



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

December 7, 2018

Dr. Melinda Krahenbuhl, Director  
Reed Reactor Facility  
Reed College  
3203 S.E. Woodstock Boulevard  
Portland, OR 97202-8199

SUBJECT: REED COLLEGE – U.S. NUCLEAR REGULATORY COMMISSION ROUTINE  
INSPECTION REPORT NO. 50-288/2018-201

Dear Dr. Krahenbuhl:

From November 5-13, 2018, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at the TRIGA Mark-I Reed Research Reactor facility. The enclosed report documents the inspection results, which were discussed on November 8, 2018, with you, Dr. Nigel Nicholson, Dean of the Faculty, and April Sams, Campus Radiation Safety Officer and Environmental Director.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspector reviewed selected procedures and records, observed various activities, and interviewed personnel. Based on the results of this inspection, no findings of significance were identified. No response to this letter is required.

In accordance with Title 10 of the *Code of Federal Regulations*, Section 2.390, "Public inspections, exemptions, requests for withholding," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (Agencywide Documents Access and Management System (ADAMS)). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

M. Krahenbuhl

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Should you have any questions concerning this inspection, please contact Craig Bassett at 240-535-1842 or by electronic mail at [Craig.Bassett@nrc.gov](mailto:Craig.Bassett@nrc.gov).

Sincerely,

*/RA/*

Anthony J. Mendiola, Chief  
Research and Test Reactors Oversight Branch  
Division of Licensing Projects  
Office of Nuclear Reactor Regulation

Docket No. 50-288  
License No. R-112

Enclosure:  
As stated

cc: See next page

Reed College

Docket No. 50-288

cc:

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SUBJECT: REED COLLEGE – U.S. NUCLEAR REGULATORY COMMISSION ROUTINE INSPECTION REPORT NO. 50-288/2018-201 DATED DECEMBER 7, 2018

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**U.S. NUCLEAR REGULATORY COMMISSION**  
**OFFICE OF NUCLEAR REACTOR REGULATION**

Docket No.: 50-288

License No.: R-112

Report No.: 50-288/2018-201

Licensee: Reed College

Facility: Reed Research Reactor

Location: Portland, Oregon

Dates: November 5-13, 2018

Inspector: Craig Bassett

Approved by: Anthony J. Mendiola, Chief  
Research and Test Reactors Oversight Branch  
Division of Licensing Projects  
Office of Nuclear Reactor Regulation

Enclosure

## EXECUTIVE SUMMARY

Reed College  
Reed Research Reactor Facility  
NRC Report No. 50-288/2018-201

The primary focus of this routine, announced inspection included onsite review of selected aspects of the Reed College (the licensee) Class II research reactor safety program. This included a review of: (1) organization and staffing, (2) operations logs and records, (3) procedures, (4) requalification training, (5) surveillance and limiting conditions for operation, (6) experiments, (7) design changes, (8) committees, audits and reviews, (9) emergency planning, (10) maintenance logs and records, and, (11) fuel handling logs and records. The licensee's program was acceptably directed toward the protection of public health and safety.

### Organization and Staffing

- The organization and staffing remain in compliance with the requirements specified in technical specification (TS) Section 6.1.

### Operations Logs and Records

- Operations were generally being conducted in accordance with TS and procedural requirements.

### Procedures

- Facility procedures were available for the safe operation of the reactor as required by TS Section 6.4.

### Operator Requalification Program

- The operator requalification/training program was up-to-date and being acceptably implemented and documented.
- Biennial medical examinations were being completed as required.

### Surveillance and Limiting Conditions for Operation

- The surveillance program, including calibration of instruments, was being completed in accordance with TS Sections 3 and 4.

### Experiments

- The program for the control of experiments satisfied TS Sections 3.6, 4.6, and 6.5.

### Design Changes

- The design change program being implemented at the facility generally satisfied the U.S. Nuclear Regulatory Commission (NRC) requirements.

### Committees, Audits, and Reviews

- Review and oversight functions required by TS Section 6.2 were acceptably completed by the Reactor Operations Committee (ROC).
- Audits were being completed as required.

### Emergency Planning

- The Emergency Plan (E-Plan) and Emergency Implementation Procedures were being audited and reviewed annually as required.
- Letters of Agreement documenting emergency support to be provided by offsite agencies were being maintained and periodically updated.
- Annual drills and follow-up critiques were being held and documentation of the drills was maintained. Subsequent corrective actions were taken as needed.
- Emergency preparedness training for staff and offsite personnel was being conducted as stipulated in the E-Plan.

### Maintenance Logs and Records

- Maintenance was being completed as needed.

### Fuel Handling Logs and Records

- Reactor fuel movements and inspections were conducted and documented in accordance with procedure.
- Twenty-five percent of the fuel elements were being inspected on an annual basis with the full core being inspected every 5 years.

## REPORT DETAILS

### Summary of Facility Status

The Reed College 250 kilowatts (kW) TRIGA Mark I research reactor was typically operated in support of undergraduate instruction, laboratory experiments, reactor system testing, reactor surveillances, and operator training. During this inspection the reactor was operated at various power levels to support experiments, tours, and operator training.

### 1. Organization and Staffing

#### a. Inspection Scope (Inspection Procedure [IP] 69001, Section 02.01)

To verify the organization and staffing requirements specified in TS Section 6.1 were being met, the inspector reviewed selected aspects of the following:

- Reactor Console Logs documenting operation from April 2017 to the present
- Reed Research Reactor (RRR) facility (RRRF) organization and staffing during reactor operations
- Administrative controls and management responsibilities specified in the TS and facility procedures
- RRR Administrative Procedures, Section 1, "Personnel," and Section 3, "Reactor Operations"
- RRR standard operating procedure (SOP) 60, "Logbook Entries"
- RRR Annual Report for the period from July 1, 2016, through June 30, 2017, submitted to the NRC on July 18, 2017
- RRR Annual Report for the period from July 1, 2017, through June 30, 2018, submitted to the NRC on July 13, 2018

#### b. Observations and Findings

Through discussions with licensee representatives, the inspector determined that management responsibilities and the organizational structure at the RRR facility had not changed since the previous NRC inspection of licensee operations in November 2016 (Inspection Report No. 50-288/2016-202). The inspector determined that the Facility Director retained direct control and overall responsibility for management of the facility as specified in the TS. The Facility Director reported to the President of Reed College through the Dean of Faculty. This organization was consistent with that specified in the TS.

It was noted that since the last operations inspection in 2016, a new person had been hired to be the Reactor Operations Manager. The licensee's current operational organization consisted of the Facility Director, a Reactor Operations Manager, a Radiation Safety Officer, an Operations Supervisor, a Training Supervisor, an Assistant Training Supervisor, a Projects Supervisor, and a Requalification Supervisor. The Facility Director, Reactor Operations Manager, and Radiation Safety Officer positions were full-time while the rest were part-time positions filled by students. Except for the Radiation Safety Officer, the aforementioned individuals, in addition to their administrative duties, were qualified reactor operators (ROs) or senior reactor operators (SROs). It was

noted that there were a total of 7 SROs and 19 ROs qualified and licensed to operate the RRRF.

c. Conclusion

Organization and staffing met the requirements specified in TS Section 6.1.

**2. Operations Logs and Records**

a. Inspection Scope (IP 69001, Section 02.02)

The inspector reviewed selected aspects of the following to verify operation of the reactor in accordance with TS Sections 3, 4, and 6.1:

- Various SCRAM Response Forms from May
- Corrective Action Reports (CARs) for 2017 and 2018
- Reactor Console Logs documenting operation from April 2017 to the present
- Selected Startup Checklist Forms for the period from January 2017 through the present
- Selected Shutdown Checklist Forms for the period from January 2017 through the present
- RRR Administrative Procedures, Section 3, "Reactor Operations"
- Various RRR SOPs and Appendices including SOP 1, "Reactor Operations;" SOP 2, "Scram or Dropped Rod;" SOP 20, "Startup Checklist;" SOP 20, Appendix A, "Startup Checklist Form;" SOP 21, "Same Day Startup Checklist;" SOP 21, Appendix A, "Same-Day Startup Checklist Form;" SOP 22, "Shutdown Checklist;" SOP 22, Appendix A, "Shutdown Checklist Form;" SOP 23, "Biweekly Checklist;" SOP 23, Appendix A, "Biweekly Checklist Form;" SOP 24, "Bimonthly Checklist;" SOP 24, Appendix A, "Bimonthly Checklist Form;" SOP 25, "Semiannual Checklist;" SOP 25, Appendix A, "Reed Research Reactor Semiannual Checklist;" SOP 26, "Annual Checklist;" SOP 26, Appendix A, "Annual Checklist Form;" SOP 33, "Nuclear Instruments;" SOP 34, "Control Rods;" SOP 60, "Logbook Entries;" and, SOP 69, "Corrective Action Report"
- RRR Annual Reports for the last two reporting periods as noted in Section 1 above

b. Observations and Findings

(1) Routine Operations

The inspector reviewed selected reactor operating records from January 2017 through the present. These records included daily Startup Checklists, Shutdown Checklists, Experimental Startup and Shutdown Checklists, associated forms, Weekly Checklists, and the Main (reactor console) Logs. The records indicated that the activities were generally carried out in accordance with written procedures as required by TS Section 6.4, except as noted below. The checklists were completed and signed off by the appropriate personnel as required.

Through interviews with operators and review of logs and records, the inspector confirmed that shift staffing met the minimum requirements for duty and on-call personnel as required by TS Section 6.1.

Information on the operational status of the facility was generally recorded properly on the log sheets and/or checklists as required by procedure. Scrams were identified in the logs and were reported and resolved as required before reactor operations were allowed to continue.

(2) Past Licensee Identified Violation of the Technical Specifications

TS Section 3.2.2 requires that the reactor shall not be operated unless the reactor power measuring channels in Table 2 are operable. Table 2 lists the Percent Power Channel, the Linear Channel, and the Logarithmic Channel.

TS Section 3.2.3 states that the reactor shall not be operated unless the minimum number of safety channels described in Table 3 and interlocks described in Table 4 are operable. Table 4 lists the Source Interlock and the Control Rod Drive Circuit.

By letter dated August 23, 2017, the licensee notified the NRC of a violation (VIO) of the TSs. On August 9, 2017, the operators on duty discovered noise in the log power signal during completion of the start-up checklist. The data indicated that the log channel power level was reading three orders of magnitude higher than normal. The operation was terminated and the problem was evaluated. It was noted that the reactor was operated on three previous runs with the high noise to signal ratio. The licensee concluded that the reactor was operated with the log channel inoperable at low power due to noise in the signal. Also, due to the signal to noise ratio, the source interlock would not have actuated if the source had not been physically present.

Further review indicated that the noise was most often associated with the status of console power. The noise was subsequently removed by repositioning the log channel's signal cable. The manufacturer was also contacted to seek assistance in finding and implementing a means of preventing future incidents of excessive noise. As a result, two changes to the Start-up Checklist were made to further eliminate the noise at low power. An acceptable range for the log power channel at start-up was added to the checklist to help exclude the readings associated with noise and help prevent future incidents of excessive noise in the signal. Also, the log channel's operability will be required to be verified by evaluating its response to the control rod movement. This test should help to identify noise related problems.

The inspector reviewed the licensee's corrective actions and verified that the Start-up Checklist had been revised as indicated. The licensee was informed that the failure to have all of required channels operable during reactor operation and failure to have a functional source interlock was a Severity Level IV violation of TS Sections 3.2.2 and 3.2.3. However, the

safety consequences were low because the reactor was operated at a power level less than 5 watts and 2 of the 3 required channels were operable to provide any required reactor scram. The inspector determined that the problem had been identified by the licensee and promptly reported to the NRC. The licensee had identified and implemented corrective actions. As a result, the licensee was informed that this issue would be treated as a Non-Cited Violation (NCV), consistent with Section VI.A.8 of the NRC Enforcement Policy (NCV 50-288/2018-201-01).

(3) Current Licensee Identified Violation of the Technical Specifications

TS Section 6.1.3.a(1) requires that the minimum staffing when the reactor is not secured shall be a licensed RO in the Control Room.

On November 8, 2018, a RO was initiating a reactor start-up. The reactor key was in the console and therefore the reactor was not secured. While performing a linear-log functional check, the operator of record realized that he needed to perform some calculations and decided that he would prefer to use his own personal calculator rather than the one provided by the facility. Another person, who was an SRO but who was not currently in "requal" (i.e., had not completed all the requirements to maintain his qualified status), was the second designated person of record (designated at the RRRF as "warm body"). This person had just completed the Startup Check list for the Reactor Bay and had re-entered the Control Room. The RO left the Control Room to retrieve his calculator from the next room and, immediately upon doing so, realized that he had violated the TS. At that point he immediately returned to the Control Room, removed the key from the console, and notified the SRO of record. The SRO then contacted the RRRF Director. The Director subsequently called the Headquarters Operations Office and reported the event as required.

After a review of the incident, it was estimated that the operator of record was absent from the Control Room for less than 1 minute. The apparent cause was that the operator was distracted because he was focused on getting the start-up completed and the reactor operating to complete an Irradiation Request for a class or tour at 3 p.m. that afternoon.

As part of the corrective actions, the licensee had the individual complete a CAR and review the episode with all the other operators during the next Requalification Meeting, which occurred on November 12, 2018. Other actions to help reinforce the requirement for the operator of record to be aware of and remember to remain in the Control Room are being contemplated including scheduling more time to allow completion of the reactor start-up.

The inspector discussed the licensee's proposed corrective actions with the Director and Operations Manager. The licensee was informed that the failure to maintain the minimum staffing requirements for having a licensed RO in the Control Room when the reactor was not secured was

a Severity Level IV violation of TS Section 6.1.3.a(1). However, the safety consequences were low because of the brief period of time the RO was gone and the fact that there was a second individual in the Control Room. The inspector determined that this problem had been identified by the licensee and promptly reported to the NRC. As part of the corrective actions, the RO completed a CAR. The event was also discussed during the Requalification Meeting. The licensee was informed that this issue would be treated as an NCV, consistent with Section VI.A.8 of the NRC Enforcement Policy (NCV 50-288/2018-201-02).

c. Conclusion

Reactor staffing, operations, and logs were generally acceptable.

**3. Procedures**

a. Inspection Scope (IP 69001, Section 02.03)

To determine whether facility procedures met the requirements outlined in TS Section 6.4, the inspector reviewed portions of the following:

- Procedural reviews and updates documented in the ROC meeting minutes
- RRR Administrative Procedures, Section 8, "Adoption and Revision of Operating Procedures," and Section 9, "Record Retention"
- Various RRR SOPs and Appendices including: SOP 20, "Start-up Checklist," SOP 26B, "Console Checkout Form," SOP 33, "Nuclear Instruments," SOP 60, "Logbook Entries;" SOP 61, "Procedure Writing and Use;" SOP 61, Appendix A, "Document Structure;" SOP 61, Appendix B, "Document Locations;" SOP 61, Appendix C, "Temporary Procedure Change;" and, SOP 67, "Annual Audit"

b. Observations and Findings

Procedures were in effect for those activities specified in TS Section 6.4 as required. RRR Administrative Procedures and SOPs were found to be acceptable for the current staffing level and status of the facility. The Administrative Procedures and SOPs specified the responsibilities of the various members of the staff. Substantive changes to procedures were being reviewed and approved by the ROC. The procedures were being audited, reviewed, and updated as needed.

The inspector reviewed the temporary procedure changes that had been promulgated during the past 12 months. The changes were written after minor problems with the procedures were noted. The temporary changes were typically incorporated in the referenced procedures if deemed appropriate by the licensee. Changes suggested as a result of the ROC and independent audits were also incorporated into the procedures if deemed appropriate.

c. Conclusion

Facility procedures for the safe operation of the reactor were available as required by TS Section 6.4.

**4. Requalification Training**

a. Inspection Scope (IP 69001, Section 02.04)

The inspector reviewed selected portions of the following regarding the RRR Requalification Plan to ensure that the requirements of the plan and Title 10 of the *Code of Federal Regulations* (10 CFR) 55.59, "Requalification," were being met:

- Active license status of all current operators
- Medical examination records for selected operators
- RRR Facility Requalification Program, dated July 2010
- Training lectures and records for the current training cycle
- NRC Form 398, "Personal Qualification Statement – Licensee"
- Written examinations given during 2016 and 2017 for selected operators
- NRC Form 396, "Certification of Medical Examination – by Facility Licensee"
- Reactor Console Logs documenting operation from April 2017 to the present
- RRR Facility Requalification Meeting attendance documentation for 2017 and to date in 2018
- "Requalification Hours and Reactivity Manipulation," sheets documenting reactivity manipulations for 2016 through the present for selected operators
- RRR Administrative Procedures, Section 9, "Record Retention"
- Various RRR SOPS including: SOP 63, "Requalification;" SOP 63 Appendix A, "Reactor Operator Physical Exam;" and SOP 63, Appendix B, "Accelerated Requalification Form"

b. Observations and Findings

(1) Routine Program

As noted previously, there are currently 7 qualified SROs and 19 qualified ROs at the RRR facility. The inspector reviewed selected operators' licenses and noted that they were current.

The inspector reviewed the requalification program for 2017 through 2018, as well as the annual drill scenarios and attendance sheets. It was noted that operators typically made entries on the "Requalification Hours and Reactivity Manipulation Sheet," that was located in the control room. Through these actions the hours "on duty" and in what capacity (i.e., RO/SRO), as well as the tasks performed, were documented. The inspector also reviewed the Requalification Meeting attendance for the same period indicated above. The inspector reviewed various individual operators' requalification/personnel records as well.

The review of the various logs and records noted above showed that training had been conducted in accordance with the licensee's

requalification and training program. Training reviews and examinations had been completed and documented as required. The records indicated that operators were completing the required activities, including reactivity manipulations and number of operating hours. Records indicated that annual operations tests and supervisory observations were being completed. Biennial written examinations were also being completed as required or credit was taken by the licensee for the exams administered by the NRC to satisfy the requalification cycle exam requirements when applicable. It appeared that the training and requalification program was being conducted as outlined in the licensee's approved Requalification Plan. Additionally, the inspector noted that operators were receiving the required biennial medical examinations within the required time frame.

(2) Licensee Identified Violation of Operator License Condition

The regulation in 10 CFR 55.53, "Conditions of licenses," states that each license contains and is subject to the following conditions whether stated in the license or not: ... (d) the license is subject to, and the licensee shall observe, all applicable rules, regulations, and orders of the Commission, and (l) the licensee shall comply with any other conditions that the Commission may impose to protect health or to minimize danger to life or property.

As noted above, there are over 20 qualified operators with active licenses who work at the RRRF. Several of these operators have special conditions listed on their personal operators' licenses. These conditions must be met in order to meet the intent of the regulations outlined in 10 CFR Part 55, "Operators' Licenses."

In September 2018, the RRRF Director was informed by one of the operators that they had stopped taking their anti-anxiety medicine on a daily basis as had been prescribed by a medical doctor. Taking the prescribed medicine daily was stipulated as one of the conditions of their operator license. The Director removed the operator's name from the list of persons allowed to operate the reactor and investigated the event. It was noted that, as of early March, the person had stopped taking the prescription on a daily basis due to nausea. However, the operator had taken the medicine on the days when they had operated the reactor assuming that they were thereby meeting the intent of the license condition. The person had operated the reactor on two occasions during the same day in March, during one reactor operation in April, and on two occasions during the same day in June.

The RRR Director notified the NRC of a problem concerning a licensed RO and it was decided that no further actions should be taken pending the results of another physical. On November 2, 2018, the operator had another physical performed in accordance with the guidance and requirements of American National Standard Institute/American Nuclear Society-15.4-2016 "Selection and Training of Personnel for Research Reactor." As a result of the November physical, the individual is no longer required to take the anti-anxiety medicine. The Director was

preparing a license amendment to remove the license condition concerning the need to take the medicine on a daily basis from the operator's license. The medical doctor's evaluation was being forwarded in support of this amendment request. As further corrective action, the individual filled out a CAR. In addition, changes to SOP 63, "Requalification," are being contemplated to help explain how, as well as the need, to comply with all the conditions of a person's RO license. A lecture was also given on the importance of following any license conditions stated on one's license during the Requalification Meeting held on November 12, 2018.

The inspector reviewed the documentation involved, including Reactor Console Log Books, and noted that no problems had occurred during the periods when the operator had been the reactor operator of record at the facility. It was also noted that, taking a medicine that causes nausea, could be detrimental in that taking the medicine could be a greater factor in causing incapacitation than the advantages of the medication.

The inspector discussed the situation with the Director and Operations Manager. The licensee was informed that the failure of the operator to take the required medicine on a daily basis as listed as a condition of the person's license was a Severity Level IV violation of 10 CFR 55.53 (d) and (l). However, the safety consequences were low because of the brief period of time the RO operated the reactor and the fact that there was always a second individual in the area as required by facility procedures. The inspector determined that this problem had been identified by the licensee and promptly reported to the NRC. The corrective actions are still pending. As a result, the licensee was informed that this issue would be treated as a NCV, consistent with Section VI.A.8 of the NRC Enforcement Policy (NCV 50-288/2018-201-03).

c. Conclusion

The requalification/training program was up-to-date and being acceptably maintained. Medical examinations were being completed biennially as required.

**5. Surveillance and Limiting Conditions for Operation**

a. Inspection Scope (IP 69001, Section 02.05)

To verify that operations, surveillance activities, and calibrations were being completed as required by the TS, the inspector reviewed selected portions of:

- Reactor Console Logs documenting operation from April 2017 to the present
- Associated surveillance and calibration data and records for 2017 and 2018
- "Other Checklists" Notebook which contained calibration forms, inspection forms, and various checklists
- Various RRR SOPs and Appendices including: SOP 23, "Biweekly Checklist;" SOP 23, Appendix A, "Biweekly Checklist Form;" SOP 24, "Bimonthly Checklist;" SOP 24, Appendix A, "Bimonthly Checklist Form;" SOP 25,

“Semiannual Checklist;” SOP 25, Appendix A, “Reed Research Reactor Semiannual Checklist;” SOP 26, “Annual Checklist;” SOP 26, Appendix A, “Annual Checklist Form;” SOP 34, “Control Rods;” SOP 34, Appendix A, “Control Rod Calibration Form;” SOP 34, Appendix B, “Control Rod Inspection Checklist;” SOP 34, Appendix C, “Control Rod Inspection Form;” and, SOP 60, “Logbook Entries;” and associated Appendix A, “Maintenance Log” forms

- RRR Annual Reports for the last two reporting periods as noted in Section 1 above

b. Observations and Findings

The licensee conducted various surveillance activities which were then documented on the appropriate forms and checklists. The inspector verified that these activities were conducted within the time frame required and according to procedure. The inspector reviewed selected daily startup and shutdown checklists, as well as, biweekly, bimonthly, semiannual, and annual forms and checklists. All the recorded results reviewed were within the TS and procedurally prescribed parameters. The records and logs reviewed appeared to be complete and were being maintained as required.

The inspector observed a Startup and a Shutdown Checklist being performed during the inspection. Also, previously completed Startup and Shutdown Checklists were reviewed. The activities observed were conducted appropriately and in accordance with procedure.

A review of the RRRF Main Logs and checklists showed that these records were also being completed as required and problems, if any, were being documented.

c. Conclusion

The program for surveillance was being carried out in accordance with TS requirements.

## 6. Experiments

a. Inspection Scope (IP 69001, Section 02.06)

In order to verify that experiments were being conducted within approved guidelines specified in TS Sections 3.6, 4.6, and 6.5, the inspector reviewed selected portions of the following:

- Experiment review and approval by the ROC
- Selected Irradiation Request Forms for 2017 and 2018
- Ten approved RRR Routine Experiments and one approved RRR Special Experiment
- RRR Administrative Procedures, Section 4, “Reactor Experiments;” and Section 9, “Record Retention”
- Various RRR SOPs and Appendices including: SOP 10, “Irradiation Preparation;” SOP 10, Appendix A, “Irradiation Request Form;” SOP 10, Appendix D, “Irradiation Request Log;” SOP 11, “Irradiation Analysis;”

SOP 12, "Lazy Susan;" SOP 13, "Rabbit;" SOP 14, "Central Thimble;"  
SOP 15, "Beam;" SOP 15, Appendix A, "Beam Irradiation Request Form;"  
SOP 16, "Near Core;" and SOP 17, "Gamma Irradiations"

b. Observations and Findings

The inspector noted that the various experiments conducted at the facility, and revisions thereto, had been reviewed and approved as required. It was also noted that no new experiments had been proposed in the past several years.

Through a review of console logs and various irradiation request forms, the inspector noted that irradiations were conducted under the cognizance of the Facility Director and the Reactor Supervisor as required. The irradiations were documented in the Main Log and the results of the experiments were documented on the irradiation request forms as required. The resulting radioactive material was being transferred to an authorized user, disposed of as stipulated by procedure, or held for decay.

c. Conclusion

The license's program for the control of experiments generally satisfied TS Sections 3.6, 4.6, and 6.5 and other regulatory requirements.

## 7. **Design Changes**

a. Inspection Scope (IP 69001, Section 02.08)

In order to determine whether facility modifications and changes were consistent with 10 CFR 50.59, "Changes, tests and experiments," and were being reviewed as required by TS Section 6.2.3, the inspector reviewed selected portions of the following:

- Maintenance Log pages completed for unscheduled work
- Design changes reviewed under 10 CFR 50.59 for 2017 and 2018
- ROC meeting minutes from October 2016 through the present
- RRR Administrative Procedures, Section 1, "Personnel;" Section 2, "Reactor Review Committee;" and Section 9, "Record Retention"
- RRR Annual Reports for the last two reporting periods as noted in Section 1 above

b. Observations and Findings

The inspector reviewed the licensee's 10 CFR 50.59 screening forms concerning changes or modifications that had been initiated at the facility for 2017 and to date in 2018. The results indicated that none of the screenings required further evaluation under 10 CFR 50.59. The inspector also reviewed the Maintenance Log pages that had been completed for unscheduled work associated with various systems. The forms contained a section which required a 10 CFR 50.59 screen to be completed prior to initiating the work. None of the maintenance items reviewed required any further actions, such as a 10 CFR 50.59 evaluation, to be completed. None of the other changes reviewed by the inspector met any

of the criteria of 10 CFR 50.59(c)(1) and (2), which would have required a TS change or a license amendment from the NRC.

c. Conclusion

The licensee's design change program generally satisfied NRC requirements.

**8. Committees, Audits and Reviews**

a. Inspection Scope (IP 69001, Section 02.09)

In order to verify that the licensee had established a ROC to conduct reviews and audits as required TS Section 6.2, the inspector reviewed selected portions of the following:

- Maintenance Log pages completed for unscheduled work
- CARs for 2017 and to date in 2018
- Annual Audit Reports for 2017 and 2018 including a supplement to the 2017 Audit
- ROC meeting minutes from May 2016 through the present
- RRR Administrative Procedures, Section 1, "Personnel;" Section 2, "Reactor Review Committee;" and Section 9, "Record Retention"
- RRR SOP 62, "Changes, Tests, and Experiments;" SOP 67, "Annual Audit;" and SOP 69, "Corrective Action Report;" and associated forms, last revised August 26, 2014
- RRR Annual Reports for the last two reporting periods as noted in Section 1 above

b. Observations and Findings

The inspector reviewed ROC meeting minutes from May 2016 through the present. These meeting minutes showed that the committee was meeting at the required frequency and was considering the types of topics outlined by the TS.

The inspector noted that, since the last NRC inspection, the appropriate audits had been completed in the various areas outlined in the TS by making use of various external auditors. The audits were designed so that most aspects of the licensee's operations and safety programs were reviewed every year. Various facility documents, such as Operations Logs and Checklists, the Radiation Protection Program, the Emergency Plan, Corrective Action Reports, 10 CFR 50.59 Reviews, the Administrative Procedures, and the Requalification Plan comprised the material that was typically reviewed. The Reactor Experiments and various SOPs were also reviewed. The inspector noted that the audits and the resulting findings were detailed and that the licensee responded and took corrective actions as needed.

c. Conclusion

Review and oversight functions required by TS Section 6.2 were acceptably completed by the ROC. Audits were being completed as required.

## 9. Emergency Planning

### a. Inspection Scope (IP 69001, Section 02.10)

To verify compliance with the RRR E-Plan, the inspector reviewed selected aspects of the following:

- RRR E-Plan latest revision dated August 2014
- Emergency response training records for the past 2 years
- Emergency drills and exercises held during 2017 and 2018
- Emergency response facilities, supplies, equipment and instrumentation
- RRR SOP 25, "Semiannual Checklist" including Appendix A, "Reed Research Reactor Semiannual Checklist"
- Various RRR E-Plan Appendices including: Appendix A, "Agreement Letters;" Appendix B, "Emergency Implementation Procedures (EIPs)," Appendix C, "Projected Doses for Bounding Accidents;" and Appendix D, "Visible and Audible Alarms"

### b. Observations and Findings

#### (1) Emergency Plan and Implementing Procedures

The E-Plan in use at the reactor had been updated, reviewed, and approved by the ROC. The licensee had determined that there was no decrease in effectiveness as defined in 10 CFR 50.54, "Conditions of licenses," paragraph (q). The licensee had submitted a letter to the NRC documenting this determination on August 18, 2014. The E-Plan and EIPs were being audited and reviewed annually as required.

#### (2) Emergency Response Training

The inspector verified that training for staff and offsite support personnel was being provided annually as required. Training for staff was typically completed through the Operator Requalification Program. Training for representatives from the Portland Fire and Rescue (PF&R) group and Portland Fire Bureau was conducted annually. Training for representatives from the Portland Police Bureau was offered but the police could not always commit to attend because of staffing level shortages.

#### (3) Emergency Equipment

Supplies, instrumentation, and equipment staged for emergency use were being maintained, controlled, and inventoried semiannually as required in the E-Plan. It was noted that the Emergency Support Center was located in the RRRF Director's office in the Chemistry Building.

Communications capabilities were acceptable and had been tested and emergency information updated as stipulated in the E-Plan. It was noted that the Emergency Notification Call List, posted in various locations throughout the facility, was current.

(4) Agreement Letters with Support Organizations

Through records review and interviews with licensee personnel, emergency responders were determined to be knowledgeable of the proper actions to take in case of an emergency. The inspector reviewed the Agreement Letters that had been signed with various emergency support organizations. These agreements were being maintained and updated as needed.

(5) Emergency Drills

Emergency drills had been conducted annually as required by the E-Plan. Critiques were held following the drills to discuss the strengths and weaknesses identified during the exercises and to develop possible solutions to any problems identified. Drills involving off-site personnel were being conducted when those groups' schedules permitted.

(6) Offsite Support

The inspector, the Facility Director, and the Campus Radiation Safety Officer attempted to visit a PF&R unit, which also housed an additional component for HAZMAT, located several miles from the RRRF. Upon arrival, it was discovered that the unit was out on an emergency call. The inspector and Director had visited the facility on a previous occasion and observed the equipment maintained by the unit for response to various types of emergencies. Despite the fact that no actual visit could be made, the inspector determined that the licensee communicated with PF&R personnel frequently and was maintaining a good working relationship with this support group.

c. Conclusion

The emergency preparedness program was conducted in accordance with the E-Plan.

**10. Maintenance Logs and Records**

a. Inspection Scope (IP 69001, Section 02.11)

To verify that operations and maintenance activities were being completed as required by the TS, the inspector reviewed selected portions of:

- Reactor Console Logs documenting operation from April 2017 to the present
- Maintenance Log pages completed for unscheduled work
- Associated surveillance and calibration data and records for 2017 and 2018
- Various RRR SOPs and Appendices including: SOP 23, "Biweekly Checklist;" SOP 23, Appendix A, "Biweekly Checklist Form;" SOP 24, "Bimonthly Checklist;" SOP 24, Appendix A, "Bimonthly Checklist Form;" SOP 25, "Semiannual Checklist;" SOP 25, Appendix A, "Reed Research Reactor Semiannual Checklist;" SOP 26, "Annual Checklist;" SOP 26, Appendix A, "Annual Checklist Form;" SOP 34, "Control Rods;" SOP 34, Appendix A,

“Control Rod Calibration Form;” and, SOP 60, “Logbook Entries;” and associated Appendix A, “Maintenance Log” forms

- RRR Annual Reports for the last two reporting periods as noted in Section 1 above

b. Observations and Findings

The licensee conducted various maintenance activities which were then documented on the appropriate forms and checklists. The inspector reviewed selected biweekly, bimonthly, semiannual, and annual forms and checklists, as well as maintenance log forms. Problems that were noted were being documented on the checklists and maintenance forms. All the recorded corrective actions and maintenance activities appeared to be appropriate. The records and logs reviewed appeared to be complete and were being maintained as required. Through observation and records review, the inspector also confirmed that maintenance was being conducted as needed, consistent with the TSs.

c. Conclusion

Maintenance was being completed as required.

11. **Fuel Handling Logs and Records**

a. Inspection Scope (IP 69001, Section 02.12)

In order to verify adherence to fuel handling and inspection requirements specified in TS Section 4.1, the inspector reviewed selected aspects of the following:

- Fuel Element Inspection Cards
- Current Core Configuration Map
- Core Status Board in the Reactor Bay indicating the current location of each element
- Reactor Console Logs documenting operation from April 2017 to the present
- Fuel Element Inspection sheets maintained in the appropriate Fuel Inspection Binder, i.e., Northeast Quadrant Fuel Inspection Binder and Northwest Quadrant Fuel Inspection Binder
- RRR Administrative Procedures Section 6, “Fuel and Special Nuclear Material”
- Various RRR SOPs including: RRR SOP 35, “Fuel and Core;” SOP 35, Appendix A, “Core Diagram;” SOP 35, Appendix B, “Fuel Handling Checklist;” SOP 35, Appendix C, “Fuel Handling SRO Qualification;” SOP 35, Appendix D, “Fuel Handling Receipt Form;” and, SOP 35, Appendix E, “Fuel Element Features”

b. Observations and Findings

Through review of the main logs and interviews with licensee personnel, the inspector verified that fuel movements were conducted in compliance with procedure. The inspector also verified that the licensee was maintaining the required records of fuel movements as they were completed. The logs were being filled out properly to indicate which elements were moved and to what locations. The physical condition of each element was also noted for future reference.

Also through records review, it was noted that the reactor fuel was being inspected upon initial receipt and 25 percent of the fuel elements in the core were being inspected annually. This exceeded the percentage of fuel elements required to be inspected as stipulated by TS Section 4.1. The last annual fuel inspection was completed during January and February 2018. The inspector verified that all fuel elements were inspected at least once every 5 years, including elements in storage and/or removed from service as required.

c. Conclusion

Reactor fuel movements and inspections were completed and documented in accordance with procedure and the fuel was being inspected more frequently than required by TS Section 4.1.

**12. Follow-up on Previously Identified Items**

a. Inspection Scope (IP 92701)

The inspector reviewed the actions taken by the licensee to address two previously identified Inspector Follow-up Items (IFIs) and two violations.

b. Observation and Findings

- (1) 50-288/2016-202-01 – IFI - Follow-up on the licensee's actions to maintain logs which contain the accurate and complete documentation of scram events and other operational events. (CLOSED)

Information on the operational status of the facility was generally being recorded on the log sheets and/or checklists as required by procedure. Scrams were identified in the logs and were reported and resolved as required before reactor operations were allowed to continue. However, during an inspection in 2016, it was noted that the logs being maintained by the licensee were not totally complete in that they did not indicate who authorized operations to resume. The inspector indicated that the complete documentation of reactor operations should include not only when and why a scram occurred, but who gave the authorization to resume operations as well.

During this inspection, the inspector interviewed staff members and reviewed the log books. It was noted that the licensee had initiated a new practice to make the logs more complete. Following a scram, the person

authorizing restart was required to sign the log indicating the action was allowed. The inspector verified that this new requirement was being followed. This issue is considered closed.

- (2) 50-288/2016-202-02 –VIO-Failure to have all of required channels operable during reactor operation as required by TS Section 3.2.2. (CLOSED)

TS Section 3.2.2 requires that the reactor shall not be operated unless the reactor power measuring channels in Table 2 are operable. Table 2 lists the Percent Power Channel, the Linear Channel, and the Logarithmic Channel.

On May 28, 2016, the licensee discovered that the facility reactor pool had overflowed due to a malfunction of the recently installed automatic fill system. On May 30, 2016, operators noticed that all reactor trips were illuminated. Because of this, the reactor was determined to be inoperable due to electronics problems. From June through August, various attempts were made to correct the problems noted; however, instrument issues persisted (see Inspection Report 50-288/2016-202 for further details).

From October 6-16, 2016, the licensee tried to correct the noted problems by various means. None of the corrective actions were successful. However, because most of the student operators were out of qualification (due to the continuing problems with the nuclear instrument (NI) channels), reactor operations continued and were conducted on various occasions for requalification but problems continued. Finally on October 21, 2016, the licensee determined that the Logarithmic Channel detector was apparently working properly but the electronics were not. At that point the reactor was declared non-operational.

The NRC reviewed the issues associated with the reactor power measuring channels. The NRC determined that, from October 6-16, 2016, licensee staff operated the reactor up to 150 kW for training and requalification. During that period when operating at 150 kW, the Linear Channel typically read 60 percent, the Percent Power Channel typically read 60 percent, but the Logarithmic Channel was reading from 90 to 100 percent. A review of the console logs for the two previous years showed that, when operating at 150 kW, the Linear Channel typically read 60 percent, the Percent Power Channel typically read 60 percent, and the Logarithmic Channel typically read 60 percent. Therefore, the NRC concluded that, from October 6-16, 2016, the Logarithmic Channel was not reading correctly because it was reading high and over responding, probably indicating that the channel detector was shorted out. The NRC concluded that the Logarithmic Channel was not operating properly and thus was not operational during this period and a violation was issued.

The licensee responded to the violation by a letter dated January 26, 2017. Corrective actions were outlined which included

installing a new Log Channel with fission chamber. Because the channel had been on order from the vendor since 2015, the licensee was not able to install it immediately. However, in April 2017, the new Log Channel was received and installed. The NRC was present to observe this operation.

During this inspection, the inspector verified that the various NI channels were functioning properly and no problems have been noted following the few that were observed during initial installation. The licensee had proposed to calibrate the Log Channel annually but this was deemed unnecessary. Also, the SOPs dealing with the new Log Channel, SOP 20, "Start-up Checklist," SOP 26B, "Console Checkout Form," and SOP 33, "Nuclear Instruments," were reviewed, revised, and approved as required. This was completed August 14, 2017. This issue is considered closed.

- (3) 50-288/2016-202-03-VIO- Failure to complete a review prior to installing a fission chamber instead of an uncompensated ion chamber (UIC) with the Percent Power Channel (as stipulated in the facility safety analysis report (SAR)) as required by 10 CFR 50.59 paragraphs (c)(1)(i and ii) and (c)(2)(i-viii). (CLOSED)

The RRR SAR states in Chapter 7, Section 7.2.3.3, that the Percent Power Channel has an UIC that provides indication for that channel.

Regulation in 10 CFR 50.59 requires that licensees evaluate a change from what was described in the SAR to ensure that a TS change or a license amendment was not required in accordance with 10 CFR 50.59 paragraphs (c)(1)(i and ii) and (c)(2)(i-viii).

As noted above, the licensee had been experiencing various problems with the reactor power measuring channels. Because of these problems, the licensee tried repeatedly to make adjustments to the channel electronics and the positions of the associated detectors. Although the power channels appeared to be working properly, the Percent Power Channel had repeated high voltage scrams. Licensee staff found a loose wire and corrected that problem but other problems persisted. Finally in mid-October, the Oregon State University (OSU) electronics specialist visited Reed College, removed the associated fission chamber, and initially installed another fission chamber in place of the old one. Up to that point, the licensee was not aware that the Percent Power Channel had a fission chamber installed in the system and not a UIC as stated in the SAR. That spare fission chamber did not function properly and the OSU electronics specialist eventually installed an UIC (one that OSU had received from another university) into the Percent Power Channel (see Inspection Report 50-288/2016-202 for further details).

The NRC reviewed this situation and the problems with the Percent Power Channel. As stated above, it was noted that the licensee was not aware that the detector associated with the Percent Power Channel was a fission chamber (and not a UIC as stated in the SAR) prior to

October 2016. However, following that date, the licensee was fully aware of the situation. Nevertheless, the decision was made to replace the existing fission chamber with a spare fission chamber that the licensee had on hand. A fission chamber was not what the SAR stipulated as the detector to be operated with the Percent Power Channel. However, no attempt was made to conduct a 10 CFR 50.59 review as to whether or not such a detector should be used with the Percent Power Channel. The licensee was informed that failure to conduct a review in this situation was a violation of 10 CFR 50.59 requirements.

The licensee responded to the violation by a letter dated January 26, 2017. Corrective actions were outlined which included installing a boron lined ion chamber on October 14, 2016. Because the reactor was not operational, it was not calibrated at that time. Once the new Log Channel with a fission chamber was installed in April 2017, all the NIs were subsequently calibrated and normal operation of the reactor resumed. The reason that no 10 CFR 50.59 evaluation was completed was because the licensee believed that the fission chamber associated with the Percent Power Channel was "original equipment" and replacing it with another fission chamber was appropriate. A screen was conducted to replace the fission chamber with another fission chamber. Through interviews with the licensee, it was determined that they are now aware of the need to conduct proper screenings, reviews, and evaluations if there is a discrepancy between what equipment or instruments are found in the facility and what the SAR states those items are supposed to be. Because of this problem, the licensee changed their Maintenance Log form (typically used for replacing such equipment) to include the following statement: "When servicing older or original equipment on the reactor, please verify and document that the USAR description is accurate and updated." If a difference is noted, then a 10 CFR 50.59 evaluation will be performed.

During this inspection, the inspector verified that the various NI channels are now functioning properly and no further problems have been noted. This issue is considered closed.

- (4) 50-288/2016-202-01 – IFI - Follow-up on the licensee's actions to correct the reactor pool overflow problem caused by the automatic fill system installed by the licensee. (CLOSED)

As noted above, near the end of May, the licensee found that the reactor pool had overflowed. Upon investigation the licensee found that the problem had occurred due to a malfunction of the recently installed automatic fill system. In the past, as part of a weekly checklist, staff members were tasked with checking the pool level and adding water if the pool level dropped below a certain mark. However, on occasion, the staff members forgot to shut the fill water off and the tank was nearly over filled. To correct that problem, under the auspices of the 10 CFR 50.59 program, the licensee installed an automatic fill control system. Unfortunately, the automatic system failed on May 28, 2016, and the pool overflowed to the point that water entered the nuclear instrumentation tubes

leading to the detectors. The Percent Power channel and the Log Channel were affected; the Linear Channel was not damaged. The overfill caused problems that persisted with the two affected channels from June through October (as noted above). The licensee was informed that the issue of correcting the overfill problem would be designated by the NRC as an IFI.

During this inspection, the inspector noted that the licensee had removed the automatic fill control system and gone back to the manual fill system with precautions to ensure that the water is turned off after the pool is filled to the required level. This issue is considered closed.

- (5) 50-288/2017-201-01 – IFI - Follow-up on the issue of revising the procedures dealing with the installation of the new Log Channel and completing the appropriate training. (CLOSED)

During an inspection in April 2017, the inspector noted that the licensee was working on revisions to the procedures necessitated by the installation of the new Log Channel. These included SOP 20, "Startup Checklist;" SOP 26B, "Console Checkout Form;" and SOP 33, "Nuclear Instruments." Training of personnel on these procedures and changes was just beginning at the conclusion of the inspection. Those operators who were not yet qualified were noted to be operating under the direction of a qualified SRO and were being instructed during the process. Because the procedure revisions and training were not yet completed, the licensee was informed that the issue of revising the procedures and completing the appropriate training would be noted as an IFI.

During this inspection, the inspector verified that the appropriate training had been completed concerning the new Log Channel. This was accomplished through the Operator Requalification Program and requalification meetings. The inspector also verified that the affected procedures had been revised, reviewed, and approved as required. This issue is considered closed.

c. Conclusion

Three IFIs was reviewed and closed. Two violations were reviewed and closed.

**13. Exit Interview**

The inspection scope and results were summarized on November 8, 2018, with members of licensee management and staff. The inspector described the areas inspected and discussed in detail the inspection findings. The licensee acknowledged the findings and did not identify as proprietary any of the material provided to or reviewed by the inspector during the inspection.

## **PARTIAL LIST OF PERSONS CONTACTED**

### Licensee

B. Dobson	Requalification Supervisor
T. Ellis	Projects Supervisor
M. Krahenbuhl	Director, Reed Reactor Facility
E. McKnight	Training Supervisor
M. Nakashima	Training Supervisor
N. Nicholson	Dean of the Faculty, Reed College
I. Novakoski	Reactor Operations Manager
A. Sams	Radiation Safety Officer and Campus Environmental Director
C. Whitmore	Operations Supervisor

## **INSPECTION PROCEDURE USED**

IP 69001	Class II Non-Power Reactors
IP 92701	Follow-up on Previously Identified Items

## **ITEMS OPENED, CLOSED, AND DISCUSSED**

### Opened

50-288/2018-201-01	NCV	Failure to have all of required channels operable during reactor operation and failure to have a functional source interlock as required by TS Sections 3.2.2 and 3.2.3.
50-288/2018-201-02	NCV	Failure to maintain the minimum staffing requirements for having a licensed reactor operator in the Control Room when the reactor was not secured as required by TS Section 6.1.3.a(1)
50-288/2018-201-03	NCV	Failure of an operator to comply with the conditions of their license.

### Closed

50-288/2016-202-01	IFI	Follow-up on the licensee's actions to maintain logs which contain the accurate and complete documentation of scram events and other operational events.
50-288/2016-202-02	VIO	Failure to have all of required channels operable during reactor operation as required by TS Section 3.2.2.
50-288/2016-202-03	VIO	Failure to complete a review prior to installing a fission chamber instead of an UIC with the Percent Power Channel (as stipulated in the facility SAR) as required by 10 CFR 50.59 (c)(1)(i and ii) and (c)(2)(i-viii).

50-288/2016-202-01	IFI	Follow-up on the licensee's actions to correct the reactor pool overfill problem caused by the automatic fill system installed by the licensee.
50-288/2017-201-01	IFI	Follow-up on the issue of revising the procedures dealing with the installation of the new Log Channel and completing the appropriate training.
50-288/2018-201-01	NCV	Failure to have all of required channels operable during reactor operation and failure to have a functional source interlock as required by TS Sections 3.2.2 and 3.2.3.
50-288/2018-201-02	NCV	Failure to maintain the minimum staffing requirements for having a licensed reactor operator in the Control Room when the reactor was not secured as required by TS Section 6.1.3.a(1)
50-288/2018-201-01	NCV	Failure of an operator to comply with the conditions of their license.

#### **LIST OF ACRONYMS USED**

10 CFR	Title 10 of the <i>Code of Federal Regulations</i>
CAR	Corrective Action Report
E-Plan	Emergency Plan
EIP	Emergency Implementation Procedures
IFI	Inspector Follow-up Item
IP	Inspection Procedure
kW	Kilowatt
NCV	Non-Cited Violation
NI	Nuclear Instrument
NRC	U.S. Nuclear Regulatory Commission
OSU	Oregon State University
PF&R	Portland Fire and Rescue
RO	Reactor Operator
ROC	Reactor Operations Committee
RRR	Reed Research Reactor
RRRF	Reed Research Reactor Facility
SAR	Safety Analysis Report
SOP	Standard Operating Procedure
SRO	Senior Reactor Operator
TS	Technical Specification
UIC	Uncompensated Ion Chamber
VIO	Violation