TECHNICAL SPECIFICATIONS

FOR THE

UNIVERSITY OF CALIFORNIA - DAVIS MCCLELLAN NUCLEAR RADIATION CENTER

(UCD/MNRC)

TECHNICAL SPECIFICATIONS FOR THE UNIVERSITY OF CALIFORNIA - DAVIS/MCCLELLAN NUCLEAR RESEACRH CENTER (UCD/MNRC)

1. Introduction

1.1 Scope

This document constitutes the Technical Specifications for the Facility License No. R-130 as required by 10 CFR 50.36 and supersedes all prior Technical Specifications. This document includes the "Basis" to support the selection and significance of the specifications. Each basis is included for information purposes only. They are not part of the Technical Specifications, and they do not constitute limitations or requirements to which the licensee must adhere, except where they reference the UCD/MNRC SAR or a specific Technical Specification. These specifications are formatted in a manner consistent with ANSI/ANS 15.1-2007.

1.2 Definitions

Channel. A channel is the combination of sensor, line, amplifier, processor, 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 shall encompass the entire channel, including equipment actuation, alarm, or trip and shall include a Channel Test.

Channel Check. A channel check is a qualitative verification of acceptable performance by observation of channel behavior. This verification, where possible, shall include 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 an enclosure of the reactor room which is designed to limit the release of effluents from the enclosure to the external environment through controlled or defined pathways.

Control Rod. A control rod is a device fabricated from neutron absorbing material, with or without a fuel or air follower, which is used to establish neutron flux changes and to compensate for routine reactivity losses. The follower may be a stainless steel section. A control rod shall be coupled to its drive unit to allow it to perform its control function, and its safety function when the coupling is disengaged. This safety function is commonly termed a scram.

> Regulating Rod. A regulating rod is a control rod used to maintain an intended power level and may be varied manually or by a servo-controller. It may have a fueled-follower section. A regulating rod shall have scram capability.
>
> Shim Rod. A shim rod is a control rod having an electric motor drive and scram capabilities. It may have a fueled-follower section. Its position is varied manually. A shim rod shall have scram capability.

Excess Reactivity. Excess reactivity is that amount of reactivity that would exist if all control devices were moved to the maximum reactive position from the point where the reactor is exactly critical ($K_{eff} = 1$) at reference core conditions.

Experiment. Any operation, hardware, or target (excluding devices such as detectors) which is designed to investigate non-routine reactor characteristics or which is intended for irradiation within an irradiation facility. Hardware rigidly secured to a core or shield structure so as to be a part of their design to carry out experiments is not normally considered an experiment. Specific experiments shall include:

> Moveable Experiment. A movable experiment is one that is not secured and intended to be moved while near or inside the core during reactor operation.
>
> Secured Experiment. A secured experiment is any experiment, experiment facility, or component of an experiment that is held in a stationary position relative to the reactor by mechanical means. The restraining force 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 which can arise as a result of credible malfunctions.

Experiment Facilities. Experiment facilities shall mean the pneumatic transfer tube, beam tubes, irradiation facilities in the reactor core or in the reactor tank, and radiography bays.

External Scram. External scrams may arise from the radiography bay doors, radiography bay ripcords, and bay shutter interlocks.

Instrumented Fuel Element. An instrumented fuel element is a standard fuel element fabricated with thermocouples for temperature measurements. An instrumented fuel element shall have at least one operable thermocouple embedded in the fuel near the axial and radial midpoints.

Licensed Area. The licensed area is that area inside of the fence immediately surrounding the reactor building. This fence also demarcates the property that is owned by the University of California from the surrounding area and is approximately 2.3 acres in size. Inside of the licensed area is also a restricted area.

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

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.

Protective Action. Protective action is the initiation of a signal or the operation of equipment within the UCD/MNRC reactor safety system in response to a parameter or condition of the UCD/MNRC reactor facility having reached a specified limit.

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 into or removed from its intended position.

Reactor Operating. The UCD/MNRC reactor is operating whenever it is not shutdown or secured.

Reactor Operator. An individual who is licensed to manipulate the controls of the facility.

Reactor Safety Systems. Reactor safety systems are those systems, including their associated input channels, which are designed to initiate automatic reactor protection or to provide information for initiation of manual protective action.

Reactor Secured. The UCD/MNRC 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 moderations and reflection;

2) Or the following conditions exist:

a) The minimum number of control rods are fully inserted to ensure the reactor is shutdown, as required by technical specifications; and

b) No work is in progress involving core fuel, core structure, installed control rods, or control rod drives, unless the control rod drives are physically decoupled from the control rods; and

c) No experiments in any reactor experiment facility, or in any other way near the reactor, are being moved or serviced if the experiments have, on movement, a reactivity worth exceeding the maximum value allowed for a single experiment or $1.00, whichever is smaller; and

d) The console key switch is in the off position, and the key is removed from the lock.

Reactor Shutdown. The UCD/MNRC reactor is shutdown if it is subcritical by at least one dollar ($1.00) both in the Reference Core Condition and for all allowed ambient conditions with the reactivity worth of all installed experiments included.

Reference Core Condition. The condition of the core when it is at ambient temperature (cold $T<28^{o}$ C), the reactivity worth of xenon is negligible (< $0.10) (i.e., cold and clean), and the central irradiation facility contains the graphite thimble plug and the aluminum thimble plug (CIF-1).

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

Scram Time. Scram time is the elapsed time between the initiation of a scram and the instant that the control rod reaches its fully-inserted position.

Senior Reactor Operator. An individual who is licensed to direct the activities of reactor operators and to manipulate the controls of the facility.

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

Shutdown Margin. Shutdown margin shall mean the minimum shutdown reactivity necessary to provide confidence that the reactor can be made subcritical by means of the control and safety system starting from any permissible operating condition with the most reactive rod assumed to be in the most reactive position, and once this action has been initiated, the reactor will remain subcritical without further operator action.

Surveillance Intervals. Maximum intervals are established to provide operational flexibility and not to reduce frequency. Established frequencies shall be maintained over the long term. The allowable surveillance interval is the interval between a check, test, or calibration, whichever is appropriate to the item being subjected to the surveillance, and is measured from the date of the last surveillance. Allowable surveillance intervals shall not exceed the following:

Quinquennial - interval not to exceed seventy-two (72) months

Annual - interval not to exceed fifteen (15) months.

Semiannual - interval not to exceed seven and a half (7.5) months.

Quarterly - interval not to exceed four (4) months.

Monthly - interval not to exceed six (6) weeks.

Weekly - interval not to exceed ten (10) days.

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

2.0 Safety Limit and Limiting Safety System Setting

2.1 Safety Limits

Applicability - This specification applies to the temperature of the reactor fuel.

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

Specification - The maximum fuel temperature in a standard TRIGA fuel element shall not exceed 930°C during steady-state operation.

Basis - This fuel safety limit applies for conditions in which the cladding temperature is above 500°C (Safety Analysis Report (SAR), Chapter 4.5). The important parameter for a TRIGA reactor is the fuel element temperature. This parameter is well suited as it can be measured directly. A loss in the integrity of the fuel element cladding could arise if the cladding stress exceeds the ultimate strength of the cladding material. The fuel element cladding stress is a function of the element's internal pressure while the ultimate strength of the cladding material is a function of its temperature. The cladding stress is a result of the internal pressure due to the presence of air, fission product gasses and hydrogen from the disassociation of hydrogen and zirconium in the fuel moderator. Hydrogen pressure is the most significant. The magnitude of the pressure is determined by the fuel moderator temperature and the ratio of hydrogen to zirconium in the alloy. At a fuel temperature of 930°C for $ZrH_{1.7}$ fuel, the cladding stress due to the internal pressure is equal to the ultimate strength of the cladding material at the same temperature. This is a conservative limit since the temperature of the cladding material is always lower than the fuel temperature. (See SAR Chapter 4.5)

2.2 Limiting Safety System Setting

Applicability - This specification applies to the protective action for the reactor fuel element temperature.

Objective - The objective is to prevent the fuel element temperature safety limit from being reached.

Specification - The limiting safety system setting shall be less than or equal to 750°C (operationally this may be set more conservatively) as measured in an instrumented fuel element. One instrumented element shall be located in the analyzed peak power location of the reactor operational core.

Basis - For steady-state operation of the reactor, the limiting safety system setting is a temperature which, if exceeded, shall cause a reactor scram to be initiated preventing the safety limit from being exceeded. A setting of 750°C provides a safety margin at the point of the measurement greater than 150°C for standard TRIGA fuel elements in any condition of operation. A part of the safety margin is used to account for the difference between the true and measured temperatures resulting from the actual location of the thermocouple. If the thermocouple element is located in the hottest position in the core, the difference between the true and measured temperatures will be only a few degrees since the thermocouple junction is near the center and mid-plane of the fuel element.

3.0 Limiting Conditions For Operation

3.1 Reactor Core Parameters

3.1.1 Excess Reactivity

Applicability - This specification applies to the reactivity condition of the reactor and the reactivity worths of control rods and experiments.

Objective - The objectives that must be simultaneously met are to assure that the reactor has sufficient reactivity to meet its mission requirements, be able to be shut down at any time, and not exceed its fuel temperature safety limit.

Specification - The maximum available excess reactivity (reference core condition) shall not exceed 5.625% Δk/k ($7.50).

Basis -This specification sets an overall reactivity limit which provides adequate excess reactivity to override the xenon buildup, to overcome the temperature change in going from zero power to 1.0 MW, to permit irradiation of negative worth experiments and account for fuel burnup over time.

3.1.2 Shutdown Margin

Applicability - These specifications apply to the reactor at all times that it is in operation.

Objective - The objective is to assure that the reactor can be placed in a shutdown condition at all times and to assure that the safety limit shall not be exceeded.

Specification - The reactor shall not be operated unless the shutdown margin provided by the control rods is greater than 0.375% Δk/k ($0.50) with:

1. The reactor in the reference core condition where there is no ^{135}Xe poison present and the core is at ambient temperature,

2. The most reactive control rod assumed fully withdrawn, and

3. Absolute value of all movable experiments analyzed in their most reactive condition or $1.00 whichever is greater.

Basis - This specification assures that the reactor can be placed in a shutdown condition from any operating condition and remain shutdown, even if the maximum worth control rod should stick in the fully withdrawn position (SAR Chapter 4.5).

3.1.3 Core Configuration Limitations

Applicability - This specification applies to the configuration of the fuel inside of the core.

Objective - The objective is to assure that provisions are made to restrict the arrangement of fuel elements so as to provide assurance that power densities greater than those analyzed for in the SAR will not be produced.

Specification-

1. The only fuel types allowed are 20/20 and 30/20 with stainless steel cladding. These elements may only be placed in any position in Hex Rings C through G.

2. Fuel shall not be inserted or removed from the core unless the reactor is subcritical by more than the calculated worth of the most reactive fuel element being moved.

3. A Control rod shall not be manually removed from the core unless the core has been shown to be subcritical by at least $0.50 with the highest worth control rod in the full-out position.

Basis - Maximum permissible power level per element is given to give reasonable assurance that the core peaking factors used (SAR Chapter 4.5) and the thermal hydraulic analysis (SAR Chapter 4.6) are always bounding. The specification also give assurance that the reactor will remain subcritical during all fuel and control rod removals.

3.1.4 Fuel Parameters

Applicability - This specification applies to the physical dimensions and condition of the fuel elements as measured on the last surveillance test.

Objective - The objective is to verify the integrity of the fuel-element cladding and U-235 burn up.

Specification - The reactor shall not be used for operation with damaged fuel. All fuel elements shall be inspected visually for damage or deterioration as per Technical Specifications Section 4.1.4. A fuel element shall be considered damaged and must be removed from the core if:

1. In measuring the transverse bend, the bend exceeds 0.125 inch (3.175 mm) over the full length 23 inches (584 mm) of the cladding, or,

2. In measuring the elongation, its length exceeds its initial length by 0.125 inch (3.175 mm), or,

3. A cladding failure exists as indicated by measurable release of fission products, or,

4. Visual inspection identifies bulges, gross pitting, or corrosion.

5. ^{235}U burnup is calculated to be greater than 50% of initial content.

In the case of specification 3, the reactor may be operated only for the purpose of identifying the specific element that is releasing measurable fission products.

Basis - 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. The above limits on the allowable distortion of a fuel element correspond to strains that are considerably lower than the strain expected to cause rupturing of a fuel element.

3.2 Reactor Control and Safety Systems

3.2.1 Control Rods

Applicability - This specification applies to the function of the control rods.

Objective - The objective is to ensure that the control rods are operable.

Specification –

1. The reactor shall not be operated unless all six control rods are operable.

2. Control rods shall not be considered operable unless conditions a, b, and c below are met:

   a. Physical damage is apparent to the rod or drive assemblies or the control rod does not respond normally to control rod motion signals.

   b. The scram time measured from the instant a signal reaches the value of a limiting safety system setting to the instant that the slowest control rod reaches its fully inserted position shall not exceed one (1) second.

   c. The maximum reactivity insertion rate of any shim or regulating rod shall not exceed $0.19 per second.

Basis -This specification ensures that the reactor shall be promptly shut down when a scram signal is initiated. Experience and analysis have indicated that for the range of transients anticipated for a TRIGA reactor, the specified scram time is adequate to ensure the safety of the reactor (SAR 13.2).

3.2.2 Reactor Instrumentation for Operation

Applicability - This specification applies to the information which shall be available to the reactor operator during reactor operations.

Objective - The objective is to specify the minimum number of power and temperature measuring channels that shall be available to the operator to ensure safe operation of the reactor

Specification - The reactor shall not be operated unless the minimum number of channels described in Table 3.1 are operable and the information is displayed on the reactor console.

Table 3.1 Required Reactor Instrumentation

Measuring Channel	Minimum Number Required
a. Reactor Power Level Safety Channel	2
b. Linear Power Channel	1
c. Log Power Channel	1
d. Fuel Temperature Channel	1

Basis -

a. The two reactor power level safety channels assure that the reactor power level is properly monitored and indicated in the reactor control room (SAR Chapter 7).

b and c. The linear power channel and log power channel assure that the reactor power level and energy are adequately monitored (SAR Chapter 7)

d. The fuel temperature channel assure that the fuel temperature is properly monitored and indicated in the reactor control room (SAR Chapter 4.5).

3.2.3 Reactor Scrams and Interlocks

Applicability - This specification applies to the scrams and interlocks.

Objective - The objective is to assure that the minimum number of scrams and interlocks are operable for safe operation of the reactor.

Specification - The reactor shall not be operated unless the minimum number of scrams and interlocks described in Table 3.2 and 3.3 are operable:

Table 3.2 Minimum Number of Scrams

Scrams	Function	Number Required
a. Console Manual Scram	SCRAM	1
b. Reactor Room Manual Scram	SCRAM	1
c. Radiography Bay Manual Scram	SCRAM to prevent worker radiation exposure.	1/Bay*
d. Reactor Power Level Safety Scrams	SCRAM at 1.02 MW (t) or less.	2
e. High Voltage Power Supplies Scrams	SCRAM on loss of nominal operating voltage to the NM1000 and NPP1000 power channels.	2
f. Fuel Temperature Scrams	SCRAM at 750 C or less	1
g. Watchdog Circuit Scram	Scram within 8 seconds upon lack of response in DAC or CSC computer	2
h. Magnet Power Key Switch Scram	SCRAM	1

Table 3.3 Minimum Number of Interlocks

Interlocks	Function	Number Required
i. Low Source Level Rod Withdrawal Prohibit Interlock	Prevents control rod withdrawal at $<2*10^{-7}$ % power.	1
j. Control Rod Withdrawal Interlock	Prevents simultaneous manual withdrawal of two rods.	1
k. Radiography Bay Shutter Interlock	Prevents simultaneous opening of shield door and massive shutter in the same radiography while the reactor is operating.	1/Bay*

*The reactor may be operated if an individual radiography bay manual Scram or reactor bay shutter interlock is inoperable. In this event, the affected radiography bay shall be placed out of service until the manual Scram or reactor bay shutter interlock becomes operable.

Basis -

a. The console manual scram allows rapid shutdown of the reactor from the control room (SAR Chapter 7).

b. The reactor room manual scram allows rapid shutdown of the reactor from the reactor room.

c. The radiography bay manual scrams allow rapid shutdown of the reactor from any of the radiography bays (SAR Chapter 9.6). This is not to protect the reactor, but to prevent an over exposure of MNRC personnel should they be located in a reactor bay when the massive shutter is open and the reactor is on.

d. The automatic power level safety scram assures the reactor will be shutdown if the power level exceeds 1.02 MW, therefore not exceeding the safety limit (SAR Chapter 4.7).

e. The loss-of-high-voltage scram assures that the reactor power level safety channels operate within their intended range as required for proper functioning of the power level scrams (SAR Chapter 7).

f. The fuel temperature Scram assure that the reactor will be shut down if the fuel temperature exceeds 750^{o} C, therefore ensuring the safety limit will not be exceeded (SAR Chapter 4).

g. The watchdog circuits assure that the control system computer and the data acquisition computer are functioning properly (SAR Chapter 7.2).

h. The magnet current key switch prevents the control rods from being energized without inserting the key. Turning off the magnet current key switch de-energizes the control rod magnets and results in a scram (SAR Chapter 7).

i. The low source level rod withdrawal prohibit interlock assures an adequate source of neutrons is present for safe startup of the reactor (SAR Chapter 7).

j. The control rod withdrawal interlock prevents the simultaneous withdrawal of two or more control rods thus limiting the reactivity-insertion rate from the control rods in manual mode (SAR Chapter 7).

k. The radiography bay shutter interlock prevents the opening of a radiography bay shutter and the massive radiation shielding door at the same time while the reactor is operating (SAR Chapter 9).

3.3 Reactor Coolant Systems

Applicability - These specifications apply to the operation of the reactor coolant measuring systems.

Objective - The objective is to assure that adequate cooling is provided to maintain fuel temperatures below the safety limit, and that the coolant quality remains high to prevent damage to the reactor fuel. The reactor reflooding system ensures that the reactor could be recovered with water in the case of a complete LOCA in order to reduce potential exposure to the public to below 10 CFR 20 limits.

Specification - The reactor shall not be operated unless the systems and instrumentation channels described below are operable, and the information is displayed locally or in the control room.

1. The bulk tank water temperature shall not exceed 45 °C;

2. The conductivity of the tank water shall be less than 5 µmhos/cm when averaged over a one month period;

3. The reactor shall not be operated if water level drops below a depth of 19 feet from the top of the fueled region of the core; and

4. The reactor shall not be operated if the radioactivity of the pool water exceeds the limits of 10 CFR 20 Appendix B Table 3 for radioisotopes with half-lives >24 hours.

5. The reactor core reflooding system is considered operable if the local pressure gauge on the system reads 20 psi or above.

Basis -

1. The primary coolant core inlet temperature alarm assures that large power fluctuations will not occur (SAR Chapter 4.6).

2. The minimum height of 19 ft. of water above the fueled region of the core guarantees that there is sufficient water for effective cooling of the fuel and that the radiation levels at the top of the reactor tank are within acceptable limits. This height of water is also a bounding condition for the core thermal hydraulic analysis. (SAR Chapter 4).

3. Maintaining the primary coolant water conductivity below 5 micromhos/cm averaged over a week will minimize the activation of water impurities and also the corrosion of the reactor structure.

4. This specification insures that in the event of a large scale release of primary coolant no effluence limits are exceeded.

5. This system will allow the facility to recover the core with water in the in the case of a complete LOCA in order to reduce potential exposure to the public to below 10 CFR 20 limits.

3.4 This section intentionally left blank

3.5 Ventilation and Confinement System

Applicability - This specification applies to the operation of the facility ventilation and the reactor room confinement system.

Objective - The objective is to ensure that the ventilation and confinement system shall be in operation to mitigate the consequences of possible releases of radioactive materials resulting from reactor operations.

Specification -

1. This specification applies to the ventilation system under normal reactor operations. Under this normal mode of operation, air from the reactor room is exhausted from the facility stack via the reactor room exhaust fan (EF-1). The reactor shall not be operated unless the normal mode ventilation system is operable. The normal mode ventilation system shall be considered operable if the reactor room exhaust fan (EF-1) is in operation and the pressure in the reactor room is negative relative to surrounding room (equipment room).

2. This specification applies to the ventilation system when high levels of airborne radioactivity are detected. In this mode no air from the reactor room exists via the facility stack. The transition from normal ventilation mode to recirculation mode is accomplished by a number of automated dampers triggered by the CAM alarms. The reactor room ventilation shall operate in the recirculation mode, with all exhaust air passing through a HEPA filter, whenever a high level continuous air monitor (CAM) alarm is present due to airborne radionuclides emitted from the reactor or samples in the reactor room. The recirculation ventilation system shall be considered operable when all dampers in the system are operable.

3. Movement of irradiated fuel or fueled experiments with significant fission product inventory outside of containers, systems, or storage areas within the reactor room shall not be performed unless the ventilation system is operating as described in TS 3.5, Specifications 1 and the ventilation system is operable as described in TS 3.5, Specification 2.

4. Core or control rod work that could cause a change in reactivity of more than one dollar shall not be performed unless the ventilation system is operating as described in TS 3.5, Specifications 1 and the ventilation system is operable as described in TS 3.5, Specification 2.

5. Movement of experiments within the core that could reasonably cause a change of total worth of more than one dollar shall not be performed unless the ventilation system is operating as described in TS 3.5, Specifications 1 and the ventilation system is operable as described in TS 3.5, Specification 2.

Basis - Operation of the reactor room exhaust system assures that:

Concentrations of airborne radioactive material in the reactor room and in air leaving the reactor room via the stack are monitored and directed during both routine operations and in accident scenarios.

3.6 This section intentionally left blank.

3.7 Reactor Radiation Monitoring Systems

3.7.1 Monitoring Systems

Applicability - This specification applies to the radiation monitoring systems.

Objective - The objective is to require that sufficient information regarding radiation levels and radioactive effluents is available to the reactor operator to assure safe operation of the reactor.

Specification - The reactor shall not be operated unless the channels described in Table 3.4 are operable, the readings are below the alarm setpoints, and the information is displayed in the control room. The Stack and Reactor Room Continuous Air Monitors (CAMS) shall not be placed out of service at the same time during reactor operation.

Table 3.4 REQUIRED RADIATION MONITORING INSTRUMENTATION

Measuring Equipment	**Minimum Number Required**	**Channel Function**
a. Facility Stack Continuous Air Monitor (CAM)	1*	Monitors Argon-41 and radioactive particulates, and alarms.
b. Reactor Room Radiation Area Monitor (RAM)	1	Monitors the radiation level in the reactor room and alarms
c. Demineralizer System Radiation Area Monitor (RAM)	1	Monitors radiation level at the demineralizer station and alarms
d. Reactor Room Continuous Air Monitor (CAM)	1**	Monitors air from the reactor room for particulate and xenon radioactivity and alarms
e. Environmental Dosimeters	8	Monitor radiation at facility boundary

RAMs and CAMs may be placed out-of-service for up to 2 hours for calibration and maintenance. During this out-of-service time, no experiment or maintenance activities shall be conducted which could result in alarm conditions (e.g., airborne releases or high radiation levels).

* If the Facility Stack Continuous Air Monitor CAM is out of service for more than 2 hours, the amount of Ar-41 effluenced may be calculated based on the number of MW hours the reactor is operated. This alternative measurement method for an out of service Facility Stack Continuous Air Monitor shall not exceed 60 days.

**If the Reactor Room CAM is out of service for more than 2 hours, a manual measurement may be performed every 4 hours of operation to verify airborne levels of radiation in the reactor room are below the CAM set points. This alternative measurement method for an out of service Reactor Room CAM shall not exceed 60 days.

Basis -

a. The facility stack monitor provides information to operating personnel regarding the release of radioactive material to the environment (SAR Chapter 11.1). The alarm setpoint on the facility stack monitor is set to limit Argon-41 concentrations to less than 10 CFR Part 20, Appendix B, Table 2, Column 1 values (averaged over one year) for unrestricted locations outside the operations area.

b. The reactor room radiation monitor provides information regarding radiation levels in the reactor room during reactor operation (SAR Chapter 11.1), to limit occupational radiation exposure to less than 10 CFR 20 limits.

c. The radiation monitor located next to the purification system resin canisters provides information regarding radioactivity in the primary system cooling water (SAR Chapter 11.1) and allows assessment of radiation levels in the area to ensure that personnel radiation doses will be below 10 CFR Part 20 limits.

d. The reactor room continuous air monitor provides information regarding airborne radioactivity in the reactor room, (SAR Chapter 11.1), to ensure that occupational exposure to airborne radioactivity will remain below the 10 CFR Part 20 limits.

e. Environmental monitors demonstrate MNRC reactor operations do not result in radiation levels in excess of 10 CFR 20 limits at the facility's boundary.

3.7.2 Effluents - Argon-41 Discharge Limit

Applicability - This specification applies to the concentration of Argon-41 that may be discharged from the UCD/MNRC reactor facility.

Objective - The annual average unrestricted area concentration of Argon-41 due to releases of this radionuclide from the UCD/MNRC, and the corresponding annual radiation dose from Argon-41 in the unrestricted area shall not exceed the applicable levels in 10 CFR Part 20.

Specification - The total Ar-41 effluenced by MNRC shall not exceed 118 Ci per calendar year.

Basis – Based on the MNRC stack height and site characteristics a release of 118 Ci of Ar-41 per year would result dose to the public of 5 mrem (SAR Appendix A).

3.8 Experiments

3.8.1 Reactivity Limits

Applicability - This specification applies to the reactivity limits on experiments installed in reactor experiment facilities.

Objective - The objective is to assure control of the reactor during the irradiation or handling of experiments in the reactor experiment facilities.

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

1. The absolute reactivity worth of any single moveable experiment in the pneumatic transfer tube, the central irradiation facility, the central irradiation fixture 1 (CIF-1), or any other in-core or in-tank irradiation facility, shall be less than $1.00 (0.75% Δk/k).

2. The absolute total reactivity of all experiments positioned in the pneumatic transfer tube, and in any other reactor in-core and in-tank irradiation facilities at any given time shall be less than ($1.75) (1.31% Δk/k), including the potential reactivity which might result from malfunction, flooding, voiding, or removal and insertion of the experiments.

Basis - These experiment reactivity worth limitations are all below the maximum reactivity insertion accident analyzed for in chapter 13 of the SAR ($1.90 for an end-of-life core).

3.8.2 Materials

Applicability - This specification applies to experiments installed in reactor experiment facilities.

Objective - The objective is to prevent damage to the reactor or significant releases of radioactivity by limiting material quantity and the radioactive material inventory of the experiment.

Specification - The reactor shall not be operated unless the following conditions governing experiment materials exist:

1. Experiments containing corrosive materials shall be doubly encapsulated. The failure of an encapsulation of material that could damage the reactor shall result in removal of the sample and physical inspection of potentially damaged components.

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

3. Explosive materials in quantities of three (3) pounds of TNT equivalent or less may be irradiated in each radiography bay. All four radiography bays may contain 3 pounds TNT equivalent simultaneously.

Basis -

1. Double encapsulation is required to lessen the experimental hazards of some types of materials.

2. The 1.5 curies limitation on iodine 131 through 135 assures that in the event of failure of a fueled experiment leading to total release of the iodine, occupational doses and doses to members of the general public in the unrestricted areas shall be within the limits in 10 CFR 20 (SAR Chapter 13.2.6).

3. The failure of an experiment involving the irradiation of 3 lbs TNT equivalent or less in each radiography bay external to the reactor tank will not result in damage to the reactor controls or the reactor tank. Safety analyses have been performed (SAR Chapter 13.2.6) which show that up to six (6) pounds of TNT equivalent can be safely irradiated in any radiography bay. Therefore, the three (3) pound limit gives a safety margin of two (2).

3.8.3 Failure and Malfunctions

Applicability - This specification applies to experiments installed in reactor experiment facilities.

Objective - The objective is to prevent damage to the reactor or significant releases of radioactive materials in the event of an experiment failure.

Specification -Where the possibility exists that the failure of an experiment (except fueled experiments) under normal operating conditions of the experiment or reactor, credible accident conditions in the reactor, or possible accident conditions in the experiment could release radioactive gases or aerosols to the reactor room or the unrestricted area, the quantity and type of material in the experiment shall be limited such that the airborne radioactivity in the reactor room or the unrestricted area will not result in exceeding the applicable dose limits in 10 CFR 20, assuming that:

1. 100% of the gases or aerosols escape from the experiment;

2. If the effluent from an irradiation facility exhausts through a holdup tank which closes automatically on high radiation level, at least 10% of the gaseous activity or aerosols produced will escape;

3. If the effluent from an irradiation facility exhausts through a filter installation designed for greater than 99% efficiency for 0.3 micron particles, at least 10% of these aerosols can escape; and

4. For materials whose boiling point is above 130 °F and where vapors formed by boiling this material can escape only through an undisturbed column of water above the core, 10% of these vapors can escape.

Basis -This specification is intended to meet the purpose of 10 CFR 20 by reducing the likelihood that released airborne radioactivity to the reactor room or unrestricted area surrounding the MNRC will result in exceeding the total dose limits to an individual as specified in 10 CFR 20.

4.0 Surveillance Requirements

General. The surveillance frequencies denoted herein are based on continuing operation of the reactor. Surveillance activities scheduled to occur during an operating cycle which cannot be performed with the reactor operating may be deferred to the end of the operating cycle. If the reactor is not operated for a reasonable time, a reactor system or measuring channel surveillance requirement may be waived during the associated time period. Prior to reactor system or measuring channel operation, the surveillance shall be performed for each reactor system or measuring channel for which surveillance was waived. A reactor system or measuring channel shall not be considered operable until it is successfully tested. Discovery of non-compliance shall limit operation of the reactor to completing that specific non-compliance surveillance.

Surveillance requirements may be deferred during prolonged periods in which the reactor shutdown (except TS 4.3 and TS 4.7). 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 practical after reactor startup. Scheduled surveillance which cannot be performed with the reactor operating may be deferred until a planned reactor shutdown.

Any additions or modifications to the ventilation system, the core and its associated support structure, the pool or its penetrations, the primary coolant system, the rod drive mechanism or the reactor safety system shall be made and tested to assure that the systems will meet their functional requirements in accordance with manufacturer specifications or specifications reviewed by the NSC. A system shall not be considered operable until after it is successfully tested.

Basis-

1. This specification provide verifications that core configuration will not deviate from the core configuration analyzed for in the SAR.

2 and 3. These specifications ensure the core will remain shut down during fuel and control rod movements and inspections.

4.1 Reactor Core Parameters

4.1.1 Excess Reactivity

Applicability - These specifications apply to the surveillance requirements for excess reactivity of the reactor core.

Objective – To ensure the core excess reactivity does not exceed the maximum core excess reactivity.

Specification - The core excess reactivity shall be verified annually or following a change in core loading, control rod configuration, or core experiment that is expected to change the reactivity by more than $0.25 (not including transient fission product poison effects).

Basis - The excess reactivity is measured to ensure that the maximum excess reactivity limit is not exceeded.

4.1.2 Shutdown Margin

Applicability- These specifications apply to the surveillance requirements for shutdown margin of the reactor core.

Objective- To ensure the reactor can be shut down under all conditions.

Specification- The core shutdown margin shall be determined at least annually and following a change in core or control rod configuration that is expected to change the shutdown margin by more than $0.25 (not including transient fission product poison effects).

Basis- Verify the reactor has sufficient shutdown margin to allow the reactor to be shut down in any foreseeable conditions.

4.1.3 Core Configuration Limitations

Applicability- These specifications apply to the surveillance requirements for core configuration limitations.

Objective- To ensure the core is in a configuration bound by the analysis in the SAR.

Specification-

1. A daily check of the core shall be made to verify only stainless steel clad 20/20 and 30/20 elements are only located Hex Rings C through G.

2. Prior to removal of any fuel element it shall be verified that the core is subcritical by more than the calculated worth of the most reactive fuel element being moved.

3. Prior to manual removal of any control rod it shall be verified that the core is subcritical by at least $0.50 with the highest worth control rod in the full-out position.

4.1.4 Fuel Parameters

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

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

Specification –

1. All fuel elements shall be inspected for damage or deterioration and measured for length and transverse bend at least at quinquennial intervals.

2. An analysis of any irradiation facility installed in the central cavity of this core shall be done before it is used with this core.

3. No single element may be operated at a power level above 17.69 kW (as analyzed) at a steady state power level of 1.0 MW.

Basis-

1. The above specifications assure that the fuel elements shall be inspected regularly and the integrity of the lead fuel elements shall be maintained.

2. and 3. Will provide assurance that the thermal hydraulic analysis provided in the SAR is always bounding.

4.2 Reactor Control and Safety Systems

4.2.1 Control Rods

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

Objective - The objective is to inspect the physical condition of the reactor control rods and establish the operable condition of the rods.

Specification –

1. Control rod worths shall be determined annually or after physical removal or any significant (>$0.25 expected reactivity change) change in core or control rod configuration.

2. Each control rod shall be inspected at annual intervals by visual observation of the fueled sections and absorber sections plus examination of the linkages and drives.

3. The scram time of each control rod shall be measured semiannually.

4. The maximum reactivity insertion rate of the highest worth control rod shall be measured annually.

Discovery of noncompliance with Technical Specifications 4.2.1 #1 or #4 shall limit reactor operations to that required to perform the surveillance.

Basis - Annual determination of control rod worths or measurements after any physical removal or significant change in core loading or control rod configuration provides information about changes in reactor total reactivity and individual rod worths. The frequency of inspection for the control rods shall provide periodic verification of the condition of the control rod assemblies. The specification intervals for scram time assure operable performance of the control rods.

4.2.2 Reactor Instrumentation for Operation

Applicability - These specifications apply to the surveillance requirements for measurements, tests, calibration and acceptability of the reactor instrumentation.

Objective - The objective is to ensure that the power level instrumentation and the fuel temperature instrumentation are operable.

Specification –

1. Reactor power level safety channels (linear and log) shall undergo a daily test prior to reactor startup and an annual calibration. If a channel is removed, replaced, or unscheduled maintenance is performed, or a significant (>$0.25 expected change in reactivity) change in core configuration occurs, a channel calibration shall be required.

2. Fuel temperature channel shall undergo a daily test prior to reactor startup and an annual calibration.

Basis –

1. Daily channel test and annual calibration will provide assurance that the two reactor power level safety channels (linear and log) are operating correctly.

2. Daily channel test and annual calibration will provide assurance that the fuel temperature channel is operating correctly.

4.2.3 Reactor Scrams and Interlocks

Applicability - These specifications apply to the surveillance requirements for measurements, test, calibration, and acceptability of the reactor scrams and interlocks.

Objective - The objective is to ensure that the reactor scrams and interlocks are operable.

Specification –

1. Scram circuits a, b, d, e, f, g, and h required in section 3.2.3 shall undergo a daily channel test prior to operation. Scram circuits d and f shall undergo an annual calibration.

2. Scram circuit c required in section 3.2.3 shall undergo a monthly channel test.

3. All Interlock circuits required in section 3.2.3 shall undergo an annual channel test.

Basis -

1. A daily channel test of scram circuits a, b, d, e, f, g, and h provides assurance of their operability. An annual calibration of scram circuits d and f is performed to provide assurance they are operating within the appropriate tolerance.

2. The radiography bay "rip cord scrams" are not required to protect the reactor and therefore a monthly channel test is sufficient to provide assurance of their operability. The bay rip cord scrams are to provide a mechanism for a worker to quickly shutdown the reactor should they accidentally become trapped in a radiography while the massive shutter is open and the reactor is on. There are a number of administrative and engineering controls in place to prevent this scenario.

3. A annual channel test of all Interlocks provides assurance of their operability.

4.3 Reactor Coolant Systems

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

Objective - The objective is to ensure that the reactor tank water level and the bulk water temperature monitoring systems are operating and to verify appropriate alarm settings.

Specification-

1. A channel check of the reactor tank bulk water temperature alarm setpoint shall be performed quarterly. A channel calibration of the reactor tank bulk water temperature system shall be performed at least annually.

2. A channel test of the reactor tank water level alarm setpoint shall be performed at least semi-annually.

3. The reactor tank water conductivity shall be measured monthly. Multiple measurements taken in one month shall be averaged to determine the monthly value.

4. The pool water radioactivity shall be measured at least semi-annually.

5. The local pressure gauge to the reactor reflooding system shall be checked to verify it is reading 35 psi or above prior to operation. Valve cycling and flow verification checks shall be made quarterly.

Basis -

Operational experiences have shown that the frequencies of checks on the system given above are appropriate and sufficient to maintain the systems in an operable state.

4.4 Ventilation and Confinement System

Applicability - This specification applies to the surveillance requirements for the reactor room exhaust system.

Objective - The objective is to assure that the reactor room exhaust system is operating properly.

Specification –

1. The reactor room exhaust system shall have a channel check during each day's operation.

2. A channel test of the reactor room ventilation system's ability to automatically switch to the recirculation mode (HEPA filtered confinement) mode upon actuation of the CAM high alarm shall be performed quarterly.

Basis - Experience has demonstrated that checks of the ventilation system on the prescribed frequencies are sufficient to ensure proper operation of the system and its control over releases of radioactive material.

4.5 This section intentionally left blank.

4.6 This section intentionally left blank.

4.7 Reactor Radiation Monitoring Systems.

Applicability - This specification applies to the surveillance requirements for the area radiation monitoring equipment and the air monitoring systems.

Objective - The objective is to ensure that the radiation monitoring equipment is operating properly and to verify the appropriate alarm settings.

Specifications-

1. A channel test of the Facility Stack Continuous Air Monitor, Reactor Room Continuous Air Monitor, Reactor Room Radiation Area Monitor, and Demineralizer System Radiation Area

Monitor (RAM) shall be performed monthly.

2. A channel calibration of the Facility Stack Continuous Air Monitor, Reactor Room Continuous Air Monitor, Reactor Room Radiation Area Monitor, and Demineralizer System Radiation Area Monitor (RAM) shall be performed annually.

3. The environmental dosimeters shall be changed and evaluated at least quarterly.

Basis- Experience has shown that an annual calibration and month tests are adequate to correct for any variation in the system due to a change of operating characteristics over a long time span. The frequency of changing and evaluating environmental dosimeters are also adequate to provide the required record based on past experience.

4.8 Experiments

Applicability - This specification applies to the surveillance requirements for experiments installed in any UCD/MNRC reactor experiment facility.

Objective - The objective is to prevent the conduct of experiments or irradiations which may damage the reactor or release excessive amounts of radioactive materials as a result of experiment failure.

Specification -

1. The reactivity worth of an experiment shall be estimated or measured, as appropriate, before routine reactor operation with that experiment to ensure that the limits of TS 3.8.1 are not exceeded.

2. An experiment shall not be installed in the reactor or its irradiation facilities unless a safety analysis has been performed and reviewed for compliance with TS 3.8.2 and TS 3.8.3 by the Facility Director or NSC in full accord with TS 6.2.3, and the procedures which are established for this purpose.

Basis - Experience has shown that experiments which are reviewed by the staff of the MNRC and the NSC can be conducted without endangering the safety of the reactor or exceeding the limits in the Technical Specifications.

5.0 Design Features

5.1 Site and Facility Description

5.1.1 Site Description

Applicability - This specification applies to the UCD/MNRC site location and specific facility design features.

Objective - The objective is to specify those features related to the Safety Analysis evaluation.

Specification -

1. The site location is situated approximately 8 miles (13 km) north-by-northeast of downtown Sacramento, California on the former McClellan AFB.

2. The licensed area is that area inside of the fence surrounding the reactor building. This fence also demarcates the property that is owned by the University of California from the surrounding area and is approximately 2.3 acres in size. Inside of the licensed area is also a restricted area. The unrestricted area is that area outside the fence surrounding the reactor building.

3. The reactor facility shall be equipped with a ventilation system designed to exhaust air and other gases from the reactor room/radiography bays and release them from a vertical level at least 60 feet above ground level

4. Emergency controls for the exhaust system shall be located in the reactor control room.

5.2 Reactor Coolant System

Applicability - This specification applies to the tank containing the reactor and to the cooling of the core by the tank water.

Objective - The objective is to assure that adequate water is available for cooling and shielding during normal reactor operation or during a Loss of Coolant Accident.

Specification -

1. During reactor operation the reactor core shall be cooled by a natural convection flow of water.

2. The tank water inlet pipe to the heat exchanger and to the demineralizer shall be equipped with a siphon break 16 feet above the top of the core or higher.

5.3 Reactor Core and Fuel

5.3.1 Reactor Core

Applicability - This specification applies to the configuration of the fuel.

Objective - The objective is to assure that provisions are made to restrict the arrangement of fuel elements so as to provide assurance that excessive power densities will not be produced.

Specifications-

1. The core shall be an arrangement of TRIGA uranium-zirconium hydride fuel-moderator elements positioned in the reactor grid plate

2. The fuel shall be arranged in a close-packed configuration except for single element

positions occupied by in-core experiments, irradiation facilities, graphite dummies, control rods, and startup sources.

3. The reflector, excluding experiments and irradiation facilities, shall be graphite. A reflector is not required if the core has been defueled.

5.3.2 Reactor Fuel

Applicability - These specifications apply to the fuel elements used in the reactor core.

Objective - The objective is to assure that the fuel elements are of such design and fabricated in such a manner as to permit their use with a high degree of reliability with respect to their physical and nuclear characteristics.

Specification - The individual unirradiated TRIGA fuel elements shall have the following characteristics:

1. Uranium content: 20 or 30 wt % uranium enriched nominally to less than 20% U-235.

2. Hydrogen to zirconium atom ratio (in the ZrH_x): 1.60 to 1.70 (1.65+/- 0.05).

3. Cladding: stainless steel, nominal 0.5mm (0.020 inch) thick.

5.3.3 Control Rods and Control Rod Drives

Applicability - This specification applies to the control rods and control rod drives used in the reactor core.

Objective - The objective is to assure the control rods and control rod drives are of such a design as to permit their use with a high degree of reliability with respect to their physical, nuclear, and mechanical characteristics.

Specification -

1. All control rods shall have scram capability and contain a neutron poison such as stainless steel, borated graphite, B_4C powder, or boron and its compounds in solid form. The shim and regulating rods shall have fuel followers sealed in stainless steel. The transient rod shall have an air filled follower and be sealed in an aluminum tube.

2. The control rod drives shall be the standard GA rack and pinion type with an electromagnet and armature attached.

5.4 Fissionable Material Storage

Applicability - This specification applies to the storage of reactor fuel at a time when it is not in the reactor core.

Objective - The objective is to assure that the fuel which is being stored will not become critical and will not reach an unsafe temperature.

Specification -

1. All fuel elements not in the reactor core shall be stored (wet or dry) in a geometrical array where the k_{eff} is less than 0.90 for all conditions of moderation.

2. Irradiated fuel elements shall be stored in an array which shall permit sufficient natural convection cooling by water or air such that the fuel element temperature shall not exceed the safety limit.

3. If stored in water, the water quality shall be maintained according to TS 3.3, Specification 2.

6.0 Administrative Controls

6.1 Organization

The Regents of the University of California shall be the licensee (license holder) for the UCD/MNRC. The Regents delegate the license holder duties to the UC Davis Chancellor who delegates the license holder duties to the Vice Chancellor of Research. The UCD/MNRC facility shall be under the direct control of the UCD/MNRC Director or a licensed Senior Reactor Operator (SRO) designated by the UCD/MNRC Director to be in direct control.

6.1.1 Structure

The UCD/MNRC management organization is shown in Figure 6.1.

6.1.2 Responsibilities

The UCD/MNRC Director shall be accountable to the Vice Chancellor for Research for the safe operation and maintenance of the MNRC facility. The UCD/MNRC Director, or his designated alternate, shall review and approve all experiments and experiment procedures prior to their use in the reactor. Individuals in the management organization (e.g., Reactor Supervisor and Radiation Safety Officer) shall be responsible for implementing UCD/MNRC policies and for operation of the facility, and shall be responsible for safeguarding the public and facility personnel from undue radiation exposures and for adhering to the operating license and technical specifications.

The following specific organizational levels and responsibilities shall exist:

1. Vice Chancellor for Research (Level 1): The Vice Chancellor for Research has the ultimate responsibility for the safe operation and maintenance of the MNRC. The Vice Chancellor for Research is also responsible for the facility license.

2. MNRC Director (Level 2): The UCD/MNRC facility shall be under the direct control of the UCD/MNRC Director. The UCD/MNRC Director, is responsible for the day-to-day operation of the facility. The UCD/MNRC Director is a direct report to the Vice Chancellor for Research.

3. Reactor Supervisor (Level 3): The Reactor Supervisor is a direct report to the MNRC Director. The reactor supervisor is responsible for directing the activities of the Reactor Operators and Senior Reactor Operators and for the day-to-day operation and maintenance of the reactor.

4. Reactor Operators and Senior Reactor Operators (Level 4): Senior Reactor Operators and Reactor Operators report to the Reactor Supervisor (or the MNRC Director) and are primarily involved in the direct manipulation of reactor controls, monitoring of instrumentation, and direct operation and maintenance of reactor-related equipment.

6.1.3 <u>Staffing</u>

A. The minimum staffing when the reactor is not secured shall be:

1. A Licensed Operator in the control room;

2. A second person present within the MNRC facility who is able to carry out prescribed instructions;

3. If neither of these two individuals is a Senior Reactor Operator, a Senior Reactor Operator shall be readily available on call. Readily available on call means an individual who:

    i. Has been specifically designated and the designation is known to the operator on duty;

    ii. Can be contacted by phone, within 5 minutes, by the operator on duty; and

    iii. 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).

4. A list of management personnel, radiation personnel, and reactor staff along with their contact information shall be available to the operator on duty.

B. Events requiring the direction of a Senior Reactor Operator:

1. Initial approach to critical after each completed shutdown checklist;

2. Initial approach to power after each completed shutdown checklist;

3. All fuel or control rod relocations within the reactor core region;

4. Relocation of any in-core components (other than normal control rod movements) or experiment with a reactivity worth greater than one dollar; or

5. Recovery from an unscheduled shutdown or an unscheduled significant (>50%) power reduction.

6.1.4 Selection and Training of Personnel

The selection, training and requalification of operations personnel shall meet or exceed the requirements of the American National Standard for Selection and Training of Personnel for Research Reactors ANSI/ANS 15.4-2016.

6.2 Review and Audit

The Nuclear Safety Committee (NSC) has been chartered to assist in meeting this responsibility by providing timely, objective, and independent reviews, audits and recommendations on matters affecting nuclear safety. The following describes the composition and conduct of the NSC.

6.2.1 Composition and Qualifications

The NSC shall be composed of at least four voting members, including the Chairperson. All members of the Committee shall be knowledgeable in subject matter related to reactor operations. To expedite Committee business, a Committee Chairperson shall be appointed. The Committee shall be appointed by the Vice Chancellor for Research. No definite term of service shall be specified; but should a vacancy occur in the Committee, the Vice Chancellor for Research shall appoint a replacement. The remaining members of the Committee shall be available to assist the Vice Chancellor for Research in the selection of new members. The Reactor Supervisor and the radiation safety officer shall be ex-officio members of the Committee. The NSC advises the MNRC Director and shall report any concerns to the Vice Chancellor for Research.

6.2.2 NSC Charter and Rules

The NSC consists of MNRC members and non-MNRC members, and the Committee shall meet at least annually.

The review and audit functions shall be conducted in accordance with an established charter for the Committee. Dissemination and review of Committee minutes shall be done within 60 days of each respective Committee meeting.

A quorum for review, audit, and approval purposes shall consist of not less than one-half of the voting membership where the operating staff does not constitute a majority. The Chairperson or an alternate must be present at all meetings in which the official business of the committee is being conducted. Approvals by the committee shall require an affirmative vote by a majority of the non-MNRC members present and an affirmative vote by a majority of the MNRC members present.

6.2.3 Review Function

The following items shall be reviewed:

1. Determinations that proposed changes in equipment, systems, test, experiments, or procedures are allowed without prior authorization by the NRC as detailed in 10 CFR 50.59;

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, license, or charter;

5. Violations of technical specifications, license, or charter. Violations of internal procedures or instructions having safety significance;

6. Operating abnormalities having safety significance;

7. Reportable occurrences listed in Sec. 6.7.2;

8. Audit reports.

A written report or minutes of the findings and recommendations of the review group shall be submitted to the Vice Chancellor for Research and the NSC members within 3 months after the review has been completed.

6.2.4 <u>Audit Function</u>

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 conformance to the technical specifications and applicable license or charter conditions: at least once per calendar year (interval between audits not to exceed 15 months);

2. The retraining and requalification program for the operating staff: at least once every other calendar year (interval 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 operations that affect reactor safety: at least once per calendar year (interval between audits not to exceed 15 months);

4. The reactor facility emergency plan and implementing procedures: at least once every other calendar year (interval between audits not to exceed 30 months).

5. The reactor security plan and implementing procedures: at least once every calendar year.

Deficiencies uncovered that affect reactor safety shall immediately be reported to the Vice Chancellor for Research. A written report of the findings of the audit shall be submitted to the Vice Chancellor for Research and the NSC within 3 months after the audit has been completed.

6.3 Radiation Safety

The radiation safety officer shall be responsible for implementation of the radiation safety program. The requirements of the radiation safety program are established in 10 CFR 20. The program should use the guidelines of the ANSI/ANS 15.11, ``Radiation Protection at Research Reactor Facilities.'' The radiation safety officer reports directly to the Director.

6.4 Procedures

Written procedures shall be prepared, reviewed, and approved prior to initiating any of the activities listed in this section. The procedures shall be reviewed by the NSC (as applicable) and approved by Director or designated alternates, and such reviews and approvals shall be documented in a timely manner. Minor modifications to the original procedures that do not change their original intent may be made by the Reactor Supervisor. Temporary deviations from the procedures may be made by the Reactor Supervisor in order to deal with special or unusual circumstances or conditions. Such deviations shall be documented and reported within 24 hours or the next working day to the director or designated alternates. Procedures shall be in effect and in use for the following items:

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 commitment and programs to maintain exposures and releases as low as reasonably achievable in accordance with the guidelines of ANSI/ANS-15.11;
6. administrative controls for operations and maintenance and for the conduct of irradiations and experiments that could affect reactor safety or core reactivity;
7. implementation of emergency or security plans;
8. use, receipt, and transfer of by-product material, if appropriate.

6.5 Experiment Review and Approval

Approved experiments shall be carried out in accordance with established and approved procedures.

1. All new experiments or class of experiments shall be reviewed by the NSC and approved in writing by Director or designated alternates prior to initiation;

2. Substantive changes to previously approved experiments shall be made only after review by the NSC and approved in writing by Director or designated alternates. Minor changes that do not significantly alter the experiment may be approved by reactor supervisor.

6.6 Required Actions

6.6.1 Action to be taken in case of a safety limit violation

In the event of a safety limit violation (fuel temperature), the following action shall be taken:

1. The reactor shall be shut down and reactor operation shall not be resumed until authorized by the NRC.

2. The safety limit violation shall be promptly reported to the UCD/MNRC Director.

3. The safety limit violation shall be reported to the Chairperson of the NSC and to the NRC by the UCD/MNRC Director.

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. Effect 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 safety limit violation report shall be reviewed by the NSC and then be submitted to the NRC when authorization is sought to resume operation of the reactor.

6.6.2 Action to be taken in the event of an occurrence of the type identified in Secs. 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, operations shall not be resumed unless authorized by the UCD/MNRC Director or his designated alternate.

2. The occurrence shall be reported to the UCD/MNRC Director or the designated alternate. The UCD/MNRC Director shall report the occurrence to the NRC.

3. Occurrence shall be reviewed by the NSC at its next scheduled meeting.

6.7 Reports

6.7.1 Annual Operating Reports

An annual report covering the previous calendar year shall be created and submitted, no later than May 31 of the year following the report period to the NRC consisting of:

1. A brief summary of operating experience including the energy produced by the reactor and the hours the reactor was critical;

2. The number of unplanned shutdowns, including corrective actions taken (when applicable);

3. A tabulation of major preventative and corrective maintenance operations having safety significance;

4. A brief description, including a summary of the safety evaluations, of changes in the facility or in procedures and of tests and experiments carried out pursuant to 10 CFR 50.59;

5. 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 prior to 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 or diffusion is less than 25% of the concentration allowed or recommended, a statement to this effect is sufficient;

6. A summarized result of environmental surveys 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; and

6.7.2 Special Reports

In addition to the requirements of applicable regulations, and in no way substituting therefore, reports shall be made to the NRC as follows:

1. A report within 24 hours by telephone, confirmed by digital submission or fax to the NRC Operations Center and followed by a report in writing to the NRC, Document Control Desk, Washington, D.C. within 14 days that describes the circumstances associated with any of the following:

    a. Any release of radioactivity above applicable limits into unrestricted areas, whether or not the release resulted in property damage, personal injury, or exposure;

    b. Any violation of a safety limit;

    c. Operation with the actual safety system setting less conservative than the LSSS;

    d. Operation in violation of a Limiting Condition for Operation;

e. Malfunction of a required reactor safety system component which renders or could render the system incapable of performing its intended safety function unless the malfunction or condition is caused by maintenance, then no report is required;

f. Any unanticipated or uncontrolled change in reactivity greater than $1.00. Reactor trips resulting from a known cause are excluded;

g. An observed inadequacy in the implementation of either administrative or procedural controls, such that the inadequacy causes or could have caused the existence or development of a condition which results or could result in operation of the reactor outside the specified safety limits; or

h. Abnormal and significant degradation in reactor fuel, cladding, or coolant boundary.

2. A report within 30 days in writing to the NRC, Document Control Desk, Washington, D.C. of:

a. Permanent changes in the facility organization involving Level 1-2 personnel; or

b . Significant changes in the transient or accident analyses as described in the SAR.

6.8 <u>Records</u>

6.8.1 <u>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</u>

1. Normal reactor facility operation (but not including supporting documents such as checklists, data sheets, etc., which shall be maintained for a period of at least two years);
2. Principal maintenance activities;
3. Reportable occurrences;
4. Surveillance activities required by the Technical Specifications;
5. Reactor facility radiation and contamination surveys;
6. Experiments performed with the reactor;
7. Fuel inventories, receipts, and shipments;
8. Approved changes to the operating procedures; and
9. NSC meetings and audit reports.

6.8.2 Records to be Retained for at Least One Operator License Term

1. Records of retraining and requalification of Reactor Operators and Senior Reactor Operators shall be retained for at least one license term; and

2. Records of retraining and requalification of licensed operators shall be maintained while the individual is employed by the licensee, or until that operator's license is renewed, whichever is shorter.

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

1. Gaseous and liquid radioactive effluents released to the environs;

2. Offsite environmental monitoring surveys as required by Technical Specifications;

3. Radiation exposures for all personnel monitored; and

4. Drawings of the reactor facility.

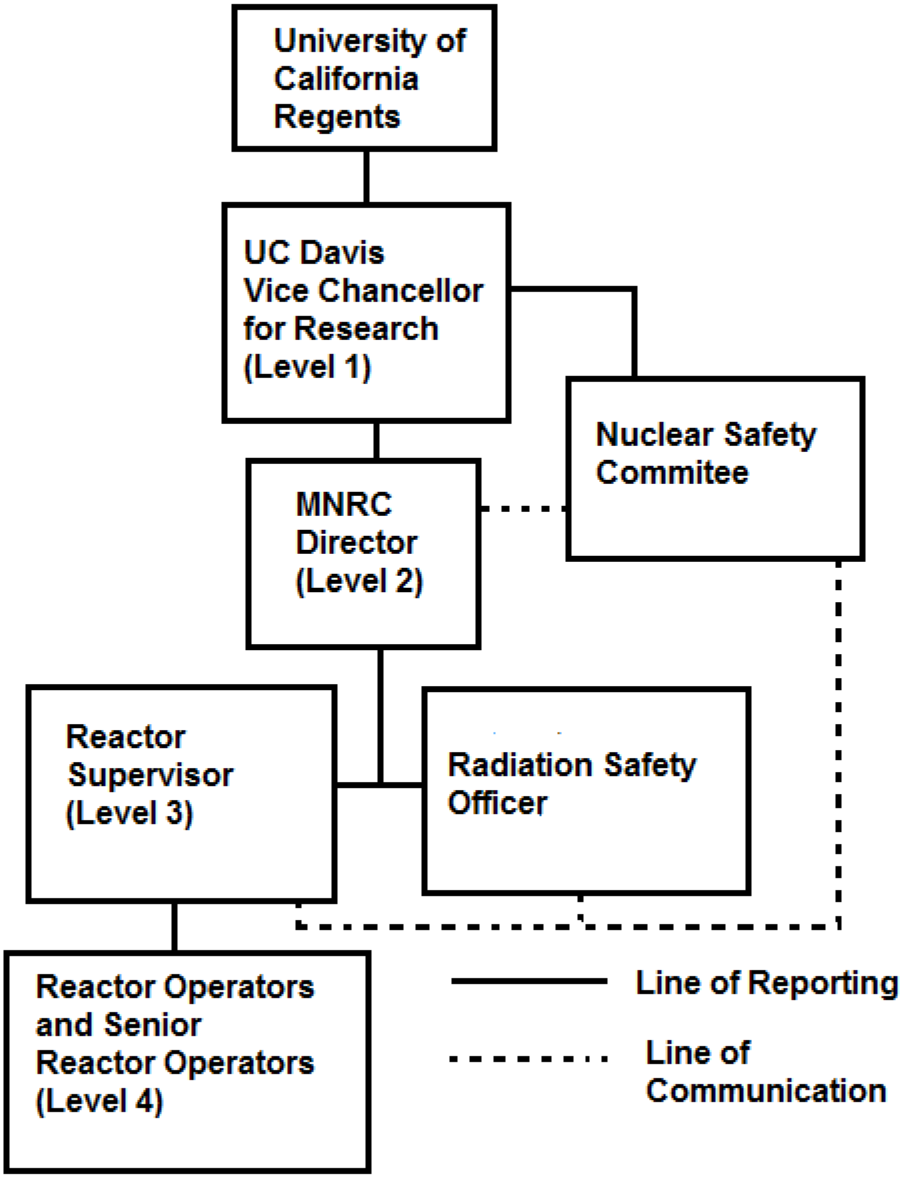

Figure 6.1 UC Davis McClellan Nuclear Research Center Organization for Reactor Operation, Licensing, and Safety