

February 29, 2016

Dr. Melinda Krahenbuhl, Director  
Reed Research Reactor  
Reed College  
3203 SE Woodstock Blvd.  
Portland, OR 97202-8199

SUBJECT: REED COLLEGE – ISSUANCE OF AMENDMENT NO. 10 TO RENEWED FACILITY OPERATING LICENSE NO. R-112 TO REMOVE PH MONITORING REQUIREMENTS FROM THE TECHNICAL SPECIFICATIONS (TAC NO. MF7284)

Dear Dr. Krahenbuhl:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 10 to Renewed Facility Operating License No. R-112 for the Reed Research Reactor (RRR). The amendment consists of changes to the facility operating license and technical specifications (TSs) in response to your application dated January 7, 2016 (Agencywide Documents Access and Management System Accession No. ML16014A121). This amendment revises RRR TSs, Section 3, "Limiting Conditions of Operation," and Section 4, "Surveillance Requirements," by removing the requirement to monitor the pH of the reactor primary pool water. The safety evaluation supporting Amendment No. 10 is enclosed.

If you have any questions, please contact me at (301) 415-0893, or by electronic mail at [Geoffrey.Wertz@nrc.gov](mailto:Geoffrey.Wertz@nrc.gov).

Sincerely,

***/RA Alexander Adams for/***

Geoffrey A. Wertz, Project Manager  
Research and Test Reactors Licensing Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

Docket No. 50-288

Enclosures:

1. Amendment No. 10 to Renewed Facility Operating License No. R-112
2. Safety Evaluation

cc: See next page

Reed College

Docket No. 50-288

cc:

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Division of Policy and Rulemaking  
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cc: See next page

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**ADAMS Accession No: ML16027A243**

**\*concurrence via e-mail**

**NRR-088**

OFFICE	NRR/DPR/PRLB/PM*	NRR/DPR/PRLB/LA*	OGC	NRR/DPR/PRLB/BC	NRR/DPR/PRLB/PM
NAME	GWertz	NParker	MYoung	AAdams	GWertz (AAdams for)
DATE	2/2/16	2/2/16	2/24/16	2/4/16	2/29/16

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REED COLLEGE

DOCKET NO. 50-288

REED RESEARCH REACTOR

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 10  
Renewed License No. R-112

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:
  - A. The application for an amendment to Renewed Facility Operating License No. R-112 filed by Reed College (the licensee) on January 7, 2016, conforms to the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in Title 10 of the *Code of Federal Regulations* (10 CFR) Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance that (i) the activities authorized by this amendment can be conducted without endangering the health and safety of the public and (ii) such activities will be conducted in compliance with the regulations of the Commission;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;
  - E. This amendment is issued in accordance with the regulations of the Commission as stated in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," and all applicable requirements have been satisfied; and
  - F. Prior notice of this amendment was not required by 10 CFR 2.105, "Notice of proposed action," and publication of a notice for this amendment is not required by 10 CFR 2.106, "Notice of issuance."

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the enclosure to this license amendment, and paragraph C.(2) of Renewed Facility Operating License No. R-112 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 10, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

*/RA/*

Alexander Adams, Jr., Chief  
Research and Test Reactors Licensing Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

Attachment:  
Changes to Renewed Facility Operating License  
and Technical Specifications

Date of Issuance: February 29, 2016

ATTACHMENT TO LICENSE AMENDMENT NO. 10  
RENEWED FACILITY OPERATING LICENSE NO. R-112  
DOCKET NO. 50-288

Replace the following page of Renewed Facility Operating License No. R-112 with the revised page. The revised page is identified by amendment number and contains a marginal line indicating the area of change.

Renewed Facility Operating License

REMOVE

INSERT

Page 3

Page 3

- (3) Pursuant to the Act and 10 CFR Part 30, the following activities are included:
- a. to receive, possess, and use, in connection with the operation of the facility, a 1.64-curie sealed americium-beryllium neutron startup source;
  - b. to receive, possess, and use, but not separate, in connection with operation of the facility, such byproduct material as may be produced by operation of the reactor.
- C. This license shall be deemed to contain and is subject to the conditions specified in 10 CFR Parts 20, 30, 50, 51, 55, 70 and 73 of the Commission's regulations; is subject to all applicable provisions of the Act, and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:
- (1) Maximum Power Level

The licensee is authorized to operate the facility at a steady-state power level not in excess of 250 kilowatts (thermal) as specified in the Technical Specifications.
  - (2) Technical Specification

The Technical Specifications contained in Appendix A, as revised through Amendment No. 10, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.
  - (3) Physical Security Plan

The licensee shall maintain and fully implement all provisions of the Commission-approved physical security plan, including amendments and changes made pursuant to the authority of 10 CFR 50.54(p). The approved physical security plan entitled "Physical Security Plan for Reed College Reactor Facility," dated June 1983, submitted by letter dated November 10, 1983, as supplemented by letter dated February 22, 1984, consists of documents withheld from public disclosure pursuant to 10 CFR 2.390(d).

ATTACHMENT TO LICENSE AMENDMENT NO. 10  
RENEWED FACILITY OPERATING LICENSE NO. R-112  
DOCKET NO. 50-288

Replace the following pages of Appendix A, "Technical Specifications," with the revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Technical Specifications

REMOVE

Page 14  
Page 24

INSERT

Page 14  
Page 24



## TECHNICAL SPECIFICATIONS

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### **3.3 Reactor Primary Pool Water**

**Applicability.** This specification applies to the primary water of the reactor pool.

**Objective.** The objective is to ensure that there is an adequate amount of water in the reactor pool for fuel cooling and shielding purposes, that the bulk temperature of the reactor pool water remains sufficiently low to guarantee demineralizer resin integrity, and that pool chemistry will limit corrosion.

**Specifications.**

- a. The pool water level shall be greater than 5 meters above the upper core plate. The pool water level shall initiate an alarm signal if the pool level falls 10 cm below normal. The alarm indication shall be visible in the control room and outside the reactor facility.
- b. The bulk pool water temperature shall be less than 40°C. The pool water temperature shall initiate an alarm if the pool temperature exceeds 40°C.
- c. The conductivity of the pool water shall be less than 5.0 microsiemens/cm averaged over 1 month.
- d. The radioactivity of the pool water shall be less than the limits in 10 CFR 20 Appendix B, Table 3 for radioisotopes with half-lives greater than 24 hours.

**Basis.**

**Pool Water Level:** The minimum height of 5 meters of water above the upper core plate guarantees that there is sufficient water for effective cooling of the fuel and that the radiation levels at the top of the reactor are within acceptable levels. The pool level is limited to a decrease of no more than 10 cm below normal to allow early detection of pool leakage. (RAI Response, May 20, 2011)

**Pool Water Temperature:** The bulk water temperature limit is necessary, according to the resin manufacturer, to ensure that the resin does not break down. The temperature limit also ensures the core inlet temperature is acceptable for the accident analysis. (RAI Response, December 12, 2011)

**Pool Water Conductivity:** Experience at many research reactor facilities has shown that maintaining the conductivity within the specified limit provides acceptable control of corrosion (NUREG-1537 Appendix 14, Section 3.3.(9)).

**Pool Water Radioactivity:** Pool activity is limited to ensure dose rates are maintained below 10 CFR 20 limits.

### **4.3 Reactor Primary Pool Water**

Applicability. This specification applies to the surveillance requirements for the reactor pool water.

Objective. The objective is to ensure that the reactor pool water level, the water temperature, and the conductivity monitoring systems are operating, and to verify appropriate alarm settings.

Specifications.

- a. A channel check of the reactor pool water level shall be performed monthly.
- b. A channel check of the reactor pool water temperature and level monitors shall be performed prior to each day's operation or prior to each operation extending more than one day.
- c. A channel calibration of the reactor pool water level and temperature monitors shall be performed annually.
- d. The reactor pool water conductivity shall be measured monthly.
- e. The reactor pool water radioactivity shall be measured quarterly.

Basis. Experience has shown that the frequencies of checks on systems that monitor reactor primary water level, temperature, and conductivity adequately keep the pool water at the proper level and maintain water quality at such a level to minimize corrosion and maintain safety.

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 10 TO

RENEWED FACILITY OPERATING LICENSE NO. R-112

REED COLLEGE

REED RESEARCH REACTOR

DOCKET NO. 50-288

1.0 INTRODUCTION

By letter dated January 7, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16014A121), Reed College (the licensee) requested an amendment to the Technical Specifications (TSs) for the Reed Research Reactor (RRR). The proposed amendment would remove the requirement to monitor the percent hydrogen (pH) of the RRR reactor primary pool water. The technical basis for this requested amendment was provided by the Nuclear Regulatory Commission (NRC) staff memorandum, "Research and Test Reactors Pool Water – Safety Evaluation on Electrolytic Conductivity," dated May 11, 2015 (ADAMS Accession No. ML15114A433). The licensee's request to remove the TS requirements associated with the reactor primary pool water pH is supported by the NRC staff memorandum, which allows licensees to maintain effective corrosion protection of reactor components by limiting the electrolytic conductivity of the primary pool water.

2.0 EVALUATION

The licensee's proposed changes to the RRR TSs would delete the requirement to maintain the pH of the pool water provide by TS Limiting Condition of Operation (LCO) 3.3.d., and remove pH from the surveillance requirement in TS Surveillance Requirement (SR) 4.3.d, leaving the reactor primary pool water conductivity as the monitored parameter. The associated TS bases would be amended to reflect the removal of the pH monitoring requirements.

The licensee's current TSs and proposed TS changes follow:

2.1 TS LCO 3.3 Reactor Primary Pool Water

The current TS LCO 3.3.d. states:

- d. The pH of the pool water shall be between 5.0 and 7.5 averaged over 1 month.

The proposed TS LCO 3.3.d

TS 3.3.d., will be removed and replaced by the current TS 3.3.e., in order to preserve the sequential listing of the specifications in TS 3.3.

2.2 TS SR 4.3 Reactor Primary Pool Water

The current TS SR 4.3.d. states:

- d. The reactor pool water conductivity and pH shall be measured monthly.

The proposed TS SR 4.3.d

- d. The reactor pool water conductivity shall be measured monthly.

2.3 Reactor Coolant Water Purity Control

The control of reactor coolant water purity in research and test reactors is important to limit the potential for corrosion and oxidation of the reactor fuel and other reactor components in contact with the reactor primary pool water. Guidance for the control of the reactor coolant water purity for research and test reactors (RTRs) has been provided in NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactor," Parts 1 and 2, February 1996, (ADAMS Accession Nos. ML042430055 and ML042430048, respectively). NUREG-1537 provides two measures of the reactor primary coolant water to maintain effective corrosion control: 1) pH between 5.5 and 7.5; and 2) electrolytic conductivity less than or equal to 5 micromhos per cm ( $\mu\text{mho/cm}$ ) (5 microsiemens/cm) or less.

However, in response to requests by various RTR licensees, the NRC staff undertook a review of the effectiveness of electrolytic conductivity, as a single control measure, to control reactor primary pool water purity. The results of the NRC staff review concluded that electrolytic conductivity would be an effective control measure for maintaining the reactor primary pool water purity sufficient to minimize the potential for corrosion or oxidation of submerged reactor components. The results, provided in NRC staff memorandum, dated May 11, 2015 (ADAMS Accession No. ML15114A433), indicated that for open (to the atmosphere) pool light water reactor coolant systems, the relationship between high purity water and conductivity at or below 5 micromhos/cm (5 microsiemens/cm) ensures that the pH values will remain within 5.6 to 5.8. The NRC staff concluded that the requirement to maintain pH is not necessary if the RTR facility design includes an open reactor primary pool coolant system, and has incorporated the guidance in NUREG-1537 into their TSs to maintain an electrolytic conductivity of 5 micromhos/cm (5 microsiemens/cm) or less, for the reactor coolant water.

The RRR uses stainless steel clad TRIGA fuel elements submerged in an open pool light water reactor coolant system. A full description of the RRR reactor primary pool water system is in the RRR Safety Evaluation Report, completed to support the RRR license renewal, dated April 25, 2012 (ADAMS Accession No. ML120530019). The current RRR TS LCO 3.3.c., has a requirement to maintain the electrolytic conductivity of the pool water at less than 5.0 microsiemens/cm averaged over 1 month. The proposed amendment would not change this TS LCO requirement. Additionally, the current RRR TS SR 4.3.d., requires that the reactor pool

water conductivity be measured monthly. The proposed amendment would not change this TS SR.

NRC staff has reviewed the licensee's proposed changes to the RRR TSs, and finds that the design of the RRR, along with the required conductivity limit in the current RRR TS LCO 3.3.c., of less than 5 micromhos/cm (5 microsiemens/cm), are consistent with the criteria listed in NRC staff memorandum, dated May 11, 2015 (ADAMS Accession No. ML15114A433) to allow the licensee to eliminate the need to monitor the reactor primary pool water pH. Based on this information provided above, the NRC staff concludes that the proposed TS changes are acceptable.

### 3.0 ENVIRONMENTAL CONSIDERATION

The NRC's regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) 51.22(a) states, in part, that the issuance of an amendment to a 10 CFR 50 license is eligible for a categorical exclusion if the Commission has declared that the action does not individually or cumulatively have a significant effect on the human environment. This amendment involves a change to use of a facility component and a change to a TS LCO and SR. Specifically, this change will eliminate the TS requirements to monitor the pH of the reactor primary pool water. As stated in 10 CFR 51.22(c)(9), the issuance of the amendment is subject to a categorical exclusion if it meets the requirements below:

- (i) *The amendment involves no significant hazards consideration; [10 CFR 51.22(c)(9)(i)]*

The NRC's regulations in 10 CFR 50.92(c) states that a license amendment involves no significant hazards consideration if operation of the facility, in accordance with the proposed amendment, would not:

- (1) *Involve a significant increase in the probability or consequences of an accident previously evaluated; or [10 CFR 50.92(c)(1)]*
- (2) *Create the possibility of a new or different kind of accident from any accident previously evaluated; or [10 CFR 50.92(c)(2)]*
- (3) *Involve a significant reduction in a margin of safety [10 CFR 50.92(c)(3)]*

These changes delete the pH monitoring parameter associated with the reactor primary pool water, which affects the potential for corrosion and oxidation of the reactor fuel and primary components. The pH is effectively controlled when the electrolytic conductivity limit is properly established and maintained in the TSs, for an open pool light water reactor cooling system, because of the physical relationship between pH and electrolytic conductivity. Therefore, the proper control of the electrolytic conductivity is effective to help ensure that the potential for corrosion or oxidation of reactor fuel or primary components is minimized. The proposed changes do not increase the probability or consequences of an accident previously evaluated, create the possibility for a new or different kind of accident from any accident previously evaluated, or involve a significant reduction in a margin of safety, based on the continued requirements for effective corrosion control and a review of any accidents involving the corrosion or oxidation of

the reactor fuel or primary components or a significant reduction in a margin of safety as described in the licensee's safety analysis report. Based on the above, the NRC staff concludes that this amendment involves no significant hazards consideration.

- (ii) *There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite; and [10 CFR 51.22(c)(9)(ii)]*

The changes delete a pH monitoring parameter associated with the reactor primary pool water, which affects the potential for corrosion and oxidation of the reactor fuel and primary components. However, monitoring the pH is not necessary to control the potential for corrosion or oxidation of the reactor fuel or primary components given the design of the RRR pool and the current TS limit associated with the control of the reactor primary pool water electrolytic conductivity. Thus, the NRC staff concludes that there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite due to allowing conductivity to limit coolant pH.

- (iii) *There is no significant increase in individual or cumulative occupational radiation exposure. [10 CFR 51.22(c)(9)(iii)]*

These changes involve a monitoring parameter associated with the reactor primary pool water, which affects the potential for corrosion and oxidation of the reactor fuel and primary components. Individual or cumulative occupational radiation exposure could be affected by the amount of corrosion products in the reactor primary pool water; however, the water quality monitoring parameter, conductivity, TS 3.3.c., effectively controls pH, for the reasons described in the evaluation above, and ensures that the potential corrosion products are maintained within acceptable limits. The licensee uses an ion exchange resin system to help ensure that the primary water radioactivity, as required by TS 3.3.d, are limited to the values provided in 10 CFR Part 20, Appendix B, Table 3. Therefore, the NRC staff finds that there is no significant increase in individual or cumulative occupational radiation exposure caused by the issuance of this amendment.

Accordingly, this amendment meets the eligibility criteria for categorical exclusion as set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

#### 4. CONCLUSION

The NRC staff concludes, on the basis of the considerations discussed above, that (1) there is reasonable assurance that the health and safety of the public will not be endangered by the proposed activities; and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or the health and safety of the public.

Principal Contributors: G. Wertz, NRR

Date: February 29, 2016