CORNELL

Ward Center for Nuclear Sciences

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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Subject: Facility License R-80; Docket 50-157: Request for a License Amendment to withdraw NRC authorization to operate the Cornell TRIGA Reactor

Reference: Letter from Cornell University to Document Control Desk, U.S. NRC, dated 8/13/2001

Dear Commissioner: June 24, 2003

The Board of Trustees of Cornell University voted on May 25, 2001, to accept the recommendation of President Hunter R. Rawlings to close the Ward Center for Nuclear Sciences and to decommission the nuclear reactor associated with the Center. Consequently, Cornell hereby requests that its Facility License R-80 be amended so as to withdraw U.S Nuclear Regulatory Commission (NRC) authorization to operate the subject reactor.

On July 1, 2002 the Cornell TRIGA Reactor ceased to operate as a user facility and since that time the TRIGA has been used solely for operator requalification and for reactivity measurements, all at powers of less than 10 watts.

In support of the Request for License Amendment, the following actions and changes to the license and to the Technical Specifications contained in Appendix A of the license are proposed:

1. Change the portion of section 2.B.2 of the license, " possess and use" to **"possess but not use"**.
2. Delete C.1 in its entirety.
3. Change the portion of section C. 2. of the license, "as revised through Amendment No. 8" to **"as revised through Amendment 13"**.
4. Proposed changes to Technical Specifications are attached herewith.
5. A proposed revision to the Operator Requalification Program is attached herewith.

(In items 4 and 5, text deletions are marked by strikethroughs, and text additions are in italics.)

In support of the subject request the following safety issues are addressed:

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1. Assurance that the reactor will remain subcritical.

On 4/22/2003 reactivity measurements showed that 83 fuel rods were required to achieve criticality, cold clean, with all control rods withdrawn. For assurance that the reactor is maintained in a subcritical state, all fuel rods have been removed from the B, C, and D rings of the TRIGA grid plate with no more than 46 fuel rods stored in the E and F rings of the grid plate. With this configuration the shut down margin is 34.00$. Of a total of 122 fuel rods at Cornell, the remaining 76 fuel rods (nineteen (19) fuel rods stored in each of four (4) approved storage racks) are located in the reactor pool. For further assurance that the TRIGA will be maintained in an inoperable state, Cornell will disconnect power to the control drive units.

The fuel rods at Cornell are handled with a long flexible handling tool provided by General Atomics. When not in use the handling tool is stored in a locked room, the door of which is equipped with an intrusion detection system described in the Cornell Physical Protection Plan.

2. Adequate operating staff.

The present operating staff consists of two Senior Reactor Operators and one Reactor Operator, which is sufficient to handle equipment maintenance and surveillance requirements specified in the Technical Specifications.

3. Radiation protection.

Radiation monitoring equipment, with the exception of the Argone-41 monitor, will be maintained in accordance with the revised Technical Specifications. Radiation monitoring of personnel will continue with film badges and pocket dosimeters.

4. Physical security

The physical security of Ward Lab is maintained by the Cornell University Police as specified in the Physical Protection Plan for Ward Lab. The number of surveillance and inspection tours by the Cornell Police has been increased since 9/11/01.

Cornell University appreciates your assistance in considering this request and is hopeful of an expeditious approval. If you have any questions or require additional information, please do not hesitate to contact me.

Sincerely,

Mr. Howard C. Aderhold
Laboratory Director

cc:

Dr. John Silcox; V.P. for Physical Sci. and Engr, Cornell University.
Mr. Charles R. Fay; V.P. for Research Administration, Cornell University.
Mr. Daniel Hughes, Project Manager, Non-Power Reactors, U.S.N.R.C.
Mr. Thomas Dragoun, Regional Administrator, U.S.N.R.C. Region I.
Mr Thomas J. McGiff, Radiation Safety Officer, Cornell University

PROPOSED REVISION

June 19, 2003

APPENDIX A

FACILITY LICENSE NO. R-80
TECHNICAL SPECIFICATIONS
FOR THE
CORNELL UNIVERSITY
TRIGA RESEARCH REACTOR
DOCKET NO. 50-197

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1.0 DEFINITIONS

The following frequently used terms are defined to aid in the uniform interpretation of these specifications.

~~Channel Calibration: A channel calibration is an adjustment of the channel so that its output responds, with acceptable range and accuracy, to known values of the parameter that the channel measures.~~

~~Channel Check: A channel check is a qualitative verification of acceptable performance by observation of channel behavior. This verification shall include comparison of the channel with expected values, or other independent channels or methods of measuring the same variable.~~

~~Channel Test: A channel test is the introduction of an input signal into a channel to verify that it is operable.~~

Control Rod, Standard: A standard control rod is one having rack and pinion, electric motor drive, and scram capability.

Control Rod, Transient: A transient rod is one that is pneumatically operated and has scram capability.

Engineered Safety Features: Engineered safety features are features of a unit, other than reactor trip or those used only for normal operation, that are provided to prevent, limit, or mitigate the release of radioactive material.

~~Experiment: An experiment is (1) any apparatus, device, or material placed in the reactor core region (in an experimental facility associated with the reactor, or in line with a beam of radiation emanating from the reactor) or (2) any incore operation designed to measure reactor characteristics.~~

~~Experimental Facility: Experimental facilities are the beamports, thermal column, pneumatic transfer systems, central thimble, rotary specimen rack, and the incore facilities (including single-element positions, and the seven-element position).~~

FSR: The "Final Safeguards Report to the U.S. Atomic Energy Commission for the Cornell University TRIGA Reactor" (CURL-2), May 1961 plus Supplement No. 1 as revised in March 1983.

~~Hexagonal Section: A hexagonal section is a part of the upper grid plate that can be removed for insertion of specimens up to 5.0 in. in diameter after relocation of the six B-ring elements and removal of the central thimble.~~

~~Independent Experiments: Independent experiments are those not connected by a mechanical, chemical, or electrical link.~~

Measured Value: The measured value of a parameter is the value as it appears at the output of a measuring channel.

Measuring Channel: A measuring channel is the combination of sensor, lines, amplifiers, and output devices that are connected for the purpose of measuring the value of a process variable.

~~Movable Experiment: A movable experiment is one that may be moved in or near the core or into and out of the reactor while the reactor is operating.~~

~~Non-secured Experiment: Non-secured experiments are those that should not move while the reactor is operating, but are held in place with less restraint than a secured experiment.~~

~~Normal Mode Operation: Normal mode operation is operation with a stainless-steel-clad high-hydride thermocouple fuel element in the core.~~

Operable: A system or component is operable when it is capable of performing its intended function in a normal manner.

Operating: A system or component is operating when it is performing its intended function in a normal manner.

~~Pulse Mode: The reactor is in the pulse mode when the reactor mode selection switch is in the pulse position. In this mode, reactor power is increased on periods less than 1 sec by motion of the transient control rod.~~

~~Reactor Safety System: The reactor safety system is that combination of measuring channels and associated circuitry that is designed to initiate reactor scram or that provides information that requires manual protective action to be initiated.~~

Reactor Secured: The reactor is secured when all of the following conditions are satisfied:

(1) reactor shutdown
(2) electrical power to the control rod circuits is switched off and the switch key is in proper custody
(3) no work is in progress involving incore components, experiments, or installed control rod drives

~~Reactor Shutdown: The reactor is in a shutdown (sub-critical) condition when the negative reactivity of the cold, clean core is equal to or greater than the shutdown margin.~~

Reportable Occurrences: A reportable occurrence is any of the conditions described in Section 6.9 of these specifications.

~~Research Reactor: A research reactor is one primarily designed to supply neutrons or ionizing radiation for experimental purposes.~~

~~Restricted Mode Operation: Restricted mode operation is operation with one aluminum-clad low-hydride thermocouple fuel element in the B-ring and no stainless-steel-clad high-hydride thermocouple fuel element in the core.~~

Ring: A ring is one of the five concentric banks of fuel elements surrounding the central opening of the core. The rings are designated by the letters B through F, with the letter B used to designate the innermost ring

~~Safety Channel: A safety channel is a measuring channel in the reactor safety system.~~

~~Secured Experiment: A secured experiment is an experiment held firmly in place by a mechanical device or by gravity providing that the weight of the experiment is such that it cannot be moved by a force of less than 60lb.~~

~~Secured Experiment With Movable Parts: A secured experiment with movable parts is one that contains parts that are intended to be moved while the reactor is operating.~~

Shutdown Margin: The shutdown margin is the minimum shutdown reactivity necessary to provide confidence that the reactor can be made sub-critical by means of the control and safety systems, starting from any permissible operating condition, and that the reactor will remain sub-critical, without further operator action.

Standard Thermocouple Fuel Element: A standard thermocouple fuel element is a standard fuel element containing three sheathed thermocouples imbedded in the fuel element.

Steady-State Mode: The reactor is in the steady-state mode when the reactor mode selection switch is in either the manual or automatic position.

True Value: The true value of a parameter is its exact value at any instant.

2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 Safety Limit Fuel Element Temperature

Applicability: This specification applies to the fuel element temperature.

Objective: The objective is to define the maximum fuel element temperature that can be permitted with confidence that no fuel element cladding damage will result.

Specification: The temperature in a stainless-steel-clad, high-hydride fuel element shall not exceed 1,000 °C under any conditions of operation. The temperature in an aluminum-clad low-hydride fuel element shall not exceed 530 °C under any conditions of operation.

Bases: The important process variable for a TRIGA reactor is the fuel element temperature. This parameter if well suited as a single specification, and it is readily measured. A loss in the integrity of the fuel element cladding could arise from an excessive buildup of pressure between the fuel moderator and the cladding. The pressure is caused by the presence of fission product gases and dissociation of the hydrogen and zirconium in the fuel moderator. The magnitude of this pressure is determined by the fuel moderator temperature.

The safety limit for the high-hydride ($ZrH_{1.7}$) fuel elements is based on data presented in the "Hazards Report for the Oregon State University 250 kW TRIGA MARK II Reactor," General Atomic Report GA-6499, June 1965, first paragraph of Section 4.7, which indicates that the stress in the cladding (resulting from the hydrogen pressure from the dissociation of the zirconium hydride) will remain below the rupture stress provided the temperature of the fuel does not exceed 1,000 °C.

The temperature at which phase transitions that may lead to cladding failure in aluminum clad low-hydride fuel elements is reported to be 530 °C; references: "Technical Foundations of TRIGA, "GA-471 (1958). pp. 63-72; also in "Hazards Analysis for the Oregon State University 250 kW TRIGA Mark II Reactor," (June 1965), section 4.7. There is also extensive operating experience with aluminum-clad low-hydride fuel; for example, with the Michigan State University TRIGA, which was licensed from 1974 to 1984 to operate with a mixed core of stainless-steel-clad high-hydride and aluminum-clad low-hydride elements at 250 kW and up to 2$ pulses.

2.2 Limiting Safety System Settings

Applicability: This specification applies to the trip setting for the fuel element temperature channel.

Objective: The objective is to prevent the safety limit from being exceeded.

Specifications: For a core composed of stainless-steel-clad, high-hydride fuel elements, limiting safety system settings apply according to the location of the standard thermocouple fuel element as indicated in the following table:

Location	Limiting Safety System Settings
B ring	600 °C
C ring	555 °C
D ring	480 °C
E ring	380 °C

For a core containing an aluminum clad low hydride thermocouple fuel element (i.e., for restricted mode operation) the limiting safety system setting for that element shall be 230 °C with the element located in the B ring.

Bases: For stainless-steel-clad, high-hydride fuel elements, the limiting safety system settings represent values of the temperature, which if exceeded, shall cause the reactor safety system to initiate a reactor scram. Because the fuel element temperature is measured in a single fuel element designed for this purpose, the limiting settings are given for different locations of that element in the core. It is assumed that the maximum fuel temperature is produced in the B ring.

For the stainless-steel-clad, high-hydride fuel elements, the margin between the safety limit of 1,000 °C and the limiting safety system setting of 600 °C in the B ring was selected to assure that conditions would not arise which would allow the fuel element temperature to approach the safety limit. The safety margin of 400 °C allows for differences between the measured peak temperature and calculated peak temperature encountered in pulse operation of TRIGA reactors and for uncertainty in temperature channel calibration. During steady-state operations, the equilibrium temperature is determined by the power level, the physical dimensions and properties of the fuel elements, and the parameters of the coolant. Because of the interrelationship of the fuel moderator temperature, the power level, and changes in reactivity required to increase or maintain a given power level, any unwarranted increase in the power level would result in a relatively slow increase in the fuel moderator temperature. The margin between the maximum setting and safety limit would ensure the reactor being shut down before conditions could result that might damage the fuel elements.

For the aluminum-clad, low-hydride element the margin of 300 °C between the safety limit of 530 °C and the limiting safety system setting of 230 °C in the B ring was selected to assure that conditions would not arise which would allow the fuel element temperature to approach the safety limit. The margin is large enough to allow for differences in properties of all aluminum clad, all stainless-steel-clad, and mixed cores and for uncertainty in temperature channel calibration.

3.0 LIMITING CONDITIONS FOR OPERATION

3.1 Reactivity

Applicability: These specifications apply to the reactivity condition of the reactor, and to the reactivity worth of control rods and experiments, and to both modes of reactor operation. Reactivity limits on experiments are specified in Section 3.8.

Objectives: The objectives are to ensure that the reactor can be shut down at all times and to ensure that the fuel temperature safety limit will not be exceeded.

Specification: The reactor shall not be operated unless the following conditions exist:

(1) The reactor is sub-critical by more than 0.50$ when in the cold, xenon-free condition, and (a) the highest worth control rod is fully withdrawn, (b) the highest worth non-secured experiment is in its most positive reactive state, and (c) secured experiments with movable parts are each in their most reactive state.

(2) The reactivity with all control rods fully withdrawn is known to be less than 4.00$ when the reactor is cold and xenon-free and no experiments that affect reactivity are in place.

(3) When operating in restricted mode operation, the reactivity with all control rods fully withdrawn is less than 2.00$ with or without experiments in place.

Base: The shutdown margin required by Specification 3.1 (1) is necessary so that the reactor can be shut down from any operating condition and remain shut down after cooldown and xenon decay, even if one control rod (including the transient control rod) should remain in the fully withdrawn position.

The values chosen are intended to limit the fuel temperature to <1,000 °C for the stainless steel-clad fuel in the event of inadvertent or accidental pulsing of the reactor.

The value chosen for (3) is intended to limit the temperature of the aluminum-clad element to <530 °C in the event of inadvertent or accidental pulsing of the reactor.

3.2 Steady State Operation

Applicability: This specification applies to operation of the reactor at high steady-state power levels.

Objectives: The objectives are to prevent the fuel temperature safety limit from being exceeded during steady-state operations and to prevent inadvertent pulse operation of the reactor while it is at high steady-state power level.

Specifications:

(1) The reactor shall not be operated in the steady-state mode at power levels above 500 kW. When operating in restricted mode operation, the reactor shall not be operated at steady state power levels above 200 kW.

(2) The reactor shall not be operated in the operated in the steady-state mode at power levels above 10 kW unless, in addition to the conditions of Section 3.1, the transient rod is fully withdrawn.

Bases: The Cornell TRIGA Hazards Analysis (Supplement 1, 1980) is based on power levels up to 500 kW.

At power levels of 10 kW or below, the steady-state fuel temperature is small compared to the temperature rise caused by a pulse of 3.00$ or less.

When our test program for initial operation above 100 kW power was conducted in February-March 1984, thermocouple measurements showed that at 200 kW the B-ring fuel temperature for the all-stainless-steel-clad high-hydride core was 160 °C. Even when allowing for differences resulting from the substitution of an aluminum-clad low-hydride element, the fuel temperature at 200 kW will be far below the safety limit of 530 °C.

3.3 Pulse Operation

Applicability: These specifications apply to operation of the reactor in the pulse mode.

Objective: The objective is to prevent the fuel temperature safety limit from being exceeded during pulse mode operation.

Specifications: The reactor shall not be operated in the pulse mode unless, in addition to the requirements of Section 3.1, the following conditions exist:

(1) The transient rod is set such that the reactivity insertion upon its withdrawal is equal to or less than 3.00$.

(2) The steady-state power level of the reactor is not greater than 10 kW.

(3) When operating in restricted mode operation, the reactor shall not be operated in pulse mode. The pulse mode circuit shall be disconnected to assure that pulsing is not possible with the key-operated switch.

Bases: These reactivity values limit the fuel temperature to < 1,000 °C. Specification 3.3(2) is intended to prohibit pulsing from a high steady-state power level so that the final peak temperature might exceed the safety limit. Pulse mode operation could result in temperatures in the aluminum-clad low-hydride element that exceed the limiting safety system setting of 230 °C.

3.4 Measuring Channels

Applicability: This specification applies to the reactor measuring channels.

Objective: The objective is to require that sufficient information is available to the operator to ensure safe operation of the reactor.

Specifications: The reactor shall not be operated unless the following conditions are met:

(1) The measuring channels described in the following table are operable and the information is displayed in the control room.

Measuring Channel	Minimum Number Operable	Required Operating Mode
Fuel element temperature	1	Both modes
Reactor power level	2	Steady state
Reactor power level	1	Pulse mode
Startup count rate	1	During reactor startup
Area radiation monitors	2	Both modes
Continuous air radiation monitor	1	Both modes
Exhaust plenum radiation monitor	1	Both modes

(2) The neutron count rate on the startup channel is greater than 1 count.

Bases: The fuel temperature displayed at the console gives continuous information on the process variable, which has a specified safety limit.

The neutron detectors ensure that measurements of the reactor power level are adequately covered.

The radiation monitors provide information to operating personnel of any impending or existing danger from radiation so that there will be sufficient time to evacuate the facility and take the necessary steps to prevent the spread of radioactivity to the surrounding environment.

The specification on the startup channel count rate is intended to ensure that sufficient neutrons are available in the core to provide a signal at the output of the startup channel during approaches to criticality.

3.5 Safety Channels and Control Rod Drop Time

Applicability: This specification applies to the reactor safety system channels and to rod drop times.

Objectives: The objectives are to require the minimum number of reactor safety system channels that must be operable in order to ensure that the fuel temperature safety limit is not exceeded, and to ensure prompt shutdown in the event of a scram signal.

Specifications: The reactor shall not be operated unless the following conditions are met.

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*In lieu of information display, high level alarms audible in the control room may be used.

(1) The safety system channels described in the following table are operable:

Safety System Channel Or Interlock	Minimum Number Operable	Function	Required Operating Mode
Fuel element temperature	1	Scram	Both modes
Reactor power level	2	Scram	Steady-state mode
Manual button	1	Scram	Both modes
Startup count rate interlock	1	Prevent control rod withdrawal when neutron count rate is less than 1/sec	Reactor startup
Standard control rod position interlock	1	Prevent withdrawal of the transient rod when either the safety or shim con-troll rods are not fully inserted	Steady-state mode

(2) The drop time of a standard control rod from the fully withdrawn position of 90% of full reactivity insertion is less than 1 sec.

(3) When operating in restricted mode operation, one reactor power level scram trip point shall be set at 200 kW.

Bases: The fuel temperature scram provides the protection to ensure that if a condition results in which the limiting safety system setting is exceeded, an immediate shutdown will occur to keep the fuel temperature below the safety limit. The power level scram is provided as added protection against abnormally high fuel temperature and to ensure that reactor operation stays within the licensed limits. The manual scram allows the operator to shut down the system if an unsafe or abnormal condition occurs. The interlock to prevent startup of the reactor with less than 1 count/sec indicated on the startup channel ensures that sufficient neutrons are available to ensure proper startup of the reactor. The control rod position interlock will prevent the withdrawal of the transient rod in the steady-state mode to prevent inadvertent pulses.

The power level scram trip point specified for restricted mode operation is an added protection against fuel temperature exceeding the safety limit for aluminum-clad low-hydride fuel and ensures that the reactor power will not exceed 200 kW.

3.6 Release of Argon-41

Applicability: This specification applies to the release of radioactive Ar-41 from the facility exhaust system to unrestricted areas.

Objective: The objective is to ensure that exposures to the public resulting from the release of Ar-41 generated by reactor operation will not exceed the limits of 10 CFR 20 for unrestricted areas, the ALARA (as low as is reasonably achievable) levels of Appendix I to 10 CFR 50 and the levels of ANS Std. 15.12.

Specification: Releases of Ar-41 from the reactor bay exhaust plenum to an unrestricted environment shall not exceed 32 Ci/year.

Bases: The Cornell TRIGA Hazards Analysis (Supplement 1, 1980) shows that the release of 32 Ci/year of Ar-41 would result in no more than 10 mrem/year exposure to any person in the unrestricted area and this is only 2% of the allowable releases that would meet 10 CFR 20 requirements.

3.7 Ventilation System

Applicability: This specification applies to the operation of the reactor room ventilation exhaust system.

Objective: The objective is to ensure that the ventilation exhaust shutdown system is operable to mitigate the consequences of the possible release of an uncontrolled amount of radioactive materials to unrestricted areas resulting from reactor operation.

Specifications: The reactor shall not be operated unless the ventilation system (including its shutdown mode) has been shown to be operable. An exception may be made for periods of time not to exceed 2 days to permit repairs to the system. During such periods of repair (1) the reactor shall not be operated in the pulse mode and (2) the reactor shall not be operated with experiments in place whose failure could result in the release of radioactive gases or aerosols.

Bases: The specifications governing operation of the reactor while the ventilation system is undergoing repair preclude the likelihood of fuel element failure during such times. It is shown in Section 7.4 of the FSAR that, if the reactor were to be operating at full steady-state power, fuel element failure would not occur even if all the reactor tank water were to be lost immediately.

3.8 Limitations on Experiments

Applicability: This specification applies to experiments placed in the reactor and its experimental facilities.

Objectives: The objectives are, in the event of an experiment failure, to limit reactivity excursions that might cause the fuel temperature to exceed the safety limit, to prevent damage to the reactor, and to prevent excessive release of radioactive materials.

Specifications: The reactor shall not be operated with experiments in places that do not meet the following specifications:

(1) The reactivity worth of any individual experiment shall not exceed 2.00$.

(2) Any experiment with a reactivity worth greater than 1.00$ shall be securely fastened (as defined in Section 1, Secured Experiment).

(3) The total of absolute values of the positive reactivity worth of all experiments in the reactor shall be less than 3.00$.

(4) If two or more experiments in the reactor are interrelated so that operation or failure of one can induce a reactivity-affecting change in the other (s), the sum of the absolute reactivities of such experiments shall not exceed 2.00$.

(5) The rate of planned reactivity addition in any experiment shall be less than 0.07$/sec, except that if the total associated reactivity addition is less than 0.40$, no limit on the rate shall be imposed.

(6) The estimate of reactivity worth of an experiment shall be based insofar as possible on experimental information. If the estimated worth is greater than 0.40$, the actual worth shall be measured and recorded at the time of insertion of the experiment; if the actual value significantly exceeds the estimate, the experiment shall be removed pending review and re-approval.

(7) No experiment shall be conducted that causes local boiling of the core water.

(8) No experiment shall be conducted that causes interference with control rods or shadowing of reactor control instrumentation.

(9) The experiments to be performed have been classified, reviewed, and approved, and are performed, in compliance with rules and procedures set forth in Section 6. (Criteria for fueled, corrosive, explosive, radioactivity releasing, and otherwise hazardous experiments are discussed there.)

(10) When operating in restricted mode operation, the specifications (1) through (9) above shall apply with two additional restrictions;

(a) the reactivity worth of any individual experiment shall not exceed 1.00$, and

(b) the total of absolute values of the positive reactivity worth of all experiments in the reactor shall be less than 2.00$.

Bases: Specifications 3.8(1) through 3.8(6) are conservatively chosen to limit unintentional and intentional reactivity additions to maximum values that are less than an addition that could cause the fuel temperature to rise above the limiting safety system set point (LSSS) value. The temperature rise for a 2.00$ insertion is known and is known not to exceed the LSSS. The additional limitations for restricted mode operation are chosen to limit the temperature excursion in a pulse initiated by possible malfunctions in experiments.

3.9 Fuel Integrity

Applicability: This specification applies to the fuel used in the Cornell TRIGA.

Objective: The objective is to prevent the use of damaged fuel in the Cornell TRIGA.

Specification: A fuel element indicating an elongation greater than 1/8 in. over its as manufactured length or a lateral bending greater than 1/8 in. shall be considered to be damaged and shall not be used in the core for further operation.

Bases: The above limits on the allowable distortion of a fuel element have been shown to correspond to strains that are considerably lower than the strain expected to cause rupture of a fuel element and have been successfully applied at TRIGA installations. Fuel cladding integrity is important since it represents the only process barrier for the TRIGA reactor.

3.10 Reactor Pool Water

Applicability: This specification applies to the water contained in the Cornell TRIGA reactor pool.

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Objective: The objective is to set acceptable limits on the water quality, temperature, conductivity, and level of the reactor pool water.

Specifications: The Cornell TRIGA shall be placed in the shutdown condition if:

(1) the water temperature exceeds 130 °F

(2) the water conductivity is greater than 5 umho/cm except that during maintenance it may exceed that level for no longer than 4 weeks.

(3) the water level above the core is below 18 1/2 ft., as measured from the top of the core.

Bases: The water temperature of the reactor pool is limited by the resin used in the mixed bed deionizer.

High water conductivity over a prolonged period indicates possible corrosion, demineralizer degradation, or slow leakage of fission products.

A reactor pool level of 18 1/2 ft. is adequate to providing shielding during power operations.

3.11 Restricted Mode Operation

Applicability: This specification applies to operation of the reactor with one aluminum-clad low-hydride thermocouple element in the B-ring and no stainless-steel-clad high-hydride thermocouple element in the core.

Objective: The objective is to define the conditions under which restricted mode operation of the reactor is permitted and the additional restrictions and specifications which that mode requires are to be in force.

Specifications: Restricted mode operation shall be the only permissible mode of operation when no operable stainless-steel-clad high-hydride thermocouple element is available for use in the core. When an operable stainless-steel-clad high-hydride thermocouple element is available for use in the core, restricted mode operation shall not be used except that during tests of the cladding integrity and measurements of the worth of that element which require reactor operation without that element in the core the restricted mode shall be used.

Bases: The specifications of conditions under which restricted mode operation shall be used limit use of that mode to situations in which operation without a stainless-steel-clad thermocouple element in the core is necessary for brief periods for test purposes or for continuity (though at a reduced scale) of programs using the reactor. The limits and restrictions required under the restricted mode make it extremely unlikely that temperatures approaching the safety limits of any element in the core could occur.

4.0 SURVEILLANCE REQUIREMENTS

4.1 Fuel

Applicability: This specification applies to the surveillance requirements for the fuel elements.

Objective: The objective is to ensure that ~~the dimensions of the fuel elements remain within acceptable limits~~ *the integrity of the fuel elements is maintained.*

Specification: The ~~standard~~ fuel elements shall be visually inspected for corrosion and mechanical damage ~~and measured for length and bend at intervals separated by not more than 500 pulses of magnitude equal to or less than a pulse insertion of 3.00$, or following the exceeding of a limited safety system set point. Elements from the B, C, D, E, and F rings comprising approximately 1/3 of the core shall be inspected~~ annually, but not to exceed 14 months. ~~The selection of elements each year shall be such that the entire core shall be inspected at 3-year intervals, but not to exceed 38 months.~~

Bases: ~~The most severe stresses induced in the fuel elements result from pulse operation of the reactor, during which differential expansion between the fuel and the cladding occurs and the pressure of the gases within the elements increases sharply.~~ *Corrosion may result from impurities in the pool water.*

~~4.2 Control Rods~~

~~Applicability: This specification applies to the surveillance requirements for the transient and standard control rods.~~

~~Objective: The objective is to ensure the integrity of the control rods and to ensure that their worth are within prescribed limits.~~

~~Specifications:~~

~~(1) The reactivity worth of each control rod shall be determined annually, but at intervals not to exceed 14 months, or following a change in core configuration unless the control rods have been previously calibrated for the particular core configuration.~~

~~(2) Control rod drop times shall be determined annually, but at intervals not to exceed 14 months.~~

~~(3) On each day that pulse mode operation of the reactor is planned, a functional performance check of the transient (pulse) rod system shall be performed.~~

~~(4) Semiannually, at intervals not to exceed 8 months, the transient (pulse) rod drive cylinder and the associated air supply system shall be inspected, cleaned, and lubricated, as necessary.~~

~~(5) The control rods shall be visually inspected annually for corrosion and mechanical damage at intervals not to exceed 14 months.~~

~~Bases: The reactivity worth of the control rods is measured to ensure that the required shutdown margin is available and to provide a means for determining the reactivity worth of experiments inserted in the core. Experience with a TRIGA reactor over more than 10 years gives assurance that measurement of the reactivity worth on an annual basis is adequate to ensure no significant changes in the shutdown margin. The visual inspection of the control rods and measurement of their drop times are made to determine whether the control rods are capable of performing properly.~~

4.3 Reactor Safety System

Applicability This specification applies to the surveillance requirements for the measuring channels of the reactor safety system.

Specifications:

(1) A channel test of each of the reactor safety system channels shall be performed before each day's operation or before each operation extending more than 1 day.

(2) A channel check of the fuel element temperature measuring channel shall be performed daily whenever the reactor is in operation.

(3) A channel check of the power level measuring channels shall be performed daily whenever the reactor is in operation.

(4) A channel calibration of the reactor power level measuring channels by the calorimetric method shall be performed annually, but at intervals not to exceed 14 months.

(5) A channel calibration of the temperature measuring channel shall be performed semiannually but at intervals not to exceed 8 months when the reactor is operated in steady-state mode only, and at the beginning of each 24-hour-operating period when the reactor is used in the pulse mode. This calibration shall consist of introducing electric potentials in place of the thermocouple input to the channels.

(6) Acceptance criteria for checks, tests, and calibrations shall be those specified in approved checklists or written procedures.

Bases: The daily tests and channel checks will ensure that the safety system channels are operable. The required periodic calibrations and verifications will permit any long-term drift of the channels to be corrected.

4.4 Radiation Monitoring Equipment

Applicability: This specification applies to the radiation monitoring equipment. required by Section 3.4 of these specifications.

Objectives: The objectives are to ensure that the radiation monitoring equipment is operable and to verify that alarm settings are within previously prescribed limits.

Specification: The alarm set points for the radiation monitoring instrumentation shall be verified *monthly*. daily during periods when the reactor is in operation. Acceptance criteria shall be those specified in approved checklists or written procedures.

Bases: Surveillance of the equipment will ensure that sufficient protection *against radiation* is available.

4.5 Maintenance

Applicability: This specification applies to the surveillance requirements following maintenance of control or safety system.

Objective: The objective is to ensure that a system is operable within specified limits before being used after maintenance has been performed.

~~Specification: Following maintenance or modification of a control or safety system or component, it shall be verified that the system is operable within specified limits before being returned to service.~~

~~Bases: This specification ensures that work on the system or component has been properly carried out and that the system or component has been properly reinstalled or reconnected before reliance for safety is placed on it.~~

4.6 Reactor Pool Water

Applicability: This specification applies to the water contained in the Cornell TRIGA reactor pool.

Objective: The objective is to provide surveillance of reactor ~~primary coolant water quality~~, pool *water* level, ~~temperature,~~ and conductivity.

Specifications: *During periods when fuel is stored in the reactor pool, the reactor pool water level and conductivity shall be checked monthly.* ~~During periods when the reactor is in operation, the following shall be checked daily:~~

(1) the water level in the reactor pool *shall be maintained at a level that provides no less than 10 feet of water over the top of the core.*

~~(2) the temperature of the reactor pool water~~

(2) the conductivity of the reactor pool water *shall be maintained at no greater than 5 micromhos/cm.*

~~If the reactor is shut down for extended maintenance, the conductivity of the reactor pool water shall be measured and recorded every 20 days.~~

Bases: Surveillance of the reactor pool will ensure that the water level is adequate ~~before reactor operation.~~ *for shielding purposes and* ~~Water temperature must be checked to ensure that the limit of the deionizer will not be exceeded.~~ water conductivity must be checked to ensure that the demineralizer is performing properly and to detect any increase in water impurities.

4.7 Special Nuclear Materials

Applicability: This specification applies to the surveillance requirements for the sealed plutonium source material.

Objective: The objective is to ensure that leakage from sealed plutonium sources does not exceed allowable limits.

Specifications:

(1) Each plutonium source shall be tested for leakage at intervals not to exceed 6 months. In the absence of a certificate from a transferor indicating that a test has been made within 6 months before the transfer, the sealed source shall not be put into use until tested.

(2) The test shall be capable of detecting the presence of 0.005 uCi of alpha contamination on the test sample. The test sample shall be taken from the source or from appropriate accessible surfaces of the device in which the sealed source is permanently or semi-permanently mounted or stored. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Commission.

(3) If the test reveals the presence of 0.005 uCi or more of removable alpha contamination, the licensee shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired by a person appropriately licensed to make such repairs or to be disposed of in accordance with Commission regulations. Within 5 days after determining that any source has leaked, the licensee shall file a report with the Director of the Office of Inspection and Enforcement, NRC, describing the source, the test results, the extent of contamination, the apparent or suspected cause of source failure, and the corrective action taken. A copy of the report shall be sent to the Director of the nearest NRC Regional Inspection and Enforcement Office listed in Appendix D to 10 CFR 20.

(4) The periodic leak test required by this condition does not apply to sealed sources that are stored and not being used. The sources excepted from this test shall be tested for leakage before any use or transfer to another person unless they have been leak tested within 6 months before the date of use or transfer.

<u>Bases</u>: Surveillance of the sealed plutonium source material will ensure that the total-body or individual organ irradiation does not exceed allowable limits in the event of ingestion or inhalation of the probable leakage from the source material.

5.0 <u>DESIGN FEATURES</u>

5.1 <u>Reactor Fuel</u>

<u>Applicability</u>: This specification applies to the fuel elements ~~used~~ *stored* in the *TRIGA* reactor ~~core~~ *grid plate and approved in-pool fuel storage racks.*

<u>Objective</u>: The objective is to ensure that the fuel elements are of such a design and fabricated in such a manner as to permit their ~~use~~ *safe storage* with a high degree of reliability with respect to their mechanical integrity.

<u>Specifications</u>:

(1) The high-hydride fuel element shall contain uranium-zirconium hydride, clad in 0.020 in. of 304 stainless steel. It shall contain a maximum of 9.0 weight percent uranium which has a maximum enrichment of 20%. There shall be 1.55 to 1.80 hydrogen atoms to 1.0 zirconium atom.

(2) ~~For the loading process, the elements shall be placed in a close packed array except for experimental facilities or for single positions occupied by control rods and a neutron startup source.~~ *For the storage process, no fuel shall be stored in the B, C, and D rings of the reactor core. All other fuel shall be stored in approved-in pool storage racks.*

(3) The low-hydride aluminum-clad ~~thermocouple~~ *fuel* elements ~~that can be used only in restricted mode operation~~ shall contain uranium-zirconium hydride, clad in 0.030 in. of aluminum. It shall contain a maximum of 8.5 weight percent of uranium which has a maximum enrichment of 20%. There shall be a ratio of approximately 1.0 hydrogen atoms to each 1.0 zirconium atom.

<u>Bases</u>: These types of fuel elements have a long history of ~~successful use in TRIGA reactors.~~ *mechanical integrity.*

Amendment No. 9

5.2 <u>Reactor Building</u>

Applicability: This specification applies to the building that houses the TRIGA reactor facility.

Objective: The objective is to ensure that provisions are made to restrict the amount of release of radioactivity into the environment.

Specifications:

(1) The reactor shall be housed in a closed room designed to restrict leakage when ~~the reactor is in operation,~~ *spent fuel is being handled exterior to the reactor pool or* when the facility is unmanned~~. or when spent fuel is being handled exterior to a cask.~~

(2) The minimum free volume of the reactor room shall be 100,000 ft^3.

(3) The building shall be equipped with a ventilation system capable of exhausting air or other gases from the reactor room at a minimum of 30 ft. above ground level

Bases: To control the escape of gaseous effluent, the reactor room contains no windows that can be opened. The room air is exhausted through an independent exhaust system, and discharged at roof level to provide dilution.

5.3 Fuel Storage

Applicability: This specification applies to the storage of reactor fuel ~~at times. when it is not in the reactor core.~~ *in approved in-pool storage racks and in the TRIGA reactor grid plate.*

Objective: The objective is to ensure that fuel that is being stored will not become supercritical and will not reach unsafe temperatures.

Specifications:

(1) ~~All~~ *F*uel elements ~~shall be~~ stored in *approved in-pool storage racks will be in* a geometrical array where the k_{eff} is less than 0.8 for all conditions of moderation.

(2) All fuel elements will be removed from the B, C, and D rings of the TRIGA reactor grid plate. Of the remaining elements, no more than forty six (46) will be stored in the E and F rings.

(3) Irradiated fuel elements and fueled devices shall be stored in an array which will permit sufficient natural convection cooling by water or air so that the fuel element or fueled device temperature will not exceed 460 °C for aluminum cladding or 600 °C for stainless steel clad fuel elements.

Bases: *Seventy six (76) fuel rods are stored in the four* ~~New fuel is stored in the shipping containers in a locked room called "Isotope and Fuel Storage" room. Irradiated fuel is stored in~~ 19-position fuel element storage racks, which rest on the bottom of the reactor pool *foundation.* ~~or which are located in fuel element storage rack pits designed into the reactor pool foundation.~~ The fuel element storage racks containing 19 fuel elements cannot form a critical array. Irradiated fuel storage is described in FSR, Section 5.3.4. *The forty six (46) fuel rods stored in the E and F rings of the reactor grid plate cannot form a critical array since the shut down margin with all control rods fully withdrawn is 34.00$.*

6.0 Administrative Controls

6.1 Organization and Responsibilities of Personnel

a) The TRIGA Reactor located in the J. Carlton Ward, Jr. Laboratory of Nuclear Engineering shall be an integral part of the Ward Center for Nuclear Sciences of Cornell University. The reactor organization shall be related to the University structure as shown in Chart I.

b) The Vice Provost for Physical Sciences and Engineering shall be responsible for the appointment of responsible and competent persons as members of the ~~Ward Center Safety Committee~~ *TRIGA Reactor Decommissioning and Decontamination (D&D) Oversight Committee* and as Director of Ward Center~~. In making these appointments, he or she shall consult with the Ward Center Advisory Board.~~

c) The Ward Laboratory (including but not limited to the TRIGA Reactor) shall be under the supervision of the Center Director, who shall have the overall responsibility for safe, efficient, and competent use of its facilities in conformity with all applicable laws, regulations, terms of facility licenses, and provisions of the ~~Ward Center Safety Committee~~ *TRIGA Reactor Decommissioning and Decontamination (D&D) Oversight Committee.* He or she shall also have responsibility for maintenance and modification of Laboratory facilities. He or she shall have education and/or experience commensurate with the responsibilities of the position. He or she shall report to the Vice Provost.

d) The Reactor Supervisor shall serve as the deputy of the Center Director in all matters relating to the establishment and enforcement of rules and procedures. He or she should have at least a bachelors degree in a physical science or engineering discipline, or equivalent knowledge and experience, and shall possess a Senior Reactor Operator's license. He or she shall have had at least two years of reactor operating experience and have a demonstrated competence in supervision. He or she shall be appointed by the Center Director with the approvals of the Vice Provost and the ~~Ward Center Safety Committee~~ *TRIGA Reactor Decommissioning and Decontamination (D&D) Oversight Committee,* and shall report to the Center Director.

e) The Responsible Person on Duty shall be responsible for enforcing all applicable rules, procedures, and regulations while he or she is on duty, ~~for ensuring adequate exchange of information between operating personnel when shifts change,~~ and for reporting all malfunctions, accidents, and other potentially hazardous occurrences and situations to the Reactor Supervisor and/or Center Director. Responsible Persons shall possess a Senior Operator's license, shall be appointed by the Center Director with the approval of the ~~Center Safety Committee~~ *TRIGA Reactor Decommissioning and Decontamination (D&D) Oversight Committee,* and shall report to the Reactor Supervisor.

~~f) The Reactor Operator shall be responsible for the safe and proper operation of the reactor, under the direction of the Responsible Person on Duty. Reactor Operators shall possess an Operator's or Senior Operator's license and shall be appointed by the Center Director.~~

f) The University Radiation Safety Officer (URSO), or his/her deputy, shall (in addition to other duties defined by the Director of Environmental Health and Safety) be responsible for overseeing the safety of Ward Center operations from the standpoint of radiation protection. He or she shall be appointed by the Director of Environmental Health and Safety with the approval of the University Radiation Safety Committee. He or she shall report to the Director of Environmental Health and Safety, whose organization is independent of the Ward Center organization, as shown on Chart I.

g) The Director of Ward Center, with the approval of the ~~Ward Center Safety Committee~~ *TRIGA Reactor Decommissioning and Decontamination (D&D) Oversight Committee,* may designate an appropriately qualified member of the Center organization as Ward Center Radiation Safety Officer (WCRSO) with duties including those of an intra-Center Radiation Safety Officer. The University Radiation Safety Officer may at his or her discretion, and with the concurrence of the Center Director, authorize the WCRSO to perform some of the specific duties of the URSO at Ward Center.

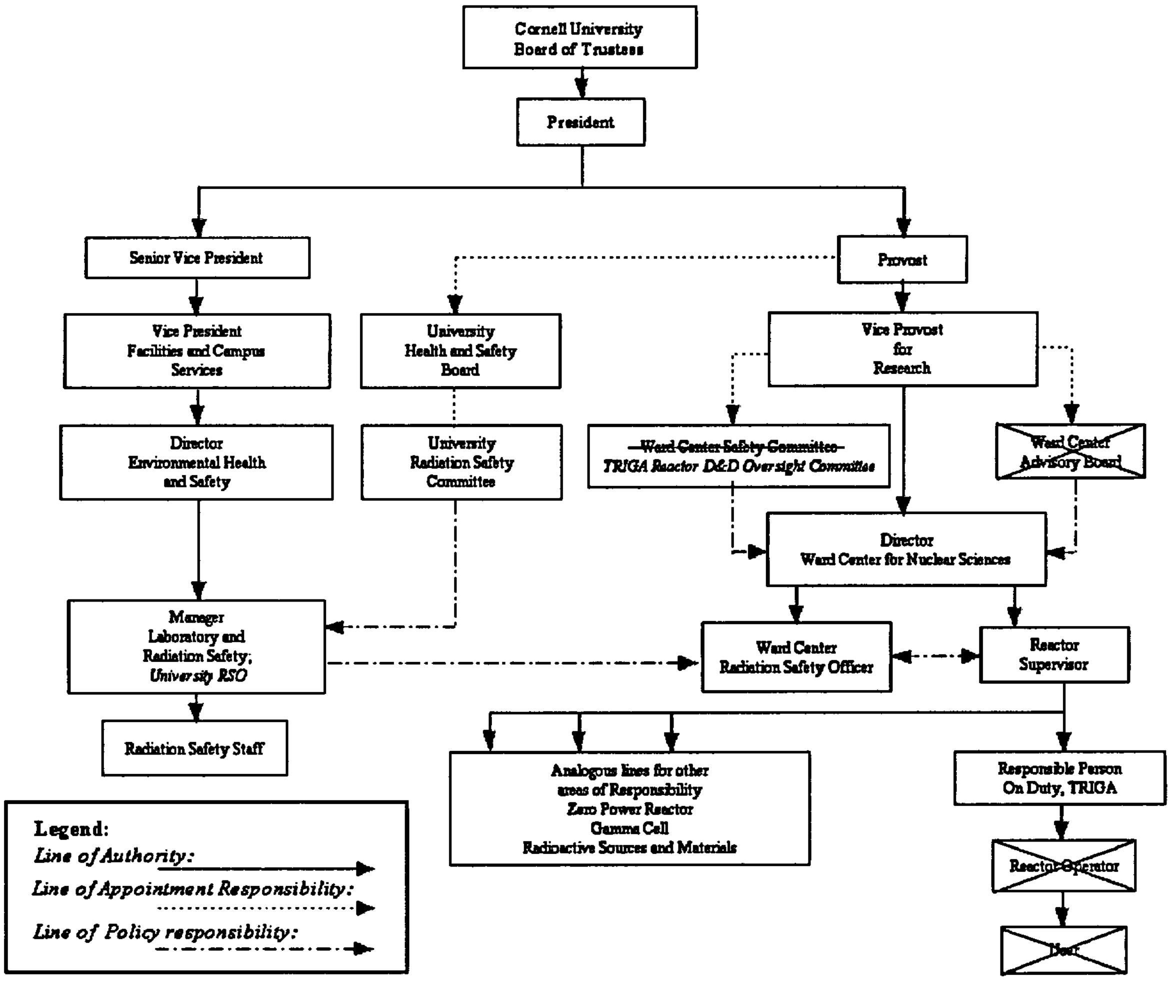

Chart I. – Organizational Structure

6.2 Review and Audit

a) There will be a ~~Ward Center Safety Committee~~ *TRIGA Reactor Decommissioning and Decontamination (D&D) Oversight Committee* which shall review ~~TRIGA reactor~~ *laboratory operations associated with decommissioning and decontamination of the TRIGA reactor and* to assure that the ~~reactor~~ facility is ~~operated and~~ used in a manner within the terms of the facility license and consistent with the safety of the public and of persons within the Laboratory.

b) The responsibilities of the Committee include, but are not limited to, the following;

1. Review and approval of rules, procedures, and proposed Technical Specifications;
2. Review and approval of all proposed changes in the facility that could have a significant effect on safety and of all proposed changes in rules, procedures, and Technical Specifications, in accordance with procedures in Section 6.3;
~~3. Review and approval of experiments using the reactor in accordance with procedures and criteria in Section 6.4;~~
3. Determination of whether a proposed change, *or* test ~~or experiment~~ would constitute an un-reviewed safety question or change in the Technical Specifications (Ref. 10 CFR 50.59);
3. Review of the operation and operations records of the facility;
4. Review of abnormal performance of plant equipment and operating anomalies;
5. Review of unusual or abnormal occurrences and incidents which are reportable under 10CFR 20 and 10 CFR 50;
6. Inspection of the facility, review of safety measures, and audit of operations at a frequency not less than once a year; and
7. Approval of appointments of Responsible Persons.

c) The Committee shall be composed of:

1. one or more persons proficient in reactor and nuclear physics,
~~2. one or more persons proficient in chemistry or chemical engineering,~~
2. one person proficient in biological effects of radiation,
3. one person proficient in geological sciences,
4. one person proficient in civil and environmental engineering,
5. the Center Director, ex officio,
6. the University Radiation Safety Officer or his or her deputy, ex officio, and,
~~6. a member of the Executive Committee of the Ward Center Advisory Board or his or her deputy, ex officio, and,~~
~~7. the Reactor Supervisor, ex officio.~~
7. one person from the University Office of Planning, Design and Construction or his or her deputy,
8. one person from the University Office of Environmental Health and Safety or his or her deputy,
9. one person from the Division of University Relations or his or her deputy,
10.the Vice Provost for Physical Sciences and Engineering, ex officio.

The same individual may serve under more than one category above, but the minimum membership shall be ~~seven~~ *ten*. At least four members shall be faculty members.

d) The Committee shall have a written statement defining its authority and responsibilities, the subjects within its purview, and other such administrative provisions as are required for its effective functioning. Minutes of all meetings and records of all formal actions of the Committee shall be kept.

e) The chairman of the Committee shall be *the Vice Provost for Physical Sciences and Engineering.* ~~elected by the Committee from its members, except that the Center Director or Reactor Supervisor shall not serve as chairman.~~ A quorum shall consist of not less than a majority of the full Committee and shall include the chairman or his or her designee.

f) The Committee shall meet a minimum of three times a year.

6.3 Procedures

a) Written procedures, reviewed and approved by the ~~Ward Center Safety Committee~~ *TRIGA Reactor D&D Oversight Committee* shall be followed for the activities listed below. The procedures shall be adequate to assure the safety of the reactor, persons within the Laboratory, and the public, but should not preclude the use of independent judgment and action should the situation require it. The activities are:

~~1. Startup, operation, and shutdown of the reactor, including~~
~~(a) startup checkout procedures to test the reactor instrumentation and safety systems, area monitors, and continuous air monitors, and~~
~~(b) shutdown procedures to assure that the reactor is secured before operating personnel go off duty.~~

1. Installation or removal of fuel elements, control rods, and other core components that significantly affect reactivity or reactor safety.

1. Preventive or corrective maintenance activities which could have a significant effect on the safety of the reactor or personnel.

~~2.~~ Periodic inspection, testing or calibration of auxiliary systems. ~~or instrumentation that relate to reactor operation.~~

b) Substantive changes in the above procedures shall be made only with the approval of the ~~Center Safety Committee,~~ *TRIGA D&D Oversight Committee,* and shall be issued to the ~~operating~~ *laboratory* personnel in written form. Temporary changes that do not change the original intent may be made by the Responsible Person on Duty with the concurrence of the ~~Reactor Supervisor or~~ Center Director. If the two parties disagree on the change, the change shall not be made. The change and the reasons thereof shall be noted in the log book, and shall be subsequently reviewed by the ~~Center Safety Committee~~ *TRIGA D&D Oversight Committee.*

c) Determination as to whether a proposed activity in categories (1), *and* (2) ~~and (3)~~ in Section 6.2(b) above does or does not have a significant safety effect and therefore does or does not require approved written procedures shall require the concurrence of:

1. the Center Director, and
2. at lease one other member of the ~~Center Safety Committee~~ *TRIGA D&D Oversight Committee,* to be selected for relevant expertise by the Center Director. If the Director and the Committee member disagree, or if in their judgment the case warrants it, the proposal shall be submitted to the full Committee, and
3. the University Radiation Safety Officer, or his or her deputy, who may withhold agreement until approval by the University Radiation Safety Committee is obtained.

Determinations that written procedures are not required shall be subsequently reviewed by the ~~Center Safety Committee~~ *TRIGA D&D Oversight Committee.* The time at which determinations are made, and the review and approval of written procedures, if required, are carried out, shall be a reasonable interval before the proposed activity is to be undertaken.

d) Determination that a proposed change in the facility does or does not have a significant safety effect and therefore does or does not require review and approval by the full ~~Center Safety Committee~~ *D&D Oversight Committee,* shall be made in the same manner as the proposed activities under (c) above.

~~6.4 Review of Proposals for Experiments~~

~~a) All proposals for experiments involving the reactor shall be reviewed with respect to safety in accordance with the procedures in (b) below and on the basis of criteria in (c) below~~

~~b) Procedures:~~

1. ~~The experimenter shall describe the proposed experiment in written form in sufficient detail for consideration of safety aspects. If potentially hazardous operations are involved, proposed procedures and safety measures including protective and monitoring equipment shall be described.~~
2. ~~If the experimenter is a student, approval by his or her research supervisor is required. If the experimenter is a staff member, his or her own signature is sufficient.~~
3. ~~The proposal is then to be submitted to the Center Director for safety review. (In the absence of the Center Director, the Vice Provost may designate another Center Safety Committee member to act.) Safety approval requires the approval of the Center Director and at least one other person selected by him or her from the membership of the Center Safety Committee. If the two individuals agree, approval is granted. If they disagree, or if in their judgment the case warrants it, the proposal will be referred to the full Center Safety Committee.~~
4. ~~Review and countersignature by the University Radiation Safety Officer or his or her deputy, who shall, if he/she deems it appropriate, indicate on the form that the experiment (or portions thereof) cannot be performed except while he or she is present.~~
5. ~~The scope of the experiment and the procedures and safety measures as described in the approved proposal, including any amendments or conditions added by those reviewing and approving it, shall be binding on the experimenter and the operating personnel. Minor deviations shall be allowed only in the manner described in Section 6.3b above.~~
6. ~~Transmission to the Reactor Supervisor for scheduling.~~

~~c) Criteria that shall be met before approval can be granted shall include:~~

1. ~~The experiment must fall within the limitations given in Section 3.8.~~
2. ~~It must not involve violation of any condition of the facility license or of Federal, State, University, or Center regulations and procedures. The possibility of an un-reviewed safety question (10 CFR 50.59) must be examined.~~
3. ~~In the safety review the basic criterion is that there shall be no hazard to the reactor, personnel or public.~~
4. ~~Each experiment is reviewed with respect to the following factors:~~
   ~~(a)pressure change~~
   ~~(b)temperature change~~
   ~~(c)collapse, implosion, or explosion~~
   ~~(d)change of state of sample during irradiation~~
   ~~(e)chemical reactions (including corrosion)~~

(f) leakage of radioactive material (double encapsulation is sometimes required)
(g)radiation levels and personnel exposure upon removal of sample
(h)internal and external radiation hazards to personnel in proposed operations subsequent to sample removal
(i) radiation levels in accessible areas during reactor operation (e.g., for beam experiments)
(j) adequacy of proposed measures to safeguard against accident during experiment
(k)adequacy of proposed emergency procedures (if needed) to supplement standard emergency procedures in the event of accident
(l) number of reactor operations personnel required

-(m)number and type of radiation monitors required
(n)reactivity effects (normal and accidental)
(o)other relevant factors not included above

3. No explosive material as defined in Title 49, Parts 172 and 173 of the Code of Federal Regulations is permitted within the reactor bay.

6.5 Emergency Plan and Procedures

An emergency plan shall be established and followed in accordance with NRC regulations. The plan shall be reviewed and approved by the Center Safety Committee *Oversight Committee*, prior to its submission to the NRC. In addition, emergency procedures that have been reviewed and approved by the Center Safety Committee *Oversight Committee,* shall be established to cover all foreseeable emergency conditions potentially hazardous to persons within the Laboratory or to the public, including, but not limited to, those involving an uncontrolled reactor excursion or an uncontrolled release of radioactivity.

6.6 Operator Re-qualification

An operator re-qualification program shall be established and followed in accordance with NRC regulations.

6.7 Physical Security Plan

A physical security plan for protection of the reactor plant shall be established and followed in accordance with NRC regulations.

6.8 Action To Be Taken In The Event A Safety Limit Is Exceeded

In the event a safety limit is exceeded:

a) The reactor shall be shut down and reactor operation shall not be resumed until authorized by the Branch Chief, Events Assessment, Generic Communications and Non-Power Reactors Branch, NRC.
b) An immediate report of the occurrence shall be made to the Chairman of the Center Safety Committee, and reports shall be made to the NRC in accordance with Section 6.11 of these specifications.
c) A report shall be made to include an analysis of the causes and extent of possible resultant damage, efficacy of corrective action, and recommendations for measures to prevent or reduce the probability of recurrence. This report shall be submitted to the Center Safety Committee for review, and a suitable similar report submitted to the NRC when authorization to resume operation of the reactor is sought.

6.9 Action To Be Taken In The Event Of A Reportable Occurrence

a) A reportable occurrence is any of the following conditions:

~~1. any actual safety system setting less conservative than specified in Section 2.2, Limiting Safety System Settings;~~
~~2. operation in violation of a limiting conditions for operation (Section 3.0);~~
~~3. incidents or conditions that prevented or could have prevented the performance of the intended safety functions of an engineered safety feature or the reactor safety system;~~
1. release of fission products from the fuel;
~~5. an uncontrolled or unanticipated change in reactivity greater than $0.50;~~
2. an observed inadequacy in the implementation of either administrative or procedural controls, such that the inadequacy has caused the existence or development of an unsafe condition in connection with ~~the operation of the reactor~~ *fuel handling and/or the decommissioning and decontamination of the reactor;*
3. an uncontrolled or unanticipated release of radioactivity.

b) In the event of a reportable occurrence, the following actions shall be taken:

~~1. The reactor shall be shut down at once. The Reactor Supervisor shall be notified and corrective action taken before operations are resumed; the decision to resume shall require approval following the procedures in Section 6.3.~~

1. A report shall be made to include an analysis of the cause of the occurrence, efficacy of corrective action, and recommendations for measures to prevent or reduce the probability of recurrence. This report shall be submitted to the ~~Center Safety Committee~~ *TRIGA D&D Oversight Committee* for review.

2. A report shall be submitted to the NRC in accordance with Section 6.11 of these specifications.

6.10 Plant Operating Records

a) In addition to the requirements of applicable regulations, in 10 CFR 20 and 50, records and logs shall be prepared and retained for a period of at least 5 years for the following items as a minimum:

1. normal plant operation, including power levels:
2. principal maintenance activities;
3. reportable occurrences;
4. equipment and component surveillance activities;
5. experiments performed with the reactor;
6. all emergency reactor scrams, including reasons for emergency shutdowns.

b) The following records shall be maintained for the life of the facility:

1. gaseous and liquid radioactive effluents released to the environs;
2. offsite environmental monitoring surveys;
3. fuel inventories and transfers;
4. facility radiation and contamination surveys;
5. radiation exposures for all personnel;
6. updated, corrected, and as-built drawings of the facility.

6.11 Reporting Requirements

All written reports shall be sent within the prescribed interval to the United States Nuclear Regulatory Commission, Washington, D.C., 20555, Attn: Document Control Desk, with a copy to the Regional Administrator, Region I.

In addition to the requirements of applicable regulations, and in no way substituting therefore, reports shall be made to the U.S. Nuclear Regulatory Commission (NRC) as follows:

a) A report within 24 hours by telephone and telegraph to the NRC Operation Center and Region I, of;
   1. any accidental release of radioactivity above permissible limits in unrestricted areas, whether or not the release resulted in property damage, personal injury, or exposure;

   ~~2. any violation of a safety limit;~~

   2. any reportable occurrences as defined in Section 6.9(a) of these specifications

b) A report within 10 days in writing to the NRC Operation Center and Region I of;

   1. any accidental release of radioactivity above permissible limits in unrestricted areas, whether or not the release resulted in property damage, personal injury or exposure; the written report (and, to the extent possible, the preliminary telephone and telegraph report) shall describe, analyze, and evaluate safety implications, and outline the corrective measures taken or planned to prevent recurrence of the event;

   ~~2. any violation of a safety limit;~~

   2. any reportable occurrence as defined in Section 6.9(a) of these specifications.

c) A report within 30 days in writing to the Branch Chief, Events Assessment, Generic Communications and Non-Power Reactors Branch, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555 of;

   ~~1.~~ any significant variation of measured values from a corresponding predicted or previously measured value of safety-connected operating characteristics. ~~occurring during operation of the reactor;~~

   2. any significant change in the transient or accident analysis as described in the FSR.

~~d) A report within 60 days after criticality of the reactor in writing to the NRC Operation Center and Region I, resulting from a receipt of a new facility license or an amendment to the license authorizing an increase in reactor power level or the installation of a new core, describing the measured values of the operating conditions or characteristics of the reactor under the new conditions.~~

d) A routine report in writing to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, DC 20555 and Region I, within 60 days after completion of the first calendar year of operating and at intervals not to exceed 12 months, thereafter, providing the following information:

3. a brief narrative summary of operating experience (including experiments performed), changes in facility design, performance characteristics, and operating procedures related to reactor safety occurring during the reporting period; and results of surveillance tests and inspections;
4. a tabulation showing the energy generated by the reactor (in megawatt-hours);
5. the number of emergency shutdowns and inadvertent scrams, including the reasons thereof and corrective action, if any, taken;
6. discussion of the major maintenance operations performed during the period, including the effects, if any, on the safe operation of the reactor, and the reasons for any corrective maintenance required;
7. a summary of each change to the facility or procedures, tests, and experiments carried out under the conditions of 10 CFR 50.59;
8. a summary of the nature and amount of radioactive effluents released or discharged to the environs beyond the effective control of the licensee as measured at or before the point of such release or discharge;
9. a description of any environmental surveys performed outside the facility;
10. a summary of radiation exposures receive by facility personnel and visitors, including the dates and time of significant exposure, and a brief summary of the results of radiation and contamination surveys performed within the facility.

Proposed Revision

Cornell University

Ward Laboratory

OPERATOR REQUALIFICATION PROGRAM

Revised and Approved June 16, 1992

I. Purpose

The purpose of the Operator Re-qualification program is to meet the requirements of 10CFR55.59 while recognizing ~~(in the spirit of 10CFR55.59(c)(7)) the special nature of a university research reactor, which has a limited scale of operation and a small staff~~ *the recent decision to permanently cease reactor operations. Therefore, the program is revised to reflect the change in operating status by removing sections related to reactor manipulations.* This is a continuing program of documented retraining and evaluation of licensed operators and senior operators; while the program's schedule is moderately flexible, it will be completed on a biennial cycle.

II. Overview of Facility Activities

With the permanent shutdown of the Cornell University TRIGA reactor, the scope of routine duties and tasks to be performed by a licensed Reactor Operators/Senior Reactor Operator (RO/RSO) at the Cornell University Ward Center for Nuclear Sciences (CU-WCNS) must be reduced to reflect the amended license conditions. Accordingly, RO/SRO participation in facility activities at the CU-WCNS under POL license status shall include the following:

a) Maintenance, monitoring, and surveillance of the TRIGA pool utilized for the interim storage of spent fuel elements.

b) Review of the proper use of the Fuel Handling Tool; as described in the General Atomics Maintenance Manual, GA-2555, in particular, sections 2.4 and 5.1, and Cornell University TRIGA Operating Procedures, OP-400, "Fuel Handling and Transfer Operations".

c) Annual review of Operations, Surveillance, and Health Physics procedures.

d) Annual review of the NRC approved Emergency Plan (EP) and Emergency Procedures (EPIPs) for Ward Laboratory.

e) Annual review of the operation, maintenance, and calibration requirements of the Area Radiation Monitors (ARMs) and the Continuous Air Monitors (CAMs) and Security Alarm System.

f) Review of changes to all CU-WCNS procedures, applicable regulations, and license amendments.

III. <u>General Conduct of Program</u>

Each biennial cycle of the program will include: (1) a pre-examination study and review phase consisting of individual study by licensees; (2) a written examination of a scope of level equivalent to examinations previously given here by examiners from the Operator Licensing Branch of the NRC; (3) systematic observation and evaluation of operators during ~~reactivity manipulations and~~ simulated emergencies; and (4) for any operator displaying a deficiency in any category, accelerated retraining by tutoring and individual study, followed by re-examination or re-observation, in the deficient categories. A severe deficiency will result in suspension of the operator from licensed duties, with resumption of such duties only after retraining and satisfactory demonstration of competence.

The re-qualification cycle will be scheduled over two years in a manner that meets NRC goals of continuing competence and re-qualification of operators and at the same time avoids undue interruption of ~~operating and other~~ activities ~~(non-licensed)~~ for which members of the small staff of a university research reactor are responsible.

All licensed operators and senior operators will participate in each biennial cycle, regardless of the outcome of previous evaluations, with the sole exception of the Reactor Supervisor (see Section IV, Special Conditions).

The individual responsible for the re-qualification program will be the Reactor Supervisor.

Written records will be maintained of study materials, examinations, observations, evaluations, and training schedules.

IV. <u>Details of Program</u>

1. <u>Study and Written Examination</u>

Under the amended POL conditions for the CU-WCNS TRIGA reactor, operation of the reactor is not recognized. Licensed authorized activities for the RO/SRO shall necessarily be limited to fuel handling activities. Accordingly, in each biennial cycle, the study phase and written examination for reactor operator and senior reactor operator licensees will include material from each of the following categories and shall conform to the requirements of 10CFR55.59(c)(2).

A. Reactor Theory, Thermodynamics, and Facility Operating Characteristics
B. Normal and Emergency Operating Procedures and Radiological Controls
C. Plant and Radiation Monitoring Systems

These categories have been chosen to be in conformance with NUREG-1021 (Rev.6), NRC Examiner Standards, which reflect written examination guidelines for non-power reactors.

In keeping with the scale of operations and the limited size of operating staff, the biennial written examination will be scheduled in the fall of every other year and may be administered in section over a period not to exceed two weeks. The sequence will be: (1) the individual responsible for the requalification program will select and organize study materials and plan tutoring; (2) after a suitable study and review phase, all operators will be given the closed-book written examination; (3) the examinations will be graded and evaluated by the Reactor Supervisor; (4) an overall score of 70% is the minimum passing grade for the requalification exam; (5) any operator passing the requalification exam but receiving a score of less than 80% in any category will be required to undergo accelerated tutoring in such areas; (6) any operator scoring less than 70% overall shall be prohibited from performing licensed duties and must undergo accelerated tutoring and re-examination in all categories in which he scored below 70% before being considered for permission to resume licenseed duties. Such permission shall be given only after (i) his overall score after re-examination is 70% or greater and (ii) his resumption of licensed duties has been approved by the Reactor Supervisor. If a re-examination is required, it will be administered in the same manner as a normal requalification exam.

~~2. Reactivity Manipulations~~

~~On a semiannual basis, the operating experience of each licensee will be reviewed with regard to the number of control manipulations he has performed or directed over the previous six-month period. These control manipulations will consist the applicable reactivity manipulations specified in 10 CFR 55.59(c)(3)(i), which include reactor start-ups, shutdowns, or other control manipulations which demonstrate skill and/or familiarity with reactivity control systems and procedures. The purpose of the semiannual review will be to assure that no less than ten such manipulations are completed by each licensee in a distributed fashion over each biennial requalification period.~~

~~3. Operator Performance and Evaluation~~

~~Not less than twice each year, the performance and competence of each licensee will be observed and evaluated during a set of reactivity manipulations. The manipulations will include a minimum of five of the manipulations specified in 10 CFR 55.45(a)(2)~~

~~through (13), as applicable to a university research reactor. The observations will include a discussion of the licensee's actions and responsibilities during simulated emergency conditions. If an actual emergency occurs, the action of the operator on duty will be evaluated regardless of direct observation.~~

~~Any operator whose evaluation indicates a significant deficiency in manipulative skill, in knowledge of operating or emergency procedures, or in actions responding to emergency conditions will be prohibited from performing licensed duties and will be required to undergo tutoring and re-observation before being considered for permission to resume licensed duties. Re-evaluation at a satisfactory level and approval of the Reactor Supervisor shall be required before resumption is permitted.~~

~~The evaluations of the licensee's performance will be included in his files.~~

4. Retraining Study Materials

A complete set of study and reference materials will be provided for use by the licensees during their retraining program. It will be the responsibility of the Reactor Supervisor to review regularly the contents of these reference material to ensure that they are adequate and that they accurately incorporate changes in procedures, facility license and technical specifications, and facility design characteristics. Furthermore, whenever such changes are made, all licensed operator shall be informed of the changes in timely manner. These materials shall include a minimum of the following items:

1. A suitable general reference text on reactor physics.
2. Copies of the operating procedures.
3. Copies of the Technical Specifications.
4. Copies of emergency procedures.
5. Copies of the facility license and amendments thereto.
6. A summary description of facility characteristics.
7. Building and control drawings for the facility.
8. Copies of 10CFR20, 50 and 55.
9. Reference material on health physics principles and techniques.

V. Special Conditions

1. The Reactor Supervisor will be considered as having met the requirements of all evaluation portions of the re-qualification program because he will have participated directly in conducting all aspects of each biennial re-qualification program. ~~The Reactor Supervisor will be required to perform the manipulations specified in Section III.3 of the re-qualification program.~~

2. An operator whose license is due for renewal while he is in a re-qualification program will be provided with a letter of certification indicating that he is currently enrolled in the re-qualification program. The letter of certification will indicate the anticipated date when that re-qualification program will be completed for the individual.

3. All licensed facility personnel who do not participate in facility operation for three or more months will be given an oral examination on facility and procedure changes ~~and perform a reactivity manipulation~~ and complete a minimum of six hours of on-shift functions under the observation of the Reactor Supervisor (or a senior operator designated by him) before being reassigned regular operational duties at the facility provided he is up to date on the biennial written examination. The results of the oral and performance examination provide the basis for re-certification of competence to the NRC as required by 10CFR55.53(f).

4. Successful completion of the initial NRC licensing examinations may be used to satisfy the licensee's biennial retraining requirements if appropriate. Such an individual's retraining program would be started with the next study phase and written examination scheduled at least 6 months after the licensee's initial licensing date.

VI. Records

The following records will be retained at the facility for a period of five years:

1. Copies of retraining study materials and schedules.
2. All question sheets and graded papers for examinations and required reexaminations which were taken by each licensee during each of the re-qualifications periods.
3. The evaluation and summary review record of examinations and reexaminations of each licensee.
~~4. Summaries of control manipulations for each licensee.~~
4. The record of observations and evaluation completed when observing the operating competence of each licensee.

Proposed Revision

Cornell University

Ward Laboratory

OPERATOR REQUALIFICATION PROGRAM

Revised and Approved June 16, 1992

I. Purpose

The purpose of the Operator Re-qualification program is to meet the requirements of 10CFR55.59 while recognizing ~~(in the spirit of 10CFR55.59(c)(7)) the special nature of a university research reactor, which has a limited scale of operation and a small staff~~ *the recent decision to permanently cease reactor operations. Therefore, the program is revised to reflect the change in operating status by removing sections related to reactor manipulations.* This is a continuing program of documented retraining and evaluation of licensed operators and senior operators; while the program's schedule is moderately flexible, it will be completed on a biennial cycle.

II. Overview of Facility Activities

With the permanent shutdown of the Cornell University TRIGA reactor, the scope of routine duties and tasks to be performed by a licensed Reactor Operators/Senior Reactor Operator (RO/RSO) at the Cornell University Ward Center for Nuclear Sciences (CU-WCNS) must be reduced to reflect the amended license conditions. Accordingly, RO/SRO participation in facility activities at the CU-WCNS under POL license status shall include the following:

a) Maintenance, monitoring, and surveillance of the TRIGA pool utilized for the interim storage of spent fuel elements.

b) Review of the proper use of the Fuel Handling Tool; as described in the General Atomics Maintenance Manual, GA-2555, in particular, sections 2.4 and 5.1, and Cornell University TRIGA Operating Procedures, OP-400, "Fuel Handling and Transfer Operations".

c) Annual review of Operations, Surveillance, and Health Physics procedures.

d) Annual review of the NRC approved Emergency Plan (EP) and Emergency Procedures (EPIPs) for Ward Laboratory.

e) Annual review of the operation, maintenance, and calibration requirements of the Area Radiation Monitors (ARMs) and the Continuous Air Monitors (CAMs) and Security Alarm System.

f) Review of changes to all CU-WCNS procedures, applicable regulations, and license amendments.

III. General Conduct of Program

Each biennial cycle of the program will include: (1) a pre-examination study and review phase consisting of individual study by licensees; (2) a written examination of a scope of level equivalent to examinations previously given here by examiners from the Operator Licensing Branch of the NRC; (3) systematic observation and evaluation of operators during ~~reactivity manipulations and~~ simulated emergencies; and (4) for any operator displaying a deficiency in any category, accelerated retraining by tutoring and individual study, followed by re-examination or re-observation, in the deficient categories. A severe deficiency will result in suspension of the operator from licensed duties, with resumption of such duties only after retraining and satisfactory demonstration of competence.

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