Boldt **SUPERVISOR** Randy Davis

AUTHORIZED EXPERIMENTS NE323L/523L Unknown Irradiation Experiment **RFU#** 651

AUTHORIZED CHANGES (loading, instruments, etc.): As noted in log

DATE LAST MONTHLY 10/26/2022 **GLORY HOLE LOADING** As noted in log

WATER TEMP. 19.0 **REMARKS** None

SUPERVISOR'S APPROVAL N/A
(SIGNATURE REQUIRED FOR NEW EXPERIMENTS)

PRECRITICAL START-UP CHECK-OUT

a. *Nearby personnel informed (Rad Safety informed if after normal hours)* ✓

b. *Radiation monitors operational* ✓

c. *Radiation Survey OK* ✓

d. Reactor Inspection:
- *Thermal column secured* ✓
- *Manhole cover secured* ✓
- *Shield doors in place* ✓
- *Check for water leaks* ✓
- *Stair gate locked, access alarm works* ✓
- *Cadmium in Glory Hole* ✓

e. TURN ON CONTROL PANEL POWER
DO NOT CONTINUE UNLESS BELL RINGS!

f. *Data Display on.* ✓

g. *Source drive operational* ✓

h. NIM bin & HVPS (1-2-3-Aux.) on ✓

i. Channel 1 instrument check:
- *Counts per minute* 136
- *Detector high voltage* 250 VDC
- *Amplifier gain:* *Fine* 7
- *Coarse* 4
- *Discriminator Level* 6
- *Automatic H V removal okay* ✓
- *Compare to previous conditions* ✓

j. Channel 2 instrument check:
- *Detector high voltage* 600 VDC
- *Low level INTERLOCK OK* ✓
- *High level SCRAM OK* ✓
- *Calibrate check @ $1x10^{-11}$ Amps* ✓
- *Calibrate check @ $5x10^{-7}$ Amps* ✓

k. Channel 3 instrument check:
- *Detector high voltage* 600 VDC
- *High level SCRAM OK* ✓
- *Calibrate check @ $1x10^{-11}$ Amps* ✓
- *Calibrate check @ $5x10^{-7}$ Amps* ✓

l. Magnet current check:
- *Magnet current level* 66 ma
- *Low current trip operational* ✓

m. *Safety Interlocks cleared* ✓

n. *Verification of Rod Interlocks* ✓

o. *Manual SCRAM operational* ✓

p. *Data Display operational* ✓

Precritical Start-up check-out completed ✓

Reactor Supervisor [signature]

Appendix III B

Date 11/23/2022 **Page** 2/ 3

Time of startup 12:00

Elapsed time meter 31.59 hours

Reactor Asst removed Cd from Glory Hole _____

Console radiation level 0.01 mR/hr

Control Rod Lower Limit Positions:

Fine rod 00.19 cm

Coarse rod 00.11 cm

Instrument Readings		
Channel	All Rods OUT	Safety Rods IN
1	167 CPM	424 CPM
2	$2.2 \cdot 10^{-11}$ Amps	$2.7 \cdot 10^{-11}$ Amps
3	$2.0 \cdot 10^{-12}$ Amps	$4.8 \cdot 10^{-12}$ Amps
Aux.	$2.5 \cdot 10^{-11}$ Amps	$6.3 \cdot 10^{-11}$ Amps
Previous Meter Readings Noted ✓		

Critical Readings

Time of day 12:13	Channel 2 $8.5 \cdot 10^{-7}$ Amps	Reactor Top 100 mR/hr
Elapsed time 35:12 Hours	Channel 3 $6.5 \cdot 10^{-8}$ Amps	Reactor Console 1.3 mR/hr
Power Level 4.02 Watts	Aux. Channel $9.0 \cdot 10^{-7}$ Amps	Check Pt. 3 25 mR/hr

OPERATIONAL DATA:

Time	Channel 3 Reading	Fine Rod Position	Coarse Rod Position	Comments (loading changes, power level, changes, scrams)
12:08	—	—	—	Source Rods Removed
12:13	$6.5 \cdot 10^{-8}$	08.88	22.50	Critical at 4.02 watts
12:22	—	—	—	Inserted iodized table salt
12:27	$6.5 \cdot 10^{-8}$	21.43	22.50	Critical at 3.99 watts
12:38	$6.4 \cdot 10^{-8}$	21.55	22.50	Critical at 3.98 watts

REACTOR SHUTDOWN:

Scram method High Power Trip

Time of day	13:10	Cadmium inserted in Glory Hole	✓
Elapsed time	36:18	Data Display off	
All rods down	✓	Console power off	✓
Startup source inserted	✓	Portable radiation monitors off	✓

Reactor Assistant

Erika R. Bolda
Licensed Reactor Operator

Authorized Operator

Reactor Supervisor

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Date 11/23/2022

OPERATIONAL DATA:

Time	Channel 3 Reading	Fine Rod Position	Coarse Rod Position	Comments (loading changes, power level, changes, scrams)
12:48	$6.5 \cdot 10^{-8}$	21.70	22.50	Critical at 3.98 watts
13:00	$6.5 \cdot 10^{-8}$	21.85	22.50	Critical at 3.99 watts
13:12	$6.5 \cdot 10^{-8}$	21.93	22.50	Critical at 3.98 watts
13:20	—	—	—	Removed iodized table salt
13:20	—	—	—	Automatic scram 6.0 watts

Appendix B. Event memorandum

Unintentional High-Level Scram

RO: E. Boldt

Supervisor: R. Davis

Date: 11/23/2022

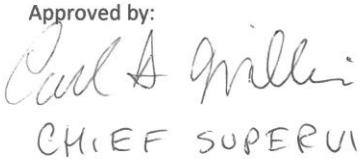
Time: 13:20:00

Iodized Table salt was inserted to centerline at 12:22 to be irradiated at 4.0 W. At 12:27, the reactor was established as critical at 4.0 W. The iodized table salt was irradiated until 13:20. At 13:20, R. Davis communicated to E. Boldt that the salt would be removed. R. Davis pulled the Salt out with the power level at 4 W. The reactor then entered a positive period and jumped to 6.0 W, resulting in an unintentional high level scram. R. Davis called C. Willis and alerted him immediately of the event who then advised to create a report of the event. C. Willis then advised that in the future, better communication is necessary to account for the reactivity differences between an inserted sample and the inserted fuel rods. This event will be added to "Lessons Learned" for future trainees.

Prepared by:

R. Davis

Approved by:



CHIEF SUPERVISOR