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TECHNICAL SPECIFICATIONS

FACILITY LICENSE NO. R-57

FOR THE DEPARTMENT OF VETERANS AFFAIRS, NEBRASKA – WESTERN IOWA HEALTH CARE SYSTEM, OMAHA DIVISION

A.J. BLOTCKY REACTOR FACILITY

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1.0 DEFINITIONS

channel. A channel is the combination of sensor, line, amplifier, and output devices, which are connected for the purpose of measuring the value of a parameter.

channel calibration. A channel calibration is an adjustment of the channel such that its output corresponds with acceptable accuracy to known values of the parameter which the channel measures. Calibration should encompass the entire channel, including equipment actuation, alarm, or trip and shall be deemed to include a channel test.

channel check. A channel check is a qualitative verification of acceptable performance by observation of channel behavior, or by comparison of the channel with other independent channels or systems measuring the same variable.

channel test. A channel test is the introduction of a signal into the channel for verification that it is operable.

confinement. Confinement means a closure on the overall facility that controls the movement of air into it and out through a controlled path.

excess reactivity. Excess reactivity is that amount of reactivity that would exist if all control rods were fully withdrawn from the point where the reactor is exactly critical (k_{eff}=1).

experiment. Any operation, hardware, or target (excluding devices such as detectors, foils, etc.), that is designed to investigate non-routine reactor characteristics or that is intended for irradiation within the pool, or irradiation facility, and that is not rigidly secured to a core or shield structure so as to be a part of their design.

measured value. The measured value is the value of a parameter as it appears on the output of a channel.

moveable experiment. A moveable experiment is one where it is intended that all or part of the experiment may be moved in or near the core or into and out of the reactor while the reactor is operating.

operable. Operable means a component or system is capable of performing its intended function.

operating. Operating means a component or system is performing its intended function.

reactivity worth of an experiment. The reactivity worth of an experiment is the value of the reactivity change that results from the experiment being inserted or removed from its intended position.

reactor operator. A reactor operator is an individual who is licensed to manipulate the controls of a reactor.

reactor operating. The reactor is operating whenever it is not secured or shutdown.

reactor safety system. Reactor safety systems are those systems, including their associated input channels, which are designed to initiate automatic reactor scram or to provide information for initiation of manual scram.

reactor secured. A reactor is secured when:

(1) Either there is insufficient moderator available in the reactor to attain criticality or there is insufficient fissile material present in the reactor to attain criticality under optimum available conditions of moderation and reflection, or

(2) The following conditions exist:

a. Three neutron absorbing control rods are fully inserted in the shutdown position, and

b. The console key is in the off position and the key is removed from the lock, and

c. No work is in progress involving core fuel, core structure, installed control rods, or control rod drives unless they are physically decoupled from the control rods.

reactor shutdown. The reactor is shutdown if it is subcritical by at least one dollar in the reference core condition with the reactivity worth of all installed experiments included.

reference core condition. The reactivity condition of the core when it is at 20 °C and the reactivity worth of xenon is zero (i.e. cold, clean, and critical).

research reactor. A research reactor is defined as a device designed to support a self-sustaining neutron chain reaction for research, development, educational training or experimental purposes, and that may have provisions for the production of radioisotopes.

rod-control. A control rod is a device fabricated from neutron absorbing material or fuel, or both, that is used to establish neutron flux changes and to compensate for routine reactivity losses. A control rod can be coupled to its drive unit allowing it to perform a safety function when the coupling is disengaged. Safety, shim, and regulating rods are control rods.

rod-regulating. The regulating rod is a low-worth control rod used primarily to maintain an intended power level that need not have scram capability and may have a fueled follower. Its position may be varied manually or by the servo-controller.

scram time. Scram time is the elapsed time between the initiation of a scram signal and the control rod fully inserted.

secured experiment. A secured experiment is any experiment that is held in a stationary position relative to the reactor by mechanical means. The restraining forces must be substantially greater than those to which the experiment might be subjected by hydraulic, pneumatic, buoyant, or other forces, which are normal to the operating environment of the experiment, or by forces that can arise as a result of credible malfunctions.

secured shutdown. Secured shutdown is achieved when the reactor meets the requirements of the definition of "reactor secured" and the facility administrative requirements for leaving the facility with no licensed reactor operator present.

senior reactor operator. A senior reactor operator is an individual who is licensed to direct the activities of reactor operators. Such an individual is also a reactor operator.

shall, should and may. The word "shall" is used to denote a requirement; the word "should" to denote a recommendation; and the word "may" to denote permission, neither a requirement nor a recommendation.

shutdown margin. Shutdown margin is the minimum shutdown reactivity necessary to provide confidence that the reactor can be made subcritical by means of the control and safety systems starting from any permissible operating condition. It should be assumed that the most reactive scrammable rod and all non-scrammable rods are in their most reactive position and that the reactor will remain subcritical without further operator action.

shutdown reactivity. Shutdown reactivity is the value of the reactivity of the reactor with all control rods in their least reactive positions (e.g., inserted). The value of shutdown reactivity includes the reactivity of all installed experiments and is determined with the reactor at ambient conditions.

unscheduled shutdown. An unscheduled shutdown is defined as any unplanned shutdown of the reactor caused by actuation of the reactor safety system, operator error, equipment malfunction, or manual shutdown in response to conditions that could adversely affect safe operation, not including shutdowns that occur during testing or check-out operations.

2.0 SAFETY LIMIT AND LIMITING SAFETY SYSTEM SETTINGS

2.1 Safety Limit

Applicability: This Specification applies to the temperature of the reactor fuel.

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

Specifications: The temperature in any fuel element in the TRIGA reactor shall not exceed 500°C under any conditions of operation.

Basis: The safety limit for aluminum-clad TRIGA fuel is a function of the hydride ratio in the zirconium matrix. Centerline temperatures must be kept below 560°C to prevent a phase change in the ZrH. Thus, the limit of 500°C above serves to provide an additional safety margin. Since the AJBRF contains a mixed core of stainless steel and aluminum clad fuel, the aluminum-clad fuel is considered to be the bounding case, since the stainless steel fuel can tolerate higher temperatures. As stated in SAR, Chapter 8, Sections 8.1.3 and 8.1.4, with the reactor constricted to an excess of one dollar or less, under the most extreme logical conditions the fuel would remain well below 500°C.

2.2 Limiting Safety System Settings (LSSS)

Applicability: This specification applies to the reactor scram setting which prevents the reactor fuel temperature from reaching the safety limit.

Objective: The objective of this specification is to provide a reactor scram to prevent the safety limit from being reached.

Specification: Reactor thermal power shall not exceed 20 kW as measured by the calibrated power channels.

Basis: The LSSS (reactor thermal power), which does not exceed 20 kW, provides a considerable safety margin. One TRIGA reactor (General Atomics, Torrey Pines) showed a maximum fuel temperature of 350°C during operation at 1500 kilowatts, while a 250-kilowatt TRIGA reactor (Reed College) showed a maximum fuel temperature of less than 150°C (reported by S. C. Hawley, R. L. Kathren, NUREG/CR-2387, PNL4028 (1982), Credible Accident Analyses for TRIGA and TRIGA-Fueled Reactors). A portion of the safety margin could be used to account for variations of flux level (and thus the power density) at various parts of the core. The safety margin should be ample to compensate for other uncertainties, including power transients during otherwise steady-state operation, and should be adequate to protect aluminum-clad fuel elements from cladding failure due to fuel phase changes.

3.0 LIMITING CONDITIONS FOR OPERATION

3.1 Reactor Core Parameters

3.1.1 Excess Reactivity

Applicability: This specification applies to the reactivity of the reactor core in terms of the available excess above reference core condition.

Objective: The objective is to prevent the fuel element temperature safety limit from being reached by limiting the potential reactivity available in the reactor for any condition of operation.

Specifications: The reactor shall not be operated unless the maximum available excess reactivity is limited to $1.00 or less with the reactor in reference core condition.

Bases: The maximum power excursion that could occur in the reactor would be one resulting from inadvertent rapid insertion of the total available excess reactivity. As demonstrated in Section 3.2.13 of the SAR, limiting the fuel loading of the reactor to $1.00 excess reactivity under reference core conditions will assure that the fuel temperature will not reach our Safety Limit specification.

3.1.2 Shutdown Margin

Applicability: This specification applies to the reactivity minimum negativity by which the reactor core will be shutdown with the maximum worth control rod fully withdrawn.

Objective: The objective is to ensure that the reactor can be shutdown safely by a margin that is sufficient to compensate for the failure of a control rod or the movement of an experiment.

Specification: The reactor shall not be operated unless the shutdown margin is greater than $0.51. The shutdown margin is determined with:

(1) all experiments in their most reactive state
(2) the highest worth control rod fully withdrawn and
(3) the reactor in the reference core condition.

Bases: The value of the minimum shutdown margin assures that the reactor can be safely shut down using only the two least reactive control rods.

3.1.3 Core Configuration

Applicability: This specification applies to the restrictions on removal of a fuel element or control rod from the reactor core for the purpose of inspection.

Objective: To establish limits to ensure that changing the core configuration by removing a fuel element or control rod would not lead to loss of control of the reactor, loss of fuel integrity, uncontrolled release of radioactivity or potential exposures exceeding 10 CFR Part 20.

Specifications:

(1) No fuel element shall be inserted or removed from the core unless the reactor is subcritical by more than the worth of the most reactive fuel element.

(2) All control rods shall be fully inserted into the core during fuel element inspection.

(3) For control rod removal, the reactor shall be more than 5 elements short of criticality with all control rods out.

Basis: These reactivity limits shall ensure inadvertent criticality is not reached and that the shutdown margin condition is maintained.

3.1.4 Pool Water Level

Applicability: This specification applies to the requirement for maintaining a minimum height of water above the reactor core.

Objective: To ensure that sufficient water covers the core to provide necessary shielding and acceptable limits of cooling temperature.

Specifications; A float alarm switch shall be operable so that if the water level drops to less than 12 feet above the core a visual and audible alarm shall sound at the Medical Center switchboard which is monitored 24 hours a day, and a visual alarm shall indicate on the reactor console.

Basis: This specification is to ensure that if there was a large leak or fracture of the reactor tank; attention would be called to the occurrence so that immediate action could be taken. The effect of a complete loss of cooling accident is analyzed in Appendix C of the SAR. Since there is a siphon break from the water skimmer 6" below the water surface, a drop in water level of 6" would cause the water circulation system to lose its prime and cease to operate. The core is cooled by natural thermal convective flow.

3.1.5 Fuel Parameters

Applicability: This specification applies to conditions set forth for dealing with damaged fuel.

Objective: The objective is to set limiting conditions for identifying and handling damaged fuel.

Specifications:

(1) The reactor shall not be operated with damaged fuel except to detect and identify damaged fuel for removal. Damaged fuel shall be indicated by release of fission products or visual observation. Any indication of the release of fission products by the facility monitoring instruments shall be considered an indication of damaged fuel.

(2) A fuel element shall be removed from operation if the burnup of uranium-235 in the UZrH fuel matrix exceeds 50 percent of the initial concentration.

Basis: These specifications ensure that damaged fuel is quickly identified and removed from operation. They also ensure that the fuel is operated within its design parameters.

3.2 Reactor Control and Safety Systems

3.2.1 Operable Control Rods

Applicability: This specification applies to the control rods used in the reactor core.

Objective: The objective is to determine that the control rods are operable by limits on the scram times of the control rods.

Specifications: The maximum scram time for a fully withdrawn control rod shall be 2 seconds from the time of initiation of the scram signal to full insertion of the rod.

Basis: The specification for rod scram time assures that the reactor will shut down promptly when a scram signal is initiated. However, as described in Section 3.2.13 of the SAR a rapid insertion of as much as $2.00 of excess reactivity would terminate with no safety problem even without backup insertion of control rods.

3.2.2 Reactivity Insertion Rates

Applicability: This specification applies to the maximum rate of positive reactivity addition to the reactor.

Objective: To assure that the reactor shall start up on a controlled rate when the control rods are withdrawn.

Specifications:

(1) The maximum reactivity insertion rate of a standard control rod shall be less than $0.10 per second.

(2) Gang or multiple withdrawal of control rods is not allowed.

Basis: As described in Section 3.2.13 of the SAR a rapid insertion of as much as $ 2.00 of excess reactivity would terminate with no safety problem even without backup insertion of control rods, however, the above limit will assure that the reactor can be started up, or power changed at a controlled rate. The value set for maximum reactivity insertion rate is based on control rod drive speed as well as the highest value of reactivity change per position increment of the control rods.

3.2.3 Scram Channels

Applicability: This specification applies to required scram channels and set points.

Objective: To determine the minimum safety system scrams that must be operable for the operation of the reactor.

Specifications:

The reactor shall not be operated unless the minimum safety channels are operable. The following scram channels shall be operable:

Table 1 Required Scrams

Safety Channel	Set Point	Minimum number required
Percent power*	100% licensed power	1
Linear power**	100% licensed power	1
Ion chamber power supply*	Loss of high voltage	1
Fission counter power supply**	Loss of high voltage	1
Console scram button	Not Applicable	1
Magnet current key switch	Not Applicable	1
Watchdog timer	1.5 Seconds	1
* Ion chamber analog system ** Fission counter digital system		

Basis: The redundancy of scrams from the analog and digital systems provides protection from single-system failure and human error. The scrams minimize the probability of reaching the safety limits. The power level scrams provide protection to ensure that the reactor can be shut down before the licensed power is exceeded. We routinely operate at 18 kW, which is 10% below the licensed power so the scram set points can be set at the licensed power. The manual scram allows the operator to shut down the system if an unsafe or abnormal condition occurs. In the event of failure of the power supply for the neutron detectors, operation of the reactor without adequate instrumentation is prevented. The NM 1000 through self-checking, with a Watchdog system Overrun timer, detects a failure of its critical task routines and will scram if these routines are not performed within 1.5 seconds.

3.2.4 Interlocks

Applicability: This specification applies to the mechanical limitations installed in the reactor control system.

Objective: To ensure that there are sufficient neutrons in the reactor core for the reactor to be started up in a controlled manner and to prevent a rapid insertion of too much excess reactivity.

Specifications: The reactor shall not be operated unless the following interlocks are operable:

Table 2 Required Interlocks

Interlock	Minimum Number Required	Function
Reactor Period	1	Prevent rod withdrawal when the period is less than 3 seconds
Neutron count rate (startup)	1	Prevent rod withdrawal (startup inhibit) if count- rate ≤ 2 cps
Simultaneous manual withdrawal of two rods	1	Prevent withdrawal

Basis: The reactor period interlock prevents operation in a regime in which transients could cause the limiting safety system setting to be exceeded. The startup countrate interlock requirement is to ensure that during startup there are adequate neutrons available to ensure that there is a continuous indication of the presence of neutrons in the neutron monitoring channels. The restriction on the removal of more than one control rod is to limit the maximum positive reactivity insertion rate available for steady state operation. As was shown in Section 3.2.13 of the SAR, as much as $ 2.00 of excess reactivity would terminate with no safety problem even without backup insertion of control rods. However, this restriction will ensure that a rapid neutron multiplication does not occur.

3.2.5 Control Systems and Instrumentation Requirements of Operation

Applicability: These specifications apply to measurements of reactor operating parameters.

Objective: The objective is to determine the minimum instrument measurement and control systems to be operable for continued operation of the reactor.

Specifications: The reactor shall not be operated unless the entire measuring channels as noted in Table 3 are operable, this includes readout meters, recorders and the protective functions they perform.

Table 3 Required Minimum Measuring Channels

Measuring Channel	Number Operable	Function
Startup (NM1000, fission chamber)	1	Monitor subcritical multiplication for startup
Power Level (NM1000, fission chamber)	1	Input for safety power level scram and to digital display unit and recorder
Log N (NM1000, fission chamber)	1	Wide range power level and display on digital unit and on recorder
Period (NM1000, fission chamber)	1	Input for period display on digital unit and period interlock
Per Cent Power (Ion chamber)	1	Input for power level scram and display on analog meter
Pool water Temperature	1	Display on analog meter*

* For purposes of maintenance the inline thermistor may be replaced by a thermistor placed in the reactor tank and read on a separate meter.

Basis: The minimum measuring channels are sufficient to provide signals for automatic safety operation. Signals from the measuring system provide information to the control and safety system for a protective action. The digital NM1000 instrumentation utilizing wide range fission and the analog percent power instrument provide diversity and redundancy for the measuring channels. Both the digital and analog channels (fission chamber and ion chamber) are calibrated separately for power level. The pool water temperature is measured by means of a thermistor installed in the cooling system loop as shown in Fig 3.8 of the SAR and allows the manual monitoring of bulk pool water temperature. Since the output of the NM1000 is indicated on the digital display unit, the signal to the recorders is merely an analog signal in parallel to the digital signal. Failure of the recorder will not effect the safety of the reactor.

3.3 Coolant System

Applicability: These specifications apply to the quality of the coolant in contact with the fuel cladding, to the level of the coolant in the pool, and to the bulk temperature of the coolant.

Objective: The objectives of this specification are:

(1) To minimize corrosion of the cladding of the fuel elements and minimize neutron activation of dissolved materials.

(2) To detect releases of radioactive materials to the coolant before such releases become significant, and

(3) To ensure the presence of an adequate quantity of cooling and shielding water in the pool.

Specifications:

(1) The conductivity of the pool water shall not exceed 5μmhos/cm averaged over one month.
(2) The pool water pH shall be in the range of 5.0 to 7.5.
(3) The amount of radioactivity in the pool water shall not exceed 0.1 μCi/mL.
(4) The water shall cover the core of the reactor to a minimum depth of 15 feet during operation of the reactor.
(5) The bulk temperature of the coolant shall not exceed 35°C during operation of the reactor.

The reactor shall not be operated unless conditions (1), (2), and (3) above are met.

Basis: Increased levels of conductivity in aqueous systems indicate the presence of corrosion products and promote more corrosion. Experience with water quality control at many reactor facilities, including operation of the AJBRF since 1959, has shown that maintaining water chemistry within the specified limit provides acceptable control. Maintaining low level of dissolved electrolytes in the pool water also reduces the amount of induced radioactivity, in turn decreasing the exposure of personnel to ionizing radiation during operation and maintenance. Monitoring the pH of the pool water provides early detection of extreme values of pH, which could enhance corrosion. In the event that the pH should exceed its specified limits the reactor shall remain shutdown until the pH is within its acceptable range; typically this is remedied by changing the ion-exchange resin. Monitoring the radioactivity in the pool water provides early detection of possible cladding failures. Limitation of the radioactivity according to this specification decreases the exposure of personnel to ionizing radiation during operation and maintenance in accordance with ALARA procedures. Maintaining the specified depth of water in the pool provides shielding of the radioactive core, which reduces the exposure of personnel to ionizing radiation in accordance with the ALARA procedures. Maintaining the bulk temperature of the coolant below the specified limit assures minimal thermal degradation of the ion exchange resin.

3.4 Confinement System

Applicability: This specification applies to the confinement system of the reactor facility.

Objective: This specification applies to the reactor room confinement.

Specification:

(1) The ventilation system shall keep the reactor laboratory at a slightly negative pressure in relation to the outdoor atmospheric pressure during reactor operation.

(2) The doors to the reactor facility shall be closed when the reactor is in operation except for normal entry.

Basis: This specification ensures that the confinement is configured to control any releases of radioactive material during fuel handling, reactor operation, or the handling of possible airborne radioactive material in the reactor room.

3.5 Ventilation Systems

Applicability: This specification applies to the air ventilation conditions in the reactor area during reactor operation.

Objective: The objective is to ensure that the ventilation system is in operation to mitigate the consequence of the possible release of radioactive materials resulting from reactor operation.

Specifications:

(1) An exhaust fan with a flow rate of at least 2970 CFM shall be operating to exhaust the laboratory air to the environs during reactor operation.

(2) During operation of the pneumatic tube its output shall be exhausted into one of the fume hoods and then to the roof of the Medical Center with a flow rate of nominally 250 CFM.

Basis: The specifications for exhaust ventilation and isolation of the reactor room provide for releases for both routine and non-routine operation conditions. Analyses in Appendix A and B of the SAR show that complying with the above specifications ensure that the doses to the public are well below regulatory limits for unrestricted areas and the potential doses to facility staff are within regulatory limits.

3.6 Radiation Monitoring Systems and Effluents

3.6.1 Monitoring Systems

Applicability: This specification applies to the radiation monitoring systems in the reactor area during reactor operation.

Objective: To monitor the radiation and radioactivity conditions in the reactor area in order to control exposures or releases.

Specifications: The reactor shall not be operated unless the minimum radiation measuring channels shown in Table 4 below are operating.

Table 4. Required Radiation Measuring Channels

Channel	Minimum number required	Function	Set point equal or less than
Area radiation monitor-pool level (gamma)	1	Alarm	2 mrem/hr
Continuous Air Monitor	1	Alarm and recorded output	2000 pCi/ml

(1) When a specified monitor becomes inoperable operations may continue only if the monitor is replaced by a substitute or portable monitor. The replacement monitor shall perform essentially the same function until the original monitor is replaced (not to exceed 1 month).

(2) The continuous air monitor shall sample the reactor room air within 5 meters of the pool at the pool access level.

Basis:

(1) Monitoring Systems - The radiation monitoring systems provide information to operating personnel of impending or existing hazards from radiation so that there will be sufficient time to take the necessary steps to control the exposure of personnel and release of radioactivity or evacuate the facility. Alarm set points do not include measurement uncertainty. These values are measured values and not true values.

(2) Area radiation monitor - The gamma radiation monitor is part of the permanent installation and is installed at the edge of the pool approximately 18 inches above the top of the reactor tank grid cover. The alarm set point of 2 mr/hr enables the operator to monitor the radiation at the top of the reactor tank both from experiments being removed and from the reactor. The set point of 2 mr/hr is designed to allow the operator and radiation safety personnel ample warning to ensure that ALARA principles are complied with.

(3) Air particulate radioactivity accumulates on the filter of a continuous monitor that records the radiation levels. An alarm set point informs the operator when the set point is exceeded and the monitor meter and recorder are within view of the operator. The alarm set point causes the monitor to annunciate when it detects particulate activity below the occupational DAC values of Appendix B of 10 CFR 20.1001-20.2401 for the relevant isotopes in the range 84-105 and 124-149 as described in Section 4.3.2 and 7.4.1 of the SAR.

3.6.2 Effluents

Applicability: This specification applies to the effluent release limits in the reactor area during reactor operation.

Objective: To monitor the radiation and radioactivity conditions in the reactor area in order to control exposures or releases.

Specifications: Normal releases of radioactive effluents from reactor operation shall not exceed 10CFR20 limits.

Basis: Releases due to normal operation of the reactor has been calculated in SAR Sections 3.2.11.2, 9.2.1, and Appendix A. These calculations show that under any normal conditions 10 CFR Part 20 releases will not be exceeded.

3.7 Experiments

3.7.1 Reactivity Limits

Applicability: These specifications apply to experiments installed in the reactor and its experimental facilities.

Objective: The objective is to prevent damage to the reactor or excessive release of radioactive materials in the event of an experimental failure.

Specifications: The reactor shall not be operated unless the following conditions governing experiments exist:

(1) The reactivity worth of any individual secured experiment shall not exceed $ 1.00. The reactivity worth of any moveable experiments shall not exceed $ 0.85.

(2) The sum of the absolute reactivity worths of all experiments in the reactor and in the associated experimental facilities at one time shall not exceed $ 1.00.

(3) The reactor shall be shut down during the changing or moving of any secured experiment.

(4) The actual experiment worth shall be measured and recorded at the time of initial insertion of the experiment if the estimated worth is greater than $0.40.

Basis: The intent of these specifications is to limit the reactivity of the system so the Safety Limit would not be exceeded even if the contribution to the total reactivity by the experiment reactivity should be suddenly removed. In addition, these specifications limit power excursions, which might be induced by the changes in reactivity due to inadvertent motion of an unsecured experiment. The safety significance of notable reactivity insertions has been analyzed in SAR, Section 3.2.12.

3.7.2 Materials

Applicability: These specifications apply to experiments installed in the reactor and its experimental facilities.

Objective: The objective is to prevent the release of radioactive material in the event of an experiment failure, either by failure of the experiment or subsequent damage to the reactor components.

Specifications: The reactor shall not be operated unless the following conditions governing experiment material exists:

(1) Experiments containing liquid, gas and potentially corrosive materials shall be doubly encapsulated.

(2) Compounds highly reactive with water, potentially explosive materials, and liquid fissionable materials shall not be irradiated in the reactor.

(3) Guidance for classification of materials shall be "Dangerous Properties of Industrial Materials" by N.I. Sax (Reinhold Publishing) or equivalent.

(4) The radioactive material content, including fission products of any experiment shall be limited so that the complete release of all gaseous, particulate, or volatile components from the encapsulation shall not result in doses in excess of the annual limits stated in 10 CFR 20.

(5) If a capsule fails and releases material which could damage the reactor fuel or structure by corrosion or other means, removal and 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 Reactor Director, or his designated alternate, and determined to be satisfactory before operation of the reactor is resumed.

(6) No experiment shall be performed unless the material content, with the exception of trace constituents, is known.

(7) Fueled experiments shall not be irradiated in the reactor except for the activation of uranium foils for calibration or other purposes.

Basis:

(1) Double encapsulation requirements lessen the leakage hazards of experiment materials.

(2) The restriction on materials that are highly reactive with water, potentially explosive or liquid fissionable is intended to prevent damage to the reactor and the release of fission products at a level that has not been analyzed in the SAR.

(3) The specification of a source for classifying materials assures that adequate information is available to assess the potential danger of materials.

(4) The specification on restriction of material content above is intended to ensure that annual limits stated in 10 CFR 20 are not exceed. Radiation hazards are analyzed in Section 7.5 of the SAR.

(5) Operation of the reactor with the reactor fuel or structure damaged is prohibited to avoid release of fission products.

(6) Knowing the material content of each experiment is necessary so as to determine the potential danger of irradiating the sample both within the reactor and upon removal.

(7) The restriction on fueled experiments is intended to reduce the severity of a possible release of these fission products, which pose a hazard to workers and the general public.

3.7.3 Failure and Malfunction

Applicability: This specification addresses the failure and malfunction of experiments.

Objective: To design experiments so that they will not contribute to the failure of other experiments, core components, or principal physical barriers, or to the uncontrolled release of radioactivity.

Specifications:

(1) In calculations pursuant to 3.7.2(4) above, if an experiment fails and releases radioactive gases to the reactor room or atmosphere, the following shall be assumed:

a. 100% of the radioactive gases or aerosols escape.

b. If the effluent exhausts through a filter with 99% efficiency for 0.3-micron particles, at least 10% of these particles escape.

c. For materials whose boiling point is above 130°F (54°C) the vapors of at least 10% of the materials escape through an undisturbed column of water above the core.

(2) Experiments shall be designed such that they will not contribute to the failure of other experiments, core components, or principal physical barriers or to the uncontrolled release of radioactivity.

Basis: These specifications establish assumptions for calculating the activity that could be released under normal operating conditions, accident conditions in the reactor, and accident conditions in the experiment. It also specifies that experiments must be designed so as to prevent damage to the reactor or other experiments. Restrictions on experiments are provided in detail in SAR, Sections 7.2.3 and 7.5.

4.0 SURVEILLANCE REQUIREMENTS

Specifications: Maximum allowable intervals listed as follows are to provide operational flexibility only and are not to be used to reduce frequency. Established frequencies shall be maintained over the long term. The allowable surveillance intervals shall not exceed the following:

(a) Five-year: interval not to exceed six years
(b) Biennial: interval not to exceed two and one-half years
(c) Annual: interval not to exceed 15 months
(d) Semiannual: interval not to exceed seven and one-half months
(e) Quarterly: interval not to exceed four months
(f) Monthly: interval not to exceed six weeks
(g) Weekly: interval not to exceed ten days
(h) Daily: shall be done during the calendar day.

Surveillance requirements (except those specifically required for safety when the reactor is shutdown) may be deferred during reactor shutdown; however, they shall be completed prior to reactor startup unless reactor operation is required for performance of the surveillance. Such surveillance shall be performed as soon as practicable after reactor startup. Scheduled surveillance, which cannot be performed with the reactor operating, may be deferred until a planned reactor shutdown. Surveillances which may not be deferred during shutdown are Sections 4.3, 4.5, and 4.6(1).

4.1 Reactor core parameters

4.1.1 Excess Reactivity

Applicability: This specification applies to the measurement of reactor excess reactivity.

Objective: The objective is to periodically determine the changes in core excess reactivity to assure compliance with Section 3.1.1 of the Technical Specifications.

Specifications: Excess reactivity shall be determined on an average annually and after changes in either the core, in-core experiments, or control rods for which the predicted change in reactivity exceeds the absolute value of the required shutdown margin.

Basis: Annual determination of excess reactivity and measurements after reactor core or control rod changes are sufficient to monitor significant changes in the core excess reactivity.

4.1.2 Shutdown Margin

Applicability: This specification applies to the measurement of reactor shutdown margin.

Objective: The objective is to periodically determine the core shutdown reactivity available for reactor shutdown.

Specifications: The shutdown margin should be determined on an average annually and after changes in either the core, in-core experiments, or control rods.

Basis: Annual determination of shutdown margin and measurements after changes in reactor core, in-core experiments, or control rods are sufficient to monitor significant changes in the core shutdown margin.

4.1.3 Core Configuration

Applicability: This specification applies to the configuration of the core.

Objective: The objective is to assure that the core configuration remains as specified in the SAR and in Section 5 of the Technical Specifications.

Specifications: A visual observation of the reactor core shall be made before each initial daily startup of the reactor and proof of the observation recorded in the daily startup checklist. The observation shall assure that the fuel elements, control rods, detectors and experimental facilities are in place as specified in the SAR and the core is free of any extraneous material.

Basis: Daily visual surveillance of the reactor tank is sufficient to assure that there have been no change in the core configuration and to verify compliance with all applicable specifications.

4.1.4 Fuel Element Inspection

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

Objective: The objective is to verify the continuing integrity of the fuel element cladding.

Specifications: The reactor fuel elements shall be examined for physical damage caused by erosion, corrosion, or other damage by a visual inspection at least once each five years, with at least 20 percent of the fuel elements examined each year. Observation shall include inspection for swelling, cracks, corrosion, and pitting.

If an annual inspection or the release of fission products identifies damaged fuel, then the entire core shall be inspected.

Basis: The frequency of examination allows each element to be inspected every 5 years. Previous inspection experience has shown that this frequency of inspection is adequate and thus reduces the risk of accident or damaged fuel due to handling. This section may be deferred. Operations at our low-power level greatly minimizes the probability for fuel damage. Since 1959, there has not been a single instance of damaged fuel found.

4.2 Reactor Control and Safety System

4.2.1 Reactivity Worth of Control Rods

Applicability: These specifications apply to the surveillance requirements for reactivity control of experiments and systems.

Objective: The objective is to measure and verify the worth of the control rods.

Specifications: The integral worth of all control rods shall be determined on an average annually and after changes of the core or control rods.

Basis: The reactivity worth of the control rods is measured to ensure that the required shutdown margin is available and to provide an accurate means for determining the reactivity worth of experiments inserted in the core. Past experience with TRIGA reactors gives assurance that measurement of the reactivity worth on an annual basis is adequate to ensure no significant changes in the shutdown margin.

4.2.2 Rod Maximum Reactivity Insertion Rate

Applicability: This specification applies to surveillance of the control rods.

Objective: To establish operable conditions of the control rods by periodic measurement of the rod withdrawal and insertion speeds.

Specifications: Withdrawal time of the Safety rod shall be measured daily prior to the first start up of the reactor and withdrawal times of the other two control rods shall be measured on an average annually. Insertion speeds of all control rods shall be measured annually.

Basis: Measurement of withdrawal times will give an indication if there is any degradation of the control rods due to operation and assure operable performance of the rods. Measurement of insertion speeds will assure compliance with Section 3.2.2 of the Technical Specifications.

4.2.3 Scram Times of Control Rods

Applicability: This specification applies to the requirements for measurement of scram times of the control rods.

Objective: To establish the operable conditions of the control rods by periodic measurement of their scram times.

Specifications: Scram times of all control rods shall be measured on an average annually or whenever work is done on the rods or rod drive systems.

Basis: Measurement of scram times on an annual basis is a check not only of the scram system electronics, but also is an indication of the capability of the control rods to perform properly. The measurement of scram times will also ensure compliance with Section 3.2.1 of the Technical Specifications.

4.2.4 Scram and Measuring Channels

Applicability: This specification applies to the logic of the reactor control system.

Objective: To set surveillance requirements for performing channel checks or tests of all scram and power measuring channels required by the Technical Specifications.

Specifications: Channel tests and checks, as applicable, of all scram channels and interlocks required by Sections 3.2.3, 3.2.4 and 3.2.5 of the Technical Specifications shall be required before each reactor startup at the beginning of each operating day after a secured shutdown and after maintenance. The fission counter power supply, and the watchdog timer shall be tested monthly.

Basis: The above tests will ensure that scram systems and interlocks are operable on a daily basis or prior to an extended run. Previous operating experience has shown that the monthly surveillance of the fission counter power supply and the watch dog timer is sufficient to ensure operability. The extended surveillance interval for the power supply and watchdog timer is recommended to prevent undue stress on the systems.

4.2.5 Thermal Power Calibration

Applicability: This specification applies to determining the thermal power of the reactor.

Objective: The objective is to specify the interval and method used to thermally calibrate the reactor.

Specification: Calibration of the power measuring channels shall be done by the calorimetric method annually or after any modification or repair of the measuring system or change in the core.

Basis: The power level channel calibration will be done by the calorimetric method. Calibration will ensure that the reactor will be at the proper power level, e.g. indicated measurement will match actual thermal value, and that the requirements of the facility license will be complied with.

4.2.6 Rod Inspection

Applicability: This specification applies to the physical inspection of the poison section of the control rods, and to the rod drive and scram mechanisms.

Objective: To assure that the integrity of the control rod cladding is maintained and to look for any degradation of the rod drive and scram mechanisms.

Specifications: The control rods shall be visually inspected for deterioration on an average annually. During this inspection the rod drive and scram mechanisms shall also be inspected.

Basis: The visual inspection of the control rods is made to evaluate any corrosion or wear caused by operation of the reactor. Inspection of the rod drive and scram mechanism for excessive wear and deterioration will ensure that a malfunction is not forthcoming.

4.3 Coolant Systems

4.3.1 Analysis of Coolant for Radioactivity

Applicability: This specification applies to the monitoring of the coolant for radioactivity.

Objective: To establish trends to quickly identify fuel or heat exchanger failure.

Specifications: The reactor water shall be sampled for gross activity on an average monthly and for isotope identification on an average quarterly.

Basis: Periodic analysis of the reactor water will establish a trend to quickly identify fuel or heat exchanger failure.

4.3.2 Conductivity and pH

Applicability: This specification applies to the surveillance of primary water quality.

Objective: To ensure that the water quality does not deteriorate thereby causing corrosion of the reactor components.

Specifications:

(1) Conductivity shall be measured weekly.

(2) pH shall be measured at least once every month.

Basis: Surveillance of the condition of the primary reactor coolant on a regular basis will ensure that the water quality is sufficient to control the corrosion of such components as the reactor fuel cladding, structure and pool and to maintain clarity of the reactor water. Monitoring of the pH of the water over many years has shown that the value varies very slightly and consequently analysis at the intervals specified above is sufficient to detect a change.

4.3.3 Pool Water Level

Applicability: This specification applies to the requirement for maintaining a minimum height of water above the reactor core.

Objective: To ensure that sufficient water covers the core to provide necessary shielding and acceptable limits of cooling temperature.

Specifications: A monthly channel test shall be performed to ensure that the alarm float switch specified in TS 3.1.4 is operable.

Basis: This specification is to ensure that if there were a large leak or fracture of the reactor tank; attention would be called to the occurrence so that immediate action could be taken. The effect of a complete loss of cooling accident is analyzed in Appendix C of the SAR. Since there is a siphon break from the water skimmer 6" below the water surface, a drop in water level of 6"

would cause the water circulation system to lose its prime and cease to operate. The core is cooled by natural thermal convective flow.

4.4 Confinement

Applicability: This specification applies to the surveillance requirements of the confinement system of the reactor facility.

Objective: To assure that the confinement system as specified in the SAR and Section 3.4 of the Technical Specifications are complied with.

Specifications:

(1) A daily check shall be made prior to reactor operation to ensure that the doors to the reactor facility are closed.

(2) A daily check of the ventilation system operability shall be made prior to reactor operation.

Basis: In accordance with the statements made in the SAR the only confinement necessary for the reactor facility is proper ventilation and a secure facility. The above surveillance requirements will assure compliance.

4.5 Ventilation Systems

Applicability: This specification applies to the ventilation system within the reactor facility.

Objective: To assure that the ventilation system is operating as specified in Section 3.1 of the SAR.

Specifications:

(1) The fume hood exhaust system audible alarm for the pneumatic tube shall be tested prior to each day's use of the pneumatic transfer tube system and following repair and maintenance.

(2) The automatic absolute damper and alarm shall be tested on an average monthly and following repair or maintenance.

Basis: Testing of the above items will assure that the radioactive effluent concentration in the reactor room and that exhausted to the environs are as specified in the SAR.

4.6 Radiation Monitoring Systems

Applicability: This specification applies to the surveillance conditions of the radiation monitoring channels.

Objective: To assure that the radiation monitors are functional.

Specifications:

(1) All radiation monitors listed in TS 3.6.1, shall be calibrated annually and after maintenance, according to the manufacturer's recommendations.

(2) A channel test of these monitors shall be performed daily prior to reactor operation. At minimum these monitors shall be checked monthly.

Basis: Periodic calibration and frequent checks are specified to maintain reliable performance of the radiation monitoring instruments. Calibration and check frequencies follow the general recommendation of guidance documents from the manufacturer.

5.0 DESIGN FEATURES

5.1 Site and Facility Description

Specifications:

(1) The reactor shall be housed in room B526 in the basement of the Department of Veterans Affairs, Nebraska - Western Iowa Health Care System, Omaha Division (Refer. SAR, Fig. 3.2). The room shall be considered a restricted area with locked doors and entrance controlled by reactor laboratory personnel.

(2) The TRIGA reactor is assembled in a below ground shield and pool structure with only vertical access to the core.

(3) The minimum number of fans necessary for the facility are one nominal 2,970 CFM exhaust fan and two fume hood fans located on the roof of the Medical Center. In addition there is one electrically operated absolute damper that prevents Medical Center forced air from entering the reactor confinement.

(4) The minimum free volume in the reactor area shall be 25,000 ft^3.

5.2 Reactor Coolant System

Specifications: The reactor core shall be cooled by natural convective water flow.

5.3 Reactor Core and Fuel

5.3.1 Reactor Core

Specifications: The reactor core shall consists of a compact array of standard TRIGA fuel elements, graphite dummy elements, 3 control rods, control rod guides, a startup neutron source, and irradiation facilities. The fuel elements are spaced so that about 33% of the core volume is occupied by water, yielding a fuel-to-water ratio resulting in a critical mass near the minimum value for 20% enriched uranium fuel. The elements are held in concentric rings by an

upper and lower grid plate. The reactor currently requires 57 fuel elements but this number may change depending on the burn-up of the fuel. The balance of the 91 fuel element positions in the grid are occupied by experimental facilities or graphite-reflector elements. The latter are elements in which the U-Zrh_x fuel is replaced by graphite.

5.3.2 Reactor Fuel

Specifications: The standard TRIGA fuel element at fabrication shall have the following characteristics:

(1) Uranium content - maximum of 9.0 weight-% uranium enriched to less than 20 % uranium-235.

(2) Hydrogen-to-zirconium atom ratio (in the ZrH_x): nominal 1.0 for aluminum clad elements and 1.7 for stainless steel clad elements.

(3) Cladding: Aluminum, nominal 0.076 cm thick. Stainless steel, nominal 0.05 cm thick.

(4) Any burnable poison shall be an integral part of the as-manufactured fuel element. A burnable poison is defined as a material fixed in place in the core for the specific purpose of compensating for fuel burnup and/or other long-term reactivity adjustment.

5.3.3 Control Rods

Specifications: The reactor shall have three control rods (safety, shim and regulating). All three control rods shall have scram capability and contain borated graphite, B_4C powder, or boron and its compounds as a poison in a suitable cladding material, such as aluminum or stainless steel to ensure mechanical stability during movement and to isolate the poison from the pool water environment.

5.3.4 Fissionable Material Storage

Specifications: Fuel not in the reactor core shall be stored in a geometrical array where k_{eff} is no greater than 0.9 for all conditions of moderation and reflection using light water, except in cases where an approved fuel shipping container is used, then the k_{eff} for the container shall apply.

5.4 Ventilation System

Specifications:

(1) The exhaust fan shall exhaust into the below ground, water treatment pit and ultimately to ground level, while the pneumatic tube shall exhaust on the roof of the Medical Center which is approximately 371 feet above ground.

(2) The fume hood exhaust system for the pneumatic tube shall have a flow switch with an audible alarm that shall indicate if the exhaust fan stops.

6.0 ADMINISTRATIVE CONTROLS

6.1 Organization

6.1.1 Structure

The facility shall be under the control of the Reactor Director/Supervisor. The management for operation of the facility shall consist of the organizational structure as shown in Figure 6.1.

6.1.2 Responsibility

(1) Responsibility for the safe operation of the reactor facility shall be with the chain of command established in Figure 6.1. The Reactor Director/Supervisor shall be responsible to the Medical Center Chief Executive Officer and the Associate Chief of Staff for Research for safe operation and maintenance of the reactor and its associated equipment. Individuals at the various management levels, in addition to having responsibility for the policies and operation of the reactor facility, shall be responsible for safeguarding the public and facility personnel from undue radiation exposure and for adhering to all requirements of the operating license and technical specifications.

(2) In all instances, responsibilities of one level may be assumed by designated alternates or by higher levels, conditional upon appropriate qualifications.

6.1.3 Staffing

(1) The minimum staffing when the reactor is not secured shall be:

a. A licensed reactor operator in the reactor room. A licensed SRO may substitute for the RO and serve as both RO and SRO.

b. A second designated person present at the reactor room able to carry out prescribed written instructions. Unexpected absence for as long as two hours to accommodate a personal emergency may be acceptable provided immediate action is taken to obtain a replacement.

c. A designated Senior Reactor Operator (SRO) shall be present at the facility or readily available on call. "Readily Available on Call" means an individual who (1) has been specifically designated and the designation known to the operator on duty, (2) keeps the operator on duty informed of where he may be rapidly contacted and the phone number, and (3) is capable of getting to the reactor facility within a reasonable time under normal conditions (e.g. 30 minutes or within a 15-mile radius).

(2) A list of facility personnel by name and telephone number shall be readily available in the reactor room for use by the operator. The list shall include:

a. Management Personnel.
b. Radiation Safety personnel.
c. Other operations personnel.

(3) Events requiring the presence at the facility of a Senior Reactor Operator:

a. Initial startup and approach to power.
b. All fuel or control-rod relocations within the reactor core region.
c. Recovery from unplanned or unscheduled shutdown or significant power reduction (In these instances documented concurrence from a Senior Reactor Operator is required).

6.1.4 Selection and Training of Personnel

Training and requalification of personnel shall be in compliance with 10 CFR Part 55. Additional guidance for selection, training and requalification of operators may be found in ANSI/ANS 15-4-1988, "Selection and Training of Personnel for Research Reactors."

6.2 Review and Audit

6.2.1 Composition and Qualifications

The members shall collectively represent a broad spectrum of expertise in the appropriate reactor technology. Individuals may be either from within or outside the operating organization.

(1) The Reactor Safeguards Committee (RSC) shall function to provide independent review and audit of facility activities and be composed of a minimum of 4 members including the following:

Chairman	Associate Chief of Staff/Research
Member (ex-officio)	Radiation Safety Officer
Member	Reactor Director/Supervisor

(2) A minimum qualification for persons on the RSC shall be 5 years of professional work experience in the discipline or specific field they represent. A baccalaureate degree may fulfill 4 years of experience.

(3) Qualified and approved alternates may serve in the absence of regular members. No more than two alternates shall participate on a voting basis in RSC activities at any one time.

(4) Members and alternates shall be appointed by and report to Level 1 management.

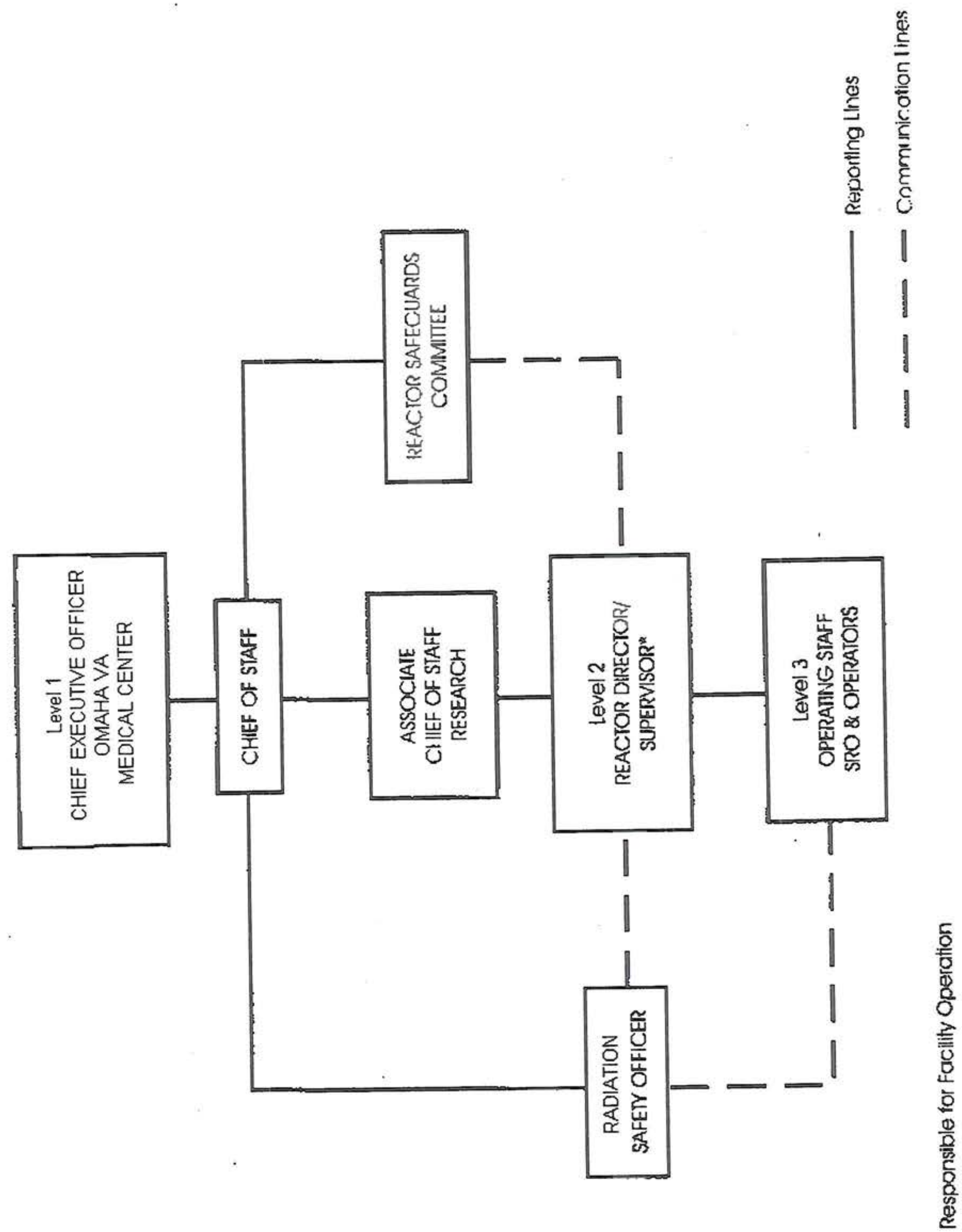

Fig. 6-1 FACILITY ORGANIZATION

6.2.2 Charter and Rules

The operations of the Reactor Safeguards Committee shall be in accordance with an established charter including provisions for:

(1) Meeting frequency – not less than once per calendar year and more frequently as circumstances warrant, consistent with effective monitoring of facility activities.

(2) Quorums - not less than one-half of the membership where the operating staff does not constitute a majority.

(3) Use of subgroups.

(4) Dissemination, review, and approval of minutes in a timely manner (within a month following the meeting).

6.2.3 Review Function

The review function shall include facility operation related to reactor and radiological safety. The following items shall be reviewed:

(1) Determinations that proposed changes in the facility and changes in procedures as described in the SAR, and tests or experiments not described in the SAR does not meet the criteria of 10 CFR 50.59(c)(2).

(2) All new procedures and major revisions thereto having safety significance, proposed changes in reactor facility equipment, or systems having safety significance.

(3) All new experiments or classes of experiments that could affect reactivity or result in the release of radioactivity.

(4) Proposed changes in technical specifications and license.

(5) Violations of technical specifications or license. Violations of internal procedures or instructions having safety significance.

(6) Operating abnormalities having safety significance.

(7) Reportable occurrences listed in 6.7.2.

(8) Audit reports.

A written report of minutes of the findings and recommendations of the review group shall be submitted to Level 1 management and the review and audit group members within a month after the review has been completed.

6.2.4 Audit Function

The audit function shall include selective (but comprehensive) examination of operating records, logs, and other documents. Discussions with cognizant personnel and observation of operations should be used also as appropriate. In no case shall the individual immediately responsible for the area perform an audit in that area. The following items shall be audited:

(1) Facility operations for compliance to the technical specifications and applicable license conditions annually.

(2) The requalification program for the operating staff, on an average of at least once every other calendar year (intervals between audits not to exceed 30 months).

(3) The results of action taken to correct those deficiencies that may occur in the reactor facility equipment, systems, structures, or methods of operation that affect reactor safety, on an average of at least once per calendar year (intervals between audits not to exceed 15 months).

(4) The reactor facility emergency plan, and implementing procedures on an average of at least once every other calendar year (at intervals between audits not to exceed 30 months).

Deficiencies uncovered that affect reactor safety shall immediately be reported to Level 1 management. A written report of the findings of the audit shall be submitted to Level 1 management and the review and audit group within three months after the audit has been completed.

6.3 Radiation Safety

(1) The radiation safety program shall comply with the requirements of 10 CFR Part 20. Additional guidance for the radiation safety program may be found in ANSI.ANS 15.11-1993 "Radiation Protection at Research Reactor Facilities."

(2) The Radiation Safety Officer or his designate shall be assigned the responsibility for implementing the radiation protection program at the reactor facility using the above guidelines.

(3) The Radiation Safety Officer shall report to Level 1 management through the Chief of Staff.

(4) Management is committed to practice an effective ALARA program that is aimed at making every reasonable effort to maintain radiation exposure as far below the limits specified in 10 CFR Part 20 as practicable. The ALARA program shall apply to facility staff, facility users, general public and the environment.

6.4 Procedures

Written procedures shall be reviewed and approved by the Reactor Director/Supervisor and reviewed by the Reactor Safeguards Committee prior to initiation of the following activities:

(1) Startup, operation, and shutdown of the reactor.

(2) Fuel loading, unloading, and movement within the reactor.

(3) Maintenance of major components of systems that could have an effect on reactor safety.

(4) Surveillance checks, calibrations, and inspections required by the technical specifications or those that may have an effect on reactor safety.

(5) Personnel radiation protection, consistent with applicable regulations or guidelines. The procedures shall include management's commitments and programs to maintain exposures and releases as low as reasonably achievable (ALARA) in accordance with the guidelines of ANSI/ANS-15.11-1993, "Radiation Protection at Research Reactor Facilities."

(6) Administrative controls for operation and maintenance and for the conduct of irradiations and experiments that could affect reactor safety or core reactivity.

(7) Implementation of required plans such as emergency plan or security procedures.

(8) Use of byproduct material and shipment of byproduct material.

(9) Any additional plans that may be deemed necessary for operation of the facility.

Substantive changes to the procedures shall be made effective only after documented review by the Reactor Safeguards Committee and approval by the Reactor Director/Supervisor. Minor modifications to procedures that do not change their original intent (and may be made under 10 CFR 50.59) may be made by the Reactor Director/Supervisor, but the modifications shall be approved by the Reactor Safeguards Committee within 14 days.

6.5 Experiment Review and Approval

Approved experiments shall be carried out in accordance with written procedures properly reviewed and approved.

(1) All new experiments or class of experiments shall be reviewed by the Reactor Safeguards Committee and approved in writing by the Committee and the Reactor Director/Supervisor or designated alternates prior to initiation. The review and approval shall be consistent with the guidelines provided in ANSI/ANS 15.1-1990.

(2) Substantive changes to previously approved experiments shall be only after review by the Reactor Safeguards Committee and approved in writing by the Reactor Director/Supervisor or designated alternate. Minor changes that do not significantly alter the experiment (and may be made under 10 CFR 50.59) may be approved by the Reactor Director/Supervisor or a designated shift Senior Reactor Operator.

6.6 Required Actions

6.6.1 Required Action to be Taken in Case of Safety Limit Violation

(1) The reactor shall be shutdown, and reactor operation shall not be resumed until authorized by the Nuclear Regulatory Commission.

(2) The safety limit violation shall be reported to the Reactor Director/Supervisor or designated alternates.

(3) The safety limit violation shall be reported to the Nuclear Regulatory Commission.

(4) A safety limit violation report shall be prepared. The report shall describe the following:

a. Applicable circumstances leading to the violation including, when known, the cause and contributing factors.

b. Effects of the violation upon reactor facility components, systems, or structures and on the health and safety of personnel and the public.

c. Corrective action to be taken to prevent recurrence.

The report shall be reviewed by the Reactor Safeguards Committee and any follow-up report shall be submitted to the Nuclear Regulatory Commission when authorization is sought to resume operation.

6.6.2 Action to be Taken in the Event of an Occurrence of the Type Identified in 6.7.2(1)b, and 6.7.2(1)c.

(1) Reactor conditions shall be returned to normal or the reactor shall be shut down. If it is necessary to shut down the reactor to correct the occurrence, operation shall not be resumed unless authorized by the Reactor Director/Supervisor or designated alternates.

(2) Occurrence shall be reported to the Reactor Director/Supervisor or designated alternates and to the Nuclear Regulatory Commission as required.

(3) Occurrence shall be reviewed by the Reactor Safeguards Committee at their next scheduled meeting.

6.7 Reports

6.7.1 Operating Reports

Routine operating reports covering the operation of the facility during the previous calendar year shall be submitted before March 31 to the Nuclear Regulatory Commission, Attn: Document Control Desk, Washington, D.C. 20555.

(1) A narrative summary of reactor operating experience including the energy produced by the reactor.

(2) The unscheduled shutdowns including, where applicable, corrective action taken to preclude recurrence.

(3) Tabulation of major preventive and corrective maintenance operations having safety significance.

(4) A brief description, as required by 10 CFR 50.59, of any changes, tests, and experiments, including a summary of the evaluation of each.

(5) A summary of the nature and amount of radioactive effluents released or discharged to environs beyond the effective control of the Medical Center as determined at or before the point of such release or discharge. The summary shall include to the extent practicable, an estimate of individual radionuclides present in the effluent. If the estimated average release after dilution is less than 25% of the concentration allowed, a statement to this effect is sufficient.

(6) A summarized result of environmental surveys, if any, performed outside the facility.

(7) A summary of exposures received by facility personnel and visitors where such exposures are greater than 25% of that allowed.

6.7.2 Special Reports

Special reports shall be used to report unplanned events as well as planned major facility and administrative changes.

(1) There shall be a report no later than the following working day by telephone to the NRC Operations Center, and confirmed in a written report or FAX to the NRC Document Control Desk within 30 days.

a. Violation of safety limits.

b. Release of radioactivity from the site above allowed limits.

c. Any of the following:

(i.) Operation with actual safety-system settings for required systems less conservative than the limiting safety-system settings specified in the technical specifications.

(ii.) Operation in violation of limiting conditions for operation established in the technical specifications unless prompt remedial action is taken.

(iii.) A reactor safety system component malfunction which renders or could render the reactor safety system incapable of performing its intended safety function unless the malfunction or condition is discovered during maintenance tests or periods of reactor shutdown.

(Note: Where components or systems are provided in addition to those required by the technical specifications, the failure of the extra components or systems is not considered reportable provided that the minimum number of components or systems specified or required perform their intended reactor safety function).

(iv.) An unanticipated or uncontrolled change in reactivity greater than one dollar. Reactor trips resulting from a known cause are excluded.

(v.) Abnormal and significant degradation in reactor fuel or cladding, or both, or coolant boundary (excluding minor leaks), which could result in exceeding prescribed radiation exposure limits of personnel or environment, or both.

(vi.) An observed inadequacy in the implementation of administrative or procedural controls such that the inadequacy causes or could have caused the existence or development of an unsafe condition with regard to reactor operations.

(2) A written report within 30 days to the NRC address in the first paragraph of this section is required for:

a. Permanent changes in facility organization involving Level 1 or 2 personnel as described in Figure 6.1.

b. Significant changes in the Safety Analysis Report.

6.8 Records

Records may be in the form of logs, data sheets, or other suitable forms. The required information may be contained in single or multiple records, or a combination thereof.

6.8.1 Records to be Retained for a Period of at Least Five Years or for the Life of the Component Involved if Less than Five Years.

(1) Normal reactor facility operation but not including supporting documents such as checklist, log sheets, etc., which shall be maintained for a period of at least one year or one inspection cycle whichever is longer.

(2) Principal maintenance operations.

(3) Surveillance activities required by the Technical Specifications.

(4) Reactor facility radiation and contamination surveys where required by applicable regulations.

(5) Experiments performed with the reactor.

(6) Fuel inventories, receipts, and shipments.

(7) Approved changes in operating procedures.

(8) Records of meeting and audit reports of the RSC.

6.8.2 Records to be Retained for at Least One Requalification Cycle.

Records of retraining and requalification of licensed operators shall be maintained at all times the individual is employed or until the license is renewed.

6.8.3 Records to be Retained for the Lifetime of the Reactor Facility.

Applicable annual reports, if they contain all of the required information, may be used as records in this section.

(1) Gaseous and liquid radioactive effluents released to the environs.

(2) Radiation exposure for all personnel monitored.

(3) Drawings of the reactor facility.

(4) Reportable occurrences.