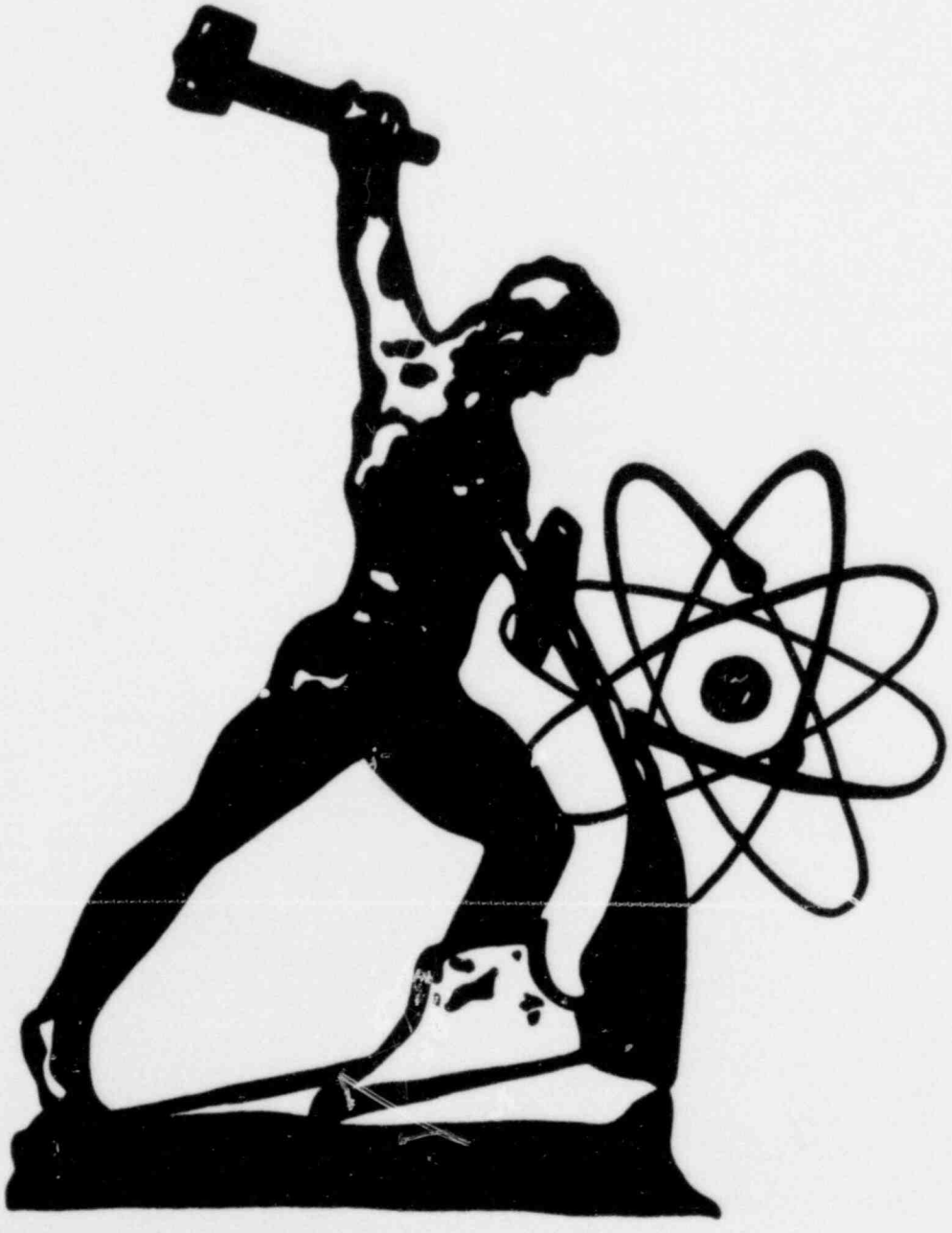
Technical Specifications
University of Missouri-Rolla Reactor



1.0 DEFINITIONS

The terms Safety Limit (SL), Limiting Safety System Setting (LSSS), and Limiting Condition of Operation (LCO) are as defined in 50.36 of 10 CFR Part 50.

1.1 Safety Channel- A Safety Channel is a measuring or protective channel in the reactor safety system.

1.2 Reactor Safety System- The Reactor Safety System is a combination of safety channels and associated circuitry which forms the automatic protective system for the reactor resulting in a scram or reactor trip, or provides information which requires the initiation of manual protective action.

1.3 Operable- Operable means a component or system is capable of performing its intended function in its normal manner.

1.4 Operating- Operating means a component or system is performing its intended function in its normal manner.

1.5 Channel Check- A Channel Check is a qualitative verification of acceptable performance by observation of channel behavior.

1.6 Channel Test- A Channel Test is the introduction of a calibration or test signal into the channel to verify that it responds in a specific manner.

1.7 Channel Calibration- A Channel Calibration is an adjustment of the channel components such that its output responds, within specified range and accuracy, to known values of the parameter which the channel measures. Calibration shall encompass the entire channel, including readouts, alarm, or trip, and may be performed by any series of sequential, overlapping steps.

1.8 Unscheduled Shutdown- An Unscheduled Shutdown is any unplanned shutdown of the reactor after startup has been initiated.

1.9 Reactor Shutdown- The reactor is Shutdown when the negative reactivity of the cold, clean core including the reactivity worths of all experiments is equal to or greater than the shutdown margin.

1.10 Reactor Operating- The reactor is considered to be Operating whenever it is not secured or shutdown.

1.11 Reactor Secured- The reactor is Secured when:

a. The core contains insufficient fuel to attain criticality under optimum conditions of moderation and reflection, or

b. The moderator has been removed, or

c. (1) The minimum number of control rods have been fully inserted as required by the Technical Specifisations, and

(2) The console key is in the off position and the key has been removed from the lock, and

(3) 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, and

(4) No in-core experiments are being moved or serviced with a reactivity worth exceeding the maximum value allowed for a single experiment or one dollar, whichever is smaller.

1.12 True Value- The True Value of a parameter is its actual value at any instant.

1.13 Measured Value- The Measured Value of a parameter is as it appears on the output of a measuring channel. The measured values deviation from true value shall be within the accuracy of the measuring channel.

1.14 Measuring Channel- A Measuring Channel is the combination of sensor, lines, amplifiers, and output devices which are connected for the purpose of measuring the value of a parameter.

1.15 Reportable Occurrence- A Reportable Occurrence is any of those conditions described in Section 6.5.3 of this specification.

1.16 Experiment- An Experiment is any apparatus, device, or material placed in the reactor core, in an experiment facility, or in line with a beam of radiation emanating from the reactor, excluding devices designed to measure reactor characteristics such as detectors and foils.

a. 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 core. The restraining forces must be substantially greater than those to which the experiment might be subjected to by hydraulic, pneumatic, 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).

b. Movable Experiment- A Movable Experiment is one which may be inserted, removed, or manipulated while the reactor is critical.

c. Untried Experiment- An Untried Experiment is a single experiment or class of experiments that have not been previously evaluated and approved by the Radiation Safety Committee.

1.17 Experiment Facilities- An Experiment Facility is any structure, device, or pipe system which is intended to guide, orient, position, manipulate, control the environment, or otherwise facilitate a multiplicity of experiments of similar character. The unused grid plate holes are also designated an experiment facility.

1.18 Control Rod- A control Rod is a rod fabricated from neutron absorbing material which is used to compensate for fuel burnup, temperature, and poison effects. A control rod is magnetically coupled to its drive unit allowing it to perform the safety function when the magnet is de-energized. The regulatory rod performs control functions but is mechanically connected to its rod drive unit.

1.19 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 (e.g. by phone, etc.), and

(3) is capable of getting to the reactor facility within a reasonable amount of time under normal conditions. (e.g., 1 hr. or within a 30 mile radius)

1.20 Scram Time- The Scram Time is the elapsed time between the instant a limiting safety system set point is reached and the instant the slowest control rod is fully inserted.

1.21 Safety Limits- The Safety Limits are limits on important process variables which are found to be necessary to reasonably protect the integrity of certain physical barriers which guard against the releases of radioactivity. The principal physical barrier is the fuel cladding.

2.0 SAFETY LIMITING AND SAFETY SYSTEM SETTING

Safety limits of reactor operation
Limits of free convection

a. Applicability- This specification applies to the thermal variables affecting the core.
   (1) Power in Kilowatts
   (2) Height of water above the core
b. Objective- To assure fuel cladding integrity.
c. Specifications
   (1) The maximum reactor power shall be less than or equal to 250 Kw.
   (2) The pool water level shall not be less than 16 feet above the top of the core.
d. Bases- At a power level of 250 Kw the maximum temperature at the cladding surface is less than or equal to 270 F which is well below the safe cladding temperature of MTR and TRIGA type fuel elements. A minimum of 16 feet of water above the core assures a negligible amount of radiation at the surface of the pool.

2.1 Limiting Safety System Settings

Safety Channel Set-points

a. Applicability- This specification applies to the set-points of the safety channels.
b. Objective- To insure that automatic action is initiated that will prevent a safety limit from being exceeded.
c. Specifications
   (1) The safety channels shall be set to scram at less than or equal to 150% power.
   (2) The Log N channel shall be set to initiate a rundown at less than or equal to 120% full power.

d. Bases - The set points are chosen to avoid boiling in the core during routine operation, and to assure the cladding temperature will be well below the melting point of the cladding.

3.0 Limiting Conditions for Operation

3.1 Reactivity Limitations

3.1.1 Shutdown Margin

The minimum shutdown margin provided by the control rods in a Cold Clean Critical position with the maximum worth rod fully withdrawn any untrippable rods and with the highest worth non-secured experiment in the core in its most reactive state shall not be less than 1.0%ΔK. This specification assures the reactor can be shutdown even if its most reactive rod is stuck in its fully withdrawn position.

3.1.2 Excess Reactivity

The core shall not be loaded with an excess reactivity greater than 3.5%.

3.1.3 Experiments

Reactivity limits on experiments shall be as follows:
Any single experiment shall not exceed 0.7% reactivity.
Any moveable experiment shall not exceed 0.4%.
Experiments having moving parts shall not have an insertion rate greater than 0.05% per second, except that experiments whose reactivity worth is less than 0.05% may be oxcillated at a higher frequency.
No experiment shall be installed in the core in such a manner that (1) continuously shadow the nuclear instrumentation, (2) failure of an experiment could interfere with the insertion of a control rod, or (3) failure of an experiment could credibly result in damage to a fuel element.
No experiment shlll be performed involving materials which could (1) credibly contaminate the reactor pool causing corrosive action on reactor components or experiments (2) cause excessive production Airborne Radio-activity, or (3) produce a violent chemical reaction.
The amount of Special Nuclear Materials contained in an experiment shall be limited to no more than five grams in non-soluable form.
Exposives such as gun powder, dynamite, TNT, or nitroglycerin shall not be irradiated.

3.1.4 Regulating Rod

The regulating rod worth shall not exceed 1.0%ΔK. This insures a malfunction of the automatic control system cannot make the reactor prompt critical.

3.2 Control and Safety Systems

3.2.1 Scram Time

The scram time after receipt of a scram signal shall not exceed 600 milliseconds.

3.2.2 Measuring Channels

Table 1 depicts the measuring channels.

Bases - To provide redundant automatic protective action to prevent exceeding the safety limits. The period scram, assisted by the linear and log N period rundown and rod inhibit, limits the rate of increase in reactor power to values that are controllable without reaching excessive power levels or temperature. These functions are not limiting safety system settings.

One inhibit on the count rate channel prevents inadvertent criticality during cold startup that could arise from lack of neutron information.

The Log N Channel provides automatic action to reduce power. The scram on the bridge lock prevents unplanned reactivity changes that could occur through core movement. The keyswitch scram prevents unauthorized operation of the reactor.

3.3 Radiation Monitoring System

The minimum acceptable monitoring instrumentation required for reactor operation is as follows:

Type	No. operable	Set point	Function
Remote area monitor	3	≤ 10 mr/hr low ≤100 mr/hr high	to detect in key locations and to alarm in control room.
Evaculation Switch	1	10 mr/hr	To alarm and initiate evacuation sequence automatic and manual.
Building CAM	1	*	Detect particulate activity in reactor building; alarm.

* 50% of the maximum permissible concentration at restricted areas according to Appendix B of 10 CFR 20.

TABLE 1

SAFETY AND CONTROL INSTRUMENTATION

Measured Value or Situation	Detector	Unit Initiating Action	Resulting Action	Setpoint
Manual Scram	Operator	Scram Button	Scram	Operator
Period 5 seconds or Less	Compensated Ion Chamber	Log N and Period	Scram	$\geq$ 5sec
150% Full Power or more	(2) Uncompensated Ion Chamber	Safety Amplifier	Scram	$\leq$ 150%
Bridge Motion	Motion Switch	Motion Switch	Scram	$\leq$ 1/2" Horizontal Travel
Log N & Period Amplifier NOT Operative	Log N Period Amplifier	Relay	Scram	N/A
120% Demand or more	Compensated Ion Chamber	Linear Recorder	Rundown	120% of selected scale
Period 15 seconds or less	Compensated Ion Chamber	Period Recorder	Rundown	$\geq$ 15sec
Regulating Rod Insert Limit on Auto	Micro-Switch	Micro-Switch	Rundown	$\geq$ 0.0
Low CIC Voltage	DC Relay	DC Relay	Rundown	$\geq$ 400v
120% Full Power or more	Compensated Ion Chamber	Log N Recorder	Rundown	$\leq$ 300Kw
High Radiation at RAM Points (1 2,3)	GM Tubes	Remote Area Monitoring (RAM) System	Rundown	$\leq$ 100mr/hr
Period 30 seconds or less (2)	Compensated Ion Chamber	Period Recorder	Rod Prohibit	$\geq$ 30sec
Any Recorder Off (4)	Relay	Relay	Rod Prohibit	N/A
Log Count Rate 2 CPS or less (2)	Fission Chamber	Log Count Rate System	Rod Prohibit	$\geq$ 2cps

TABLE 1

SAFETY AND CONTROL INSTRUMENTATION

Measured Value or Situation	Detector	Unit Initiating Action	Resulting Action	Setpoint
Safety Rods Below Shim Range or Regulating Rod Above Insert Limit (2)	Micro-Switch	Relay	Rod Prohibit	N/A
Reactor Power Deviation More than ± 5% of Selected Power Level	Compensated Ion Chamber	Linear Channel Recorder	Servo-Prohibit	N/A
Core Inlet Water Temperature 135° F or more	Thermocouple	Relay	Rod Prohibit	<135°F
Interlock Bypassed	Key Switch	Key Switch	-------	N/A
Effluent Pool Demineralizer Conductivity 0.5 Meg Ohms	Conductivity Bridge	Relay	-------	<0.5 megohm per cm

3.4 Engineered Safety Features

These specifications apply to required equipment for the confinement of activity through controlled release of the reactor building to the atmosphere.

3.4.1 Excursion Monitor

a. Specification; see 3.3

b. Bases- This monitor senses excessive radiation at the reactor bridge and automatically initiates the evacuation alarm. In the event of an evacuation the operator shuts off the ventilating fans which are equipped with automatic closure devices.

3.4.2 Containment- The containment ventilation system is set up as follows: Air flow is from other parts of the building, over the pool, and exhausted through the roof fans. When the ventilation system is shutdown, all outside vents automatically close. It is possible to isolate the reactor bay from the remainder of the building by closing of doors. The control room, offices, and laboratories are air conditioned and isolated by doors from the remainder of the building.

3.5 Fuel

a. Applicability- These specifications apply to the number and condition of the fuel elements in the core.

b. Objective- To ensure that power is distributed in the core among a sufficient number of fuel elements to avoid excessive peak/average ratio, and to avoid excessive release of fission products.

c. Specifications-

(1) The number of fuel elements loaded will be such as to assure that Kex is 3.5% or less.

(2) Fuel elements exhibiting release of fission products due to cladding rupture shall, upon positive identification, be removed from the core. An increase in the noemal gaseous fission products released by a factor or 100 shall constitute initial evidence of cladding rupture and require identification of the cause.

(3) The fuel elements shall be any enriched MTR or Triga type construction.

(4) The reactor shall be operated only when all lattice

positions internal to the active fuel boundary are occupied by either a control or standard rod fuel element or an experimental facility.

d. Bases- This specification limits the number of fuel elements that can be loaded into the core, and defines the type of fuel to be used in the core. This specification precludes the possibility of operating with a "flux trap". There is a normal small and variable amount of fission product release due to uranium contamination in the cladding on the fuel. It is thus safe to specify a recognizable and substantial increase in background as possible indication of cladding rupture.

3.6 Pool Water Quality

a. Applicability- To minimize corrosion of the fuel element cladding, and to prevent the activation of dissolved minerals.

b. Specifications

(1) The pool water temperature shall not exceed 135 F measured at the core inlet.

(2) The pool water specific resistance shall not be less than 500,000 ohm/cm.

3.7 Experiment Limitations- see Section 3.1.3

4.0 Surveillance Requirements

4.1 General

The requirements listed below generally prescribe tests or inspections to verify periodically that the performance of required systems is in accordance with the specifications given above. In all instances where the specified frequency is annual, the interval between tests is not to exceed 14 months; when semiannual, the interval shall not exceed 7 months; when monthly, the interval shall not exceed 6 weeks; when weekly, the interval shall not exceed 10 days; and when daily, the interval shall not exceed 3 days.

4.2 Safety Channel Calibration

A channel calibration of each safety channel shall be performed semi-annually.

4.3 Reactivity Surveillance

(1) The reactivity worth of each control rod (including the regulating rod) and the shutdown margin shall be determined whenever operation requires re-evaluation of core physics parameters, a.e. new core loading.

(2) The rod worth will be determined using the reactivity-period or rod-drop methods.

(3) The reactivity worth of an experiment shall be estimated, or measured at low power, before conducting the experiment.

(4) The control rods shall be inspected annually.

4.4 Control and Safety System Surveillance

(1) The scram time shall be measured semi-annually. If a control rod is removed from the core temporarily, or if a new rod is installed, its scram time shall be measured before the reactor is critical.

(2) A channel test of each measuring channel in the reactor safety system shall be preformed weekly. A channel test before start-up is, however, required on any channel receiving maintenance during the shutdown period.

(3) A startup check list shall be completed before the reactor is put in operation.

4.5 Radiation Monitoring Systems

(1) The area monitors shall be calibrated quarterly.

(2) The area monitors shall receive a channel test weekly.

(3) The area monitors shall receive a channel check and a set-point verification daily during reactor operating periods.

4.6 Engineered Safety Features

4.6.1 Excursion Monitor- see above.

Excursion monitor is station 1 of the radiation area monitoring system.

4.7 Reactor Fuel

(1) Upon receipt from the fuel vendor, all fuel elements shall be visually inspected and the accompanying quality control documents checked for compliance with specifications.

(2) Each new fuel element will be inspected for damage and flow obstructions prior to insertion into the core.

4.8 Sealed Sources

The PuBe sealed source shall be leak tested semi-annually.

4.9 Pool Water

The specific resistance of the pool water shall be determined daily.

5.0 Control and Safety Systems

Design features of the components of this system that are important to safety are given below.

5.1 Power Level Safety Channels

For this function two independent measuring channels are provided.

(1) Each channel covers reliably the range from about 0% to 150% of 200Kw.
(2) Each channel comprises an uncompensated boron-coated ion chamber, or fission chamber, feeding an amplifier that controls electronic switches in the DC current that flows through each control rod magnet.
(3) Each channel controls and scrams all shim rods.
(4) Each channel is fail-safe.
(5) Each channel indicates power level on a panel meter allowing channel checks to be done during reactor operation.
(6) Each chamber can be changed in position, over a limited range, so as to allow the channel reading to be standardized against reactor thermal power.

5.1.1 Linear Channel

A linear channel is included for measurement of power levels from approximately 0.06 watts to 300 Kilowatts. It derives its signal from a compensated ion chamber which can be changed in position, over a limited range, so as to allow the channel reading to be standardized against reactor thermal power. The chamber can be compensated against gamma as is the Log N channel.

This channel provides the 120% demand rundown function. This rundown occurs anytime the linear recorder indicates 120%. (e.g. failure to switch scales). Control rod withdrawal when the neutron count rate information may not be reliably indicated, inhibits are provided on count rate. A scaler is also provided for obtaining accurate values at low count rates if needed (e.g., approach to critical with new fuel or new core configuration).

5.2 Neutron Source

For obtaining the reliable neutron information necessary for startup from a cold shut-down condition, an Plutonium-Beryllimum neutron source is provided for insertion into the core as needed. Integrity of the source is checked by periodic wipe tests.

5.3 Rod Control System

5.3.1 Control Rods

Up to three control rods are provided for the control of core reactivity. These rods may be either boron-carbide or stainless steel with boron. Individual integral worths vary from about 2 to 4%Δ K, depending on position and core configuration. The rods are coupled to drive shafts through electromagnets that allow release of the rods within 60 ms after receiving a scram signal. Position indicators on the control console show the extent of withdrawal for each rod. To limit the rate of reactivity increase upon startup, the rod dirve speeds are limited to 6 in/min.

5.3.2 Regulating Rod

One regulating rod is provided to aid in fine control and maintenance of constant reactor power for long periods. It is limited to a total worth of 1.0% ΔK for safety.

5.4 Cooling System

5.4.1 Primary Cooling System

Core cooling is provided by natural convection through the reactor core. Two nitrogen 16 diffusers are provided which jet streams of pool water over the top of the core to reduce the N16 activity reaching the surface. Water flow is from the reactor pool, through the filter demineralizer, and back to the pool, at a flow rate of approximately 30 gal. per minute.

5.5 Containment System

The reactor is housed in a steel framed double walled building with a free air volume of approx. 36,000 cuft. All circulatory fans shall have their shut off switches near the control r om and shall be equipped with automatic closure devices.

5.6 Fuel Storage

5.6.1 Fuel Storage and Transfer

The fuel storage pit, located below the floor of the reactor pool and at the end opposite from the core shall be capable of storing the fuel inventory allocated to the reactor pool area. The geometry of the storage pit shall be such that criticality is impossible when the complete fuel inventory is stored there.

6.0 Administrative Controls

6.1 Organization

6.1.1 Structure

The organizations for the management and operation of the reactor facility shall be as a minimum the structure shwon in Fig. Job titles are for illustrations only and may vary. Four levels of authority are provided as follows:

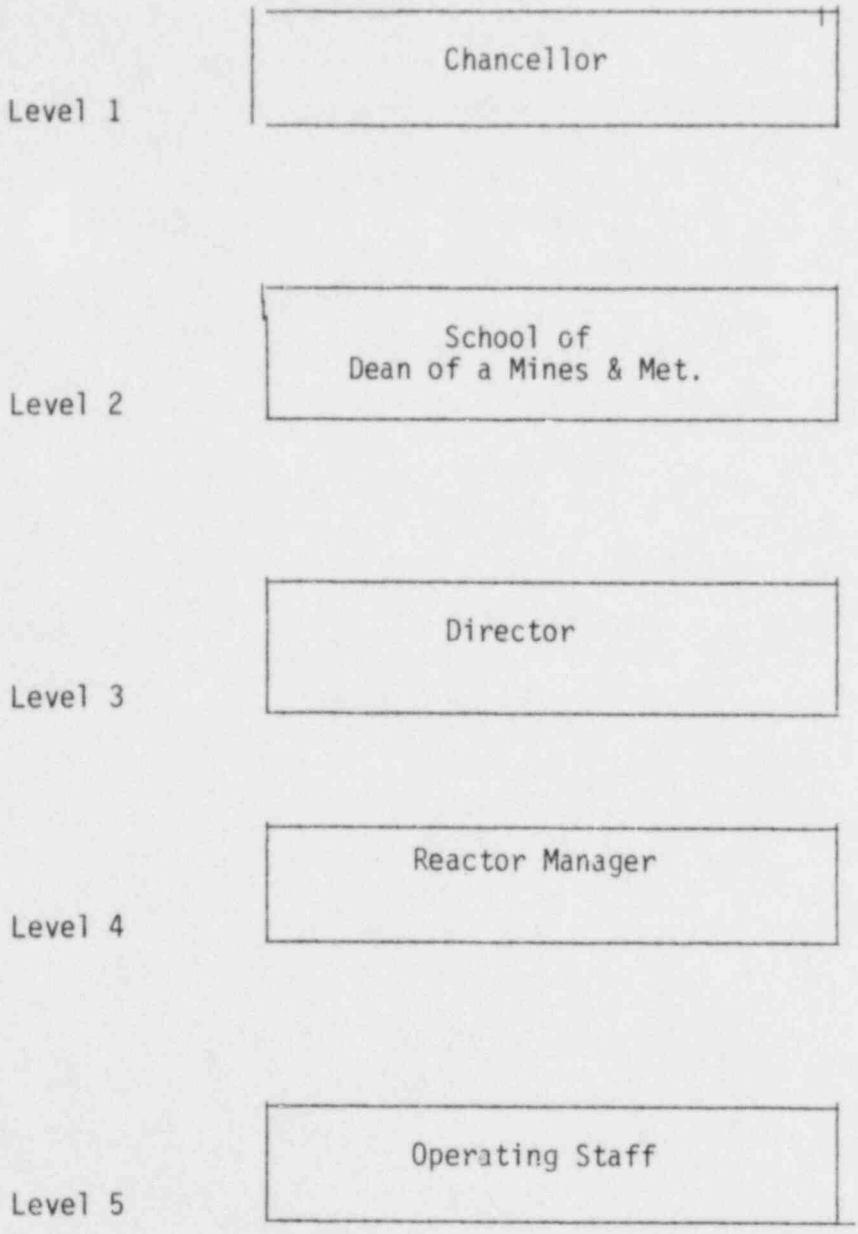
Level 1 - Authorities reported to by Director
Level 2 - Individual responsible for the facility license
Level 3 - Individual responsible for the facility operation and management.
Level 4 - Reactor operating staff.
The Radiation Safety Committee shall report to Level 1. Radiation safety personnel shall report to Level 3 or higher.

6.1.2 Responsibility

Responsibility for the safe operation of the reactor facility shall be within the chain of command shown in Figure . 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 exposures and for adhering to all requirements of the operating license and technical specifications. In all instances responsibilities of one level may be assumed by written designated alternates or by higher levels, conditional upon appropriate qualifications.

6.1.3 Staffing

a. The minimum staffing when the reactor is not secured shall be:
    1. A licensed Reactor Operator in the control room
    2. A licensed reactor operator or Senior Reactor Operator present at the reactor facility. Unexpected absence for two hours is acceptable provided immediate action is taken to abtain a replacement.


Level 1
Chancellor
Level 2
School of
Dean of a Mines & Met.
Level 3
Director
Level 4
Reactor Manager
Level 5
Operating Staff

3. A licensed Senior Reactor Operator shall be readily available on call.
4. A member of the operating shift shall be designated by Level 3 management as knowledgeable in radiation control.

b. Events requiring the presence of a Senior Operator:

1. All Fuel-element or control-rod alterations within the reactor core region.
2. Relocations of any experiments with reactivity worth greater than 0.4%.
3. Recovery from unplanned or unscheduled shutdowns. Furthermore, the presence of a senior operator at the facility shall not be required during recovery from a planned or scheduled shutdowns or significant changes of power or in shutdowns which result from:
    1. Electrical power interruptions, or external failures.
    2. False signals, which, in the opinion of the Senior Operator, were properly verified to be false and to have resulted from monitoring, experimental, or control equipment, or from personnel inadvertence.
    3. Intentional shutdowns made by the Reactor Operator which are not related to the safety of the reactor provided that prior to the initiation of such recovery. The Senior Operator shall be notified of the shutdown or power reduction, and shall determine that the shutdown was caused by one of the enumerated occurrences, and shall determine that his presence at the facility during recovery is not required. This notification and determination by the Senior Reactor Operator will be made prior to restart or power increase.

6.1.4 Selection and Training of Personnel

The selection, training, and requalification of personnel shall meet or exceed the requirements of ANS-15.4/N380 and Appendix A of CFR Part 55 and be in accordance with a requalification plan approved by the Commission.

6.1.5 Review and Audit

The independent review and audit of reactor facility operations shall be performed by a qualified person designated by the Safety Committee.

6.1.5.1 Composition and Qualifications

The Nuclear Safeguards Committee shall be composed of a minimum of 5 members. The members shall collectively provide a broad spectrum of expertise in the appropriate reactor technology. Members and alternates shall be appointed by and report to the Level 1 authority. They may include individuals from within and/or outside the operating organization. Qualified and approved alternates may serve in the absence of regular members.

6.1.5.2 Charter and Rules

The committee shall function under the following operating rules:
Meetings shall be held not less than semi-annually or more frequently as circumstances warrant consistent with effective monitoring of facility activities. A quorum shall consist of not less than one half the membership, where the operating staff does not constitute a majority.
Sub-groups may be appointed to review specific items.
Minutes shall be kept, and shall be disseminated to members and to the Level 1 authority within one month after the meeting.
The Committee shall appoint one or more qualified individuals to perform the Audit Function.

6.1.5.3 Review Function

The following items shall be reviewed by the review group or a subgroup thereof:
Determinations that proposed changes in equipment, systems test, experiments, or procedures do not involve an unreviewed safety question.
All new procedures and major revisions there to having safety significance, proposed changes in reactor facility equipment, or systems having safety significance.
Tests and experiments in accordance with section.
Proposed changes in technical specifications, license, or charter.
Violoations of technical specifications, license, or charter. Violations of internal procedures or instructions having safety significance.
Operating abnormalities having safety significance, and audit reports.
Reportable occurrences listed in section.

6.1.5.4 Audit Function

The audit function shall include selective but comprehensive examination of operating records, logs, and other documents where necessary, discussions with responsible personnel shall take place. In no case shall the individual or individuals conducting the audit be immediately responsible for the area being audited. The following items shall be audited:

a. The conformance of facility operations to the Technical Specifications and applicable license or charter conditions, at least once per calendar year (interval not to exceed 18 months).
b. The Reactor Facility Security Plan and implementing procedures at least once every other calendar year (interval not to exceed 30 months).

Deficiencies uncovered that affect reactor safety shall immediately be reported to the Level 2 authority. A written report of the findings of the audit shall be submitted to the Level 1 authority and the Nuclear Safeguards Committee members within 90 days after the audit has been completed.

6.2 Procedures

There shall be written procedures for, and prior to, initiating any of the activities listed in this section. The procedures shall be reviewed by the Nuclear Safeguards Committee and approved by Level 3 or designated alternates, and such reviews and approvals shall be documented. Several of the following activities may be included in a single manual or set of procedures or divided among various manuals or procedures.

a. Startup, operation, and shutdown of the reactor.
b. Fuel loading, unloading, and movement within the reactor.
c. Routine maintenance of Reactor Safety System components that could have an effect on reactor safety.
d. Surveillance tests and calibrations required by the Technical Specifications or those that may have an effect on reactor safety systems.
e. Personnel radiation protection, consistent with applicable regulations.

f. Administrative controls for operations and maintenance, and for the conduct of irradiations and experiments that could affect the reactor safety or core reactivity.

Substantive changes to the above proceedures shall be made only after documented review by the Nuclear Safeguards Committee and approved by Level 2 or designated alternatives. Minor modifications to the original procedures which do not change their original intent may be made by the Level 4 authority, (Reactor Manager), and must be approved by Level 3 of designated alternatives within 14 days. Temporary changes to the procedures that do not affect reactor safety may be made by a Senior Reactor Operator and are valid for a period of one month. Such temporary changes shall be documented and reported to Level 4 or a designated alternative.

6.3 Experiment Review and Approval

a. All new classes of experiments that could affect reactivity or result in a release of radioactive materials shall be reviewed by the Nuclear Safeguards Committee (NSC). This review shall assure that compliance with the requirements of the license, technical specifications, and applicable regulations have been satisfied, and shall be prepared by the experimentor descibing the experiment including any safety considerations and this submitted to the reactor manager. Review comments of the Nuclear Safeguards Committee setting forth any conditions and/or limitations shall be documented in Committee minutes and submitted to Level 2.

b. All new experiments or classes of experiments shall be approved in writing by Level 3 prior to their initiation.

c. Substantive changes to approved experiments shall be made only after review by the Nuclear Safeguards Committee and written approval by Level 2 or designated alternates. Minor changes that do not significantly alter the experiment may be approved by the Level 4 authority (Reactor Manager). Approved experiments shall be carried out in accordance with approved procedures.

6.4 Required Actions

6.4.1 Action to be taken in Case of Safety Limit Violation

a. The reactor shall be shutdown, and reactor operations shall not be resumed until authorized by the Commission.

b. The safety limit violation shall promptly be reported to the Level 1 authority or designated alternates.

c. The safety limit violation shall be reported to the Commission in accordance with section

d. A safety limit violation report shall be prepared. The report shall describe the following:

1. Applicable circumstances leading to the violation.
2. Effect of the violation upon reactor facility components, systems, or structures.
3. Corrective action to be taken to prevent recurrence.
4. The report shall be reviewed by the Nuclear Safeguards Committee. A follow-up report describing extant activities shall be submitted to the Commission when authorization is sought to resume operation of the reactor.

6.4.2 Action to be taken in the event of an occurrence as defined in section 6.5.3.

a. Corrective action shall be taken to return conditions to normal; otherwise, the reactor shall be shutdown and reactor operation shall not be resumed unless authorized by the Level 3 authority or designated alternates.

b. All such occurrences shall be promptly reported to the Level 2 authority or designated alternates.

c. All such occurrences where applicable shall be reported to the Commission in accordance with section

d. All such occurrences including action taken to prevent or reduce the probability of a recurrence shall be reviewed by the Nuclear Safeguards Committee.

6.5 Reports

In addition to the requirements of applicable regulations, reports shall be made to the Commission as follows:

6.5.1 Operating Reports

Routine annual reports covering the activities of the Reactor Facility during the previous calendar year shall be submitted to the appropriate NRC Regional Office with a copy to the Director of Inspection & Enforcement within 3 months following the end of each prescribed year. Each annual operating report shall include the following information:

a. A narrative summary of reactor operating experience including the energy produced by the reactor.
b. The unscheduled shutdowns including, where applicable, corrective action taken to preclude recurrence, but excluding those of the types listed in Section 6.1.3 B(2) Tabulation of major preventive and corrective maintenance operations having safety significance.
c. Tabulation of major changes in the reactor facility procedures, and new tests and/or experiments significantly different from those performed previously and which are not described in the Safety Analysis Report, including conclusions that no unreviewed safety questions were involved.
d. A summary of the nature and amount of radioactive effluents from the reactor facility released or discharged to the environs. The summary shall include where practicable an estimate of individual radionuclides present in the effluent if the estimated average release after dilution or diffusion is greater than 25% of the concentration allowed or recommended.
e. A summary of the calculated doses to a critical individual in the unrestricted area due to the airborne releases of noble gases and radioiodines.

6.5.3 Special Reports (Reportable Occurrences)

There shall be a report not later than the following working day by telephone and confirmed by telegraph or similar conveyance to the Commission to be followed by a written report within 14 days of any of the following: Release of radioactivity from the reactor above allowed limits, as provided by section of this specification.

6.5.3.1 Violation of Safety Limits

Any of the following:

a. Operation with actual safety-system settings less conservative than

the limiting safety-system setting specified in the Technical Specifications.

b. Operation in violation of Limiting Conditions for Operation established in the Technical Specifications.

c. Operation in violation of Limiting Conditions for Operation established in the Technical Specifications.

d. A reactor safety system component malfunction which renders or could render the reactor safety system incapable of performing its intended safety system incapable of performing its intended safety function unless the malfunction or condition is discovered during tests or periods of reactor shutdowns.

(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 perofrm their intended reactor safety function).

e. An unanticipated or uncontrolled change in reactivity greater than or equal to 1% Δ k/k.

f. Abnormal and significant degradation in reactor fuel, and/or cladding, coolant boundary, or containment boundary (excluding minor leaks) where applicable which could result in exceeding prescribed radiation-exposure limits of personnel and/or environment.

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

6.5.3.2 A written report within 30 days to the Commission of:

1. Permanent changes in the facility organization structure.
2. Significant changes in the transient or accident analysis as described in the Safety Analysis Report.

6.6 Records

Records of the following activities shall be maintained and retained for the periods specified below. The 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. Recorder charts showing operating parameters of the reactor

parameters of the reactor (i.e., power level, temperature, etc.) for unscheduled shutdown and significant unplanned transients shall be maintained for a minimum period of two years.

6.6.1 Records to be retained for a period of at least five years or for the life of the component involved whichever is smaller.

a. Normal reactor facility operations (including scheduled and unscheduled shutdowns). Note: Supporting documents such as checklists, log sheets, etc. shall be maintained for a period of at least two years.
b. Principal maintenance operations.
c. Reportable occurrences.
d. Surveillance activities required by the Technical Specifications.
e. Reactor facility radiation and contamination surveys where required by applicable regulations.
f. Experiments performed with the reactor.
g. Special Nuclear Materials (SNM) inventories, receipts, and shipments.
h. Approved changes in operating procedures.
i. Records of meeting and audit reports of the Nuclear Safeguards Committee.
j. Sealed source leak test results.

6.6.2 Records to be retained for at least one requalification cycle or for the length of employment of the individual whichever is smaller:

a. Retraining and requalification of licensed operations personnel. However, records of the most recent complete cycle shall be maintained at all time the individual is employed.

6.6.3 Records to be retained for the lifetime of the reactor facility: (Note: Annual reports may be used where applicable as records in this section)

a. Gaseous and liquid radioactive effluents released to the environs.
b. Radiation exposure for all personnel monitored.
c. Updated drawings of the reactor facility.