UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

THE REED INSTITUTE (REED COLLEGE)

DOCKET NO. 50-288

FACILITY LICENSE

License No. R-112

The Atomic Energy Commission ("the Commission") having found, with respect to the application for license of The Reed Institute (Reed College) (hereinafter "Reed College" or "the licensee"), that:

a. The application for license complies with the requirements of the Atomic Energy Act of 1954, as amended (hereinafter "the Act"), and the Commission's regulations set forth in Title 10, Chapter 1, CFR;

b. The reactor has been constructed in conformity with Construction Permit No. CPRR-101 and will operate in conformity with the application and in conformity with the Act and the rules and regulations of the Commission;

c. There is reasonable assurance that the reactor can be operated at the designated location without endangering the health and safety of the public;

d. Reed College is technically and financially qualified to engage in the proposed activities in accordance with the Commission's regulations;

e. The issuance of this license will not be inimical to the common defense and security or to the health and safety of the public; and

f. Reed College is a nonprofit educational institution and will operate the reactor for the conduct of educational activities. Reed College is therefore exempt from the financial protection requirements of Section 170 of the Act.

Facility License No. R-112, effective as of the date of issuance, is issued as follows:

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1. This license applies to the TRIGA Mark I type nuclear reactor (herein "the reactor"), owned by Reed College and located on its campus in Portland, Oregon, and which is described in the application for license dated April 15, 1967, and supplements thereto dated July 5 and August 22, 1967, and March 13 and April 26, 1968 (herein referred to as "the application"), and authorized for construction by Construction Permit No. CPRR-101.

2. Subject to the conditions and requirements incorporated herein, the Commission hereby licenses Reed College:

   A. Pursuant to Section 104 c of the Act and Title 10, Chapter 1, CFR, Part 50, "Licensing of Production and Utilization Facilities", to possess, use and operate the reactor as a utilization facility in accordance with the procedures and limitations described in the application and in this license;

   B. Pursuant to the Act and Title 10, Chapter 1, CFR, Part 70, "Special Nuclear Material", to receive, possess and use up to 2500 grams of contained uranium-235 and a 1-curie plutonium-beryllium neutron source, all for use in connection with operation of the reactor; and

   C. Pursuant to the Act and Title 10, Chapter 1, CFR, Part 30, "Rules of General Applicability to Licensing of Byproduct Material", to receive, possess and use a 1.64-curie sealed americium-beryllium neutron source for reactor startup and to possess, but not to separate, such byproduct material as may be produced by operation of the reactor.

3. This license shall be deemed to contain and be subject to the conditions specified in Part 20, Section 30.34 of Part 30, Sections 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70 of the Commission's regulations; is subject to all applicable provisions of the Act and rules, regulations and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

   A. Maximum Power Level

      The licensee may operate the reactor at steady-state power levels up to a maximum of 250 kilowatts (thermal).

B. Technical Specifications:

B. The Technical Specifications contained in Appendix A, as revised through Change No. 4, are hereby incorporated in this license. The licensee shall operate the reactor in accordance with these Technical Specifications. No changes shall be made in the Technical Specifications unless authorized by the Commission as provided in Section 50.59 of 10 CFR Part 50.

C. Records

In addition to those otherwise required under this license and applicable regulations, the licensee shall keep the following records:

(1) Reactor operating records, including power levels and periods of operation at each power level.

(2) Records showing radioactivity released or discharged into the air or water beyond the effective control of of the licensee as measured at or prior to the point of such release or discharge.

(3) Records of emergency shutdowns and inadvertent scrams, including reasons therefor.

(4) Records of maintenance operations involving substitution or replacement of reactor equipment or components.

(5) Records of experiments installed including description, reactivity worths, locations, exposure time, total irradiation and any unusual events involved in their handling.

(6) Records of tests and measurements performed pursuant to the Technical Specifications.

D. Reports

In addition to reports otherwise required by applicable regulations:

(1) The licensee shall inform the Commission of any incident or condition relating to the operation of the reactor which prevented or could have prevented a nuclear system from performing its safety function as described in the Technical Specifications or in the safety analysis report. For each such occurrence, Reed College shall promptly notify by telephone or telegraph the Director of the appropriate Atomic Energy Commission Regional Compliance Office listed in Appendix D of 10 CFR Part 20 and shall submit within ten (10) days a report in writing to the Director, Division of Reactor Licensing (hereinafter, "Director, DRL"), with a copy to the Regional Compliance Office.

(2) As promptly as practicable, but no later than sixty (60) days after the initial criticality of the facility, Reed College shall submit a written report to the Director, DRL, describing the measured values of the operating conditions or characteristics listed below and evaluating any significant variation of a measured value from the corresponding predicted value:

(a) Maximum excess reactivity of the facility, not including the worth of control rods or other control devices such as burnable poison strips or soluble poison, or any experiments;

(b) Total control rod reactivity worth;

(c) Minimum shutdown margin both at room and operating temperatures;

(d) Maximum worth of the single control rod of highest reactivity value; and

(e) Maximum total and individual reactivity worth of any fixed or movable experiments inserted in the facility.

(3) The licensee shall report to the Director, DRL, in writing within thirty (30) days of its occurrence any substantial variance disclosed by operation of the

reactor from performance specifications contained in the safety analysis report or in the Technical Specifications.

(4) The licensee shall report to the Director, DRL, in writing within thirty (30) days of its occurrence, any significant change in the transient or accident analysis, as described in the safety analysis report.

E. 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 2.790(d).

Amdt. #4, 7-9-84

4. This license is effective as of the date of issuance and shall expire at midnight, October 3, 2007.

FOR THE ATOMIC ENERGY COMMISSION

Donald J. Skovholt

Donald J. Skovholt
Assistant Director for Reactor Operations
Division of Reactor Licensing

Attachment:
Appendix A - Technical Specifications

Date of Issuance: July 2, 1968

APPENDIX A

LICENSE R-112

TECHNICAL SPECIFICATIONS FOR THE

REED COLLEGE TRIGA MARK I REACTOR

DATE: July 2, 1968

The dimensions, measurements, and other numerical values given in these specifications may differ from measured values owing to normal construction and manufacturing tolerances, or normal accuracy of instrumentation.

A. Definitions

1. Shutdown

The reactor, with fixed experiments in place, shall be considered to be shut down (not in operation) whenever all of the following conditions have been met: (a) the console key switch is in the "off" position and the key is removed from the console and under the control of a licensed operator (or stored in a locked storage area); (b) sufficient control rods are inserted so as to assure the reactor is subcritical by a margin greater than 0.7% delta k/k cold, without xenon; (c) no work is in progress involving fuel handling or refueling operations or maintenance of its control mechanisms.

2. Steady-State Mode

Steady-state mode shall mean operation of the reactor at power levels not to exceed 250 kilowatts utilizing the scrams in Table I and the interlocks in Table II. However, for the purpose of testing the 110% full power safety circuits, an exception shall be made to allow the reactor to be operated at power levels not to exceed 287.5 kilowatts during the testing period.

3. Operable

A system or component shall be considered operable when it is capable of performing its intended functions in its normal manner.

4. Experiment

Experiment shall mean:

(a) Any apparatus, device, or material installed in the core or experimental facilities (except for underwater lights, fuel element storage racks and the like) which is not a normal part of these facilities.

(b) Any operation designed to measure reactor parameters or characteristics.

5. Experimental Facilities

Experimental facilities shall mean rotary specimen rack, vertical tubes, pneumatic transfer systems, central thimble, and in-pool irradiation facilities.

6. Reactor Safety Circuits

Reactor safety circuits shall mean those circuits, including their associated input circuits, which are designed to initiate a reactor scram.

B. Site

The minimum distance from the center of the reactor pool to the boundary of the exclusion area shall be 250 feet.

C. Reactor Building

1. The reactor shall be housed in a closed room designed to restrict leakage. The minimum free volume in the reactor room shall be 12,000 cubic feet.

2. All air or other gas exhausted from the reactor room and from associated experimental facilities during reactor operation shall be released to the environment at a minimum of 12 feet above ground level.

D. Reactor Pool and Bridge

1. The reactor core shall be cooled by natural convective water flow. Corrective action shall be taken if during reactor operation the pool water level is less than 16 feet above the top grid plate. The bulk pool temperature shall be monitored while the reactor is in operation and the reactor shall be shut down if the temperature exceeds 120°F.

2. The pool water shall be sampled for conductivity at least weekly. Conductivity averaged over a month shall not exceed 2 micromhos per centimeter.

E. Reactor Core

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1. The core shall be an assembly of TRIGA Mark I aluminum clad (and/or stainless steel cla fuel-moderator elements arranged in a close-packed array except ... 1) replacement of single individual elements with in core irradiation facilities or control rods; (2, two separated experiment positions in the D through E rings, each occupying a maximum of three fuel element positions. The reflector (excluding experiments and experimental facilities) shall be water or a combination of graphite and water.

2. The maximum available excess reactivity above cold, critical, without xenon, shall be 2.25% delta k/k with experiments in place.

"3. Each standard fuel element shall be visually inspected at least once every five years. At least 1/5 of all the fuel elements of the core shall be inspected at yearly intervals. If indication of apparent deterioration or distortion is found, the fuel element(s) shall be removed from the core. Ch 4 #4 1-17-74

4. Any fuel element which exhibits a clad break as indicated by a measurable release of fission products shall be located and removed from service before resumption of routine reactor operation.

F. Control and Safety Systems

1. The control elements shall have scram capability and the poison section shall contain borated graphite, B_4C powder, or boron and its compounds in solid form as a poison in an aluminum clad.

2. The control elements shall be visually inspected at least once every two years. If indication of significant distortion or deterioration is found, the element(s) will be replaced.

3. The minimum shutdown margin (with fixed experiments in place) provided by operable control elements in the cold condition, without xenon, with the most reactive of the operable control elements withdrawn shall be 0.4% delta k/k.

4. The maximum rate of reactivity insertion associated with movement of a standard rod shall be no greater than 0.12% delta k/k sec.

5. The type and minimum number of safety circuits which shall be operable for reactor operation are shown in Table I.

6. The type and minimum number of interlocks which shall be operable for reactor operation are shown in Table II.

7. The reactor instrumentation channels and safety circuits as listed in Table I shall be verified to be operable at least once each day the reactor is operated unless the operation extends continuously beyond one day, in which case their operability need only be verified prior to beginning the extended operation.

8. Following maintenance or modification of the control or safety systems, it shall be verified that the affected system is operable before reactor operation is resumed.

9. The tests listed below shall be performed at least once semi-annually, with the exception that if the reactor is operating continuously, the tests shall be performed after the first shutdown if this occurs more than six months after the previous tests:

   a. Verification that all control element drop times are less than one second. If drop time is found to be greater than this, the element shall not be considered operable.

   b. A functional test of the ventilation system interlocks.

10. The linear power level channel shall be calibrated at least annually by thermal power calibration.

G. Radiation Monitoring

1. The radiation levels within the reactor laboratory shall be monitored by at least one area radiation monitor during reactor operation or when work is done on or around the reactor core or experimental facilities. The monitor shall have a readout and provide a signal which actuates an evacuation alarm. During short periods of repair to this monitor, reactor operations may continue while a portable gamma-sensitive ion chamber is utilized as a temporary substitute.

2. A continuous air monitor with readout and audible alarm shall be operable in the reactor room when the reactor is operating.

3. The alarm set points for the above radiation monitoring instrumentation shall be verified at least once a week. This instrumentation shall be calibrated at least once a year.

H. Fuel Storage

1. All fuel elements or fueled devices shall be rigidly supported during storage in a safe geometry (k_{eff} less than 0.8 under all conditions of moderation).

2. Irradiated fuel elements and fueled devices shall be stored in an array which will permit sufficient natural convection cooling such that the fuel element or fueled device temperature will not exceed design values.

I. Administrative Requirements

1. The facility shall be under the direct control of the Facility Director. He shall be responsible to the President of Reed College for safe operation and maintenance of the reactor and its associated equipment. His staff shall include a reactor supervisor, senior reactor operators, and reactor

operators. He (or his appointee) shall review and approve all experiments and experimental procedures prior to their use in the reactor. He shall enforce rules for the protection of personnel against radiation.

2. A Radiation Safety Committee shall review and approve safety standards associated with operation and use of the facility. It shall report directly to the President of Reed College. Its membership shall consist of faculty members and individuals from outside organizations not connected with operation of the reactor facility. It shall meet at least twice yearly to review **safety aspects of facility operations.** Ch 9 2, LEL 10/3/72

3. A Reactor Operations Committee shall be composed of a minimum of four members of the faculty and facility staff, including the reactor supervisor and a qualified health physicist. **It shall rewiew facility operations at least twice yearly and shall meet as required to review all questions of** safety of operation and scheduling of work of a non-routine nature. **It shall review all experiments of the following types:**

   (a) Any experiment involving fissionable material.

   (b) Any new experiment of a type not previously reviewed by the committee.

   (c) Any experiment involving a change of core configuration or change in equipment associated with the reactor.

   The Committee shall be responsible for determining whether a proposed change, test or experiment would constitute an unreviewed safety question or a change in technical specifications, as required by 10 CFR 50.59. The Committee shall establish written procedures regarding quorums, subcommittees, review of experiments and operations and others as appropriate.

4. Any additions, modifications, or maintenance to the core and its associated support structure, the pool structure, and rod drive mechanisms, or the reactor safety system, shall be made and tested in accordance with the specifications to which the systems or components were originally designed and fabricated, or to specifications approved by the Reactor Operations Committee as suitable and not involving an unreviewed safety question. The reactor shall not be placed in operation until the affected system has been verified to be operable.

5. Written instructions shall be in effect for, but not limited to:

   (a) Checkout and calibration of reactor operating instrumentation and control, control rod drives, and area radiation monitors and air particulate monitors.

   (b) Reactor startup, routine operation and reactor shutdown.

   (c) Emergency and abnormal conditions, including evacuations, reentry and recovery.

   (d) Fuel loading or unloading.

   (e) Control rod removal and replacement.

   (f) Maintenance operations which may affect reactor safety.

J. Experiments

1. Prior to performing any new reactor experiment, the proposed experiment shall be evaluated by a person or persons appointed by the Facility Director to be responsible for reactor safety. He shall consider the experiment in terms of its effect on reactor operation and the possibility and consequences of its failure, including, where significant, consideration of chemical reactions, physical integrity, design life, proper cooling, interaction with core components, and reactivity effects. He shall determine whether, in his judgment, the experiment by virtue of its nature and/or design does not constitute a significant threat to the integrity of the core or to the safety of personnel. Following a favorable determination and prior to conducting an experiment, he must sign an authorization form containing the basis for the favorable determination.

2. No experiment shall be performed if failure of such experiment could lead to a failure of a fuel element or of other experiments and these associated failures could result in a measurable increase in reactivity or a measurable release of radioactivity.

3. No new experiment shall be performed until the proposed experimental procedure for that experiment or type of experiment has been reviewed by the Reactor Operations Committee.

4. The following limitations on reactivity shall apply to all experiments:

   (a) The reactivity worth of any individual in-core experiment shall not exceed $1.35.

   (b) The total reactivity worth of in-core experiments shall not exceed $2.00. This includes the potential reactivity which might result from experimental malfunction, experiment flooding or voiding and removal or insertion of experiments.

(c) Experiments having reactivity worths greater than $1.00 shall be securely located or fastened to prevent inadvertent movement during reactor operations.

5. Experiments containing materials corrosive to reactor components, compounds highly reactive with water, and liquid fissionable materials shall be doubly encapsulated.

6. Explosive materials shall not be irradiated in the reactor.

7. Experiment materials, except fuel materials, which could off-gas, sublime, volatilize or produce aerosols under (a) normal operating conditions of the experiment or reactor, (b) credible accident conditions in the reactor, or (c) possible accident conditions in the experiment shall be limited in activity such that if 100% of the gaseous activity or radioactive aerosols produced escaped to the reactor room or the atmosphere, the airborne concentration of radioactivity averaged over a year would not exceed the limits of Appendix B of 10 CFR Part 20.

8. The following assumptions shall be used in calculations regarding experiments:

(a) If the effluent from an experiment facility exhausts through a holdup tank which closes automatically on high radiation level, 10% of the gaseous activity or aerosols produced will escape.

(b) If the effluent from an experiment facility exhausts through a filter installation designed for greater than 99% efficiency for 0.3 micron particles, 10% of the aerosols produced will escape.

(c) For materials whose boiling point is above 130°F and where vapors formed by boiling this material could escape only through an undistrubed column of water above the core, 10% of these vapors will escape.

9. Each fueled experiment shall be controlled such that the total inventory of iodine isotopes 131 through 135 in the experiment is no greater than 1.5 curies and the maximum strontium-90 inventory is no greater than 5 millicuries.

10. If a capsule fails and releases material which could damage the reactor fuel or structure by corrosion or other means, physical inspection shall be performed to determine the consequences and need for corrective action. The results of the inspection and any corrective action taken shall be reviewed by the Facility Director and determined to be satisfactory before operation of the reactor is resumed.

TABLE I

MAXIMUM REACTOR SAFETY SYSTEM SCRAMS

Originating Channel	Set Point
1. Linear	110% of full power
2. Percent Power	110% of full power
3. Scram button on console	Manual

TABLE II

MINIMUM INTERLOCKS

Action Prevented
1. Control element withdrawal with less than two neutron induced counts per second on the startup channel.
2. Simultaneous manual withdrawal of two control elements.

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K. Plant Operating Records

In addition to the requirements of applicable regulations and in no way substituting therefor, records and logs of the following items, as a minimum, shall be kept in a manner convenient for review and shall be retained as indicated:

1. Records to be retained for a period of at least five (5) years:

   (a) reactor operations, including unscheduled shutdowns;

   (b) principal maintenance activities and the reasons therefor;

   (c) shipments of radioactive materials;

   (d) equipment and components surveillance activities;

   (e) experiments performed with the reactor.

2. Records to be retained for the life of the facility:

   (a) gaseous and liquid radioactive waste released to the environs;

   (b) off-site environmental monitoring surveys;

   (c) facility radiation and contamination surveys;

   (d) fuel inventories and transfers;

   (e) updated, corrected and as-built facility drawings.