Manhattan College

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MECHANICAL ENGINEERING DEPARTMENT

November 15, 1984

Ms. Angela Chu, Project Manager
U. S. Nuclear Regulatory Commission
Standardization and Special Projects Branch
Division of Licensing
Washington, D. C. 20555

Subject: Manhattan College
Zero Power Reactor(MCZPR)
Docket 50-199
Technical Specifications

Dear Ms. Chu:

Attached find a copy of our latest revision of the Technical Specifications for the MCZPR. This was requested during your site visit of September 18 and 19, 1984 with an agreed due date of November 15, 1984. Our response to the NRC Final Questions was mailed to you on October 26, 1984. The revised Technical Specifications and our response to the NRC Final Questions represent the completion of our commitments resulting from the site visit. We hope these will enable you to complete your review.

If you have any questions on the Technical Specifications, please contact our Chief Reactor Supervisor, Dr. Jih-Perng Hu (212)-920-0147 or the writer (212)920-0145.

Very truly yours,

Ronald S. Kane

Dr. Ronald S. Kane
Reactor Administrator

RSK/w
enc

This 15th day of November 1984

Peter M. Brown

PETER M. BROWN
Notary Public, State of New York
No. 4502374
Qualified in Westchester County
Commission Expires March 30, 1985

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16.0 TECHNICAL SPECIFICATIONS FOR THE MANHATTAN COLLEGE ZERO POWER REACTOR

Dr. Jih-Perng Hu
Bro. Gabriel Kane, FSC
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Revision 2
November 15, 1984

Revision Record

Revision No.	Comment
0	Submitted to U.S.N.R.C. on August 26, 1983 as part of the Safety Analysis Report for the MCZPR
1	Complete revision submitted on January 12, 1984
2	Complete revision submitted on November 15, 1984

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1.0 DEFINITIONS

The terms Safety Limit, Limiting Safety System Setting, and Limiting Condition for Operation are as defined in paragraph 50.36 of 10 CFR Part 50.

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

<u>channel test</u> - A channel test is the introduction of a signal into the channel for verification that it is operable.

<u>channel calibration</u> - 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 be deemed to include a channel test.

<u>channel check</u> - 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.

<u>control rod</u> - Plates fabricated with neutron absorbing material used to establish neutron flux changes and to compensate for routine reactivity losses. This includes safety-type and regulating rods.

<u>core</u> - The portion of the reactor volume which includes the fuel elements, the source, and the control rods.

<u>delayed neutron fraction</u> - When converting between absolute - and dollar-value reactivity units, a beta of 0.00645 is used.

<u>drop time</u> - The elapsed time between reaching the complete removal setpoint and the full insertion of a safety-type rod. (It must be less than 1.0 second).

<u>excess reactivity</u> - Excess reactivity is that amount of reactivity that would exist if all control rods (control, regulating) were moved to the maximum reactive condition from the point where the reactor is exactly critical ($K_{eff} = 1$).

experiment - Any object, other than a fuel element or handling tool, which is inserted into the volume formed by projecting the grid plate vertically to the tank pool water surface is to be regarded as an experiment in the core.

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

movable experiment - An experiment where it is intended that the entire experiment may be moved in or near the core or into and out of the reactor pool water.

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

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

reactivity limits - The reactivity limits are those limits imposed on reactor core excess reactivity. For the MCZPR the reactivity limits are 0.44% $\Delta k/k$ (0.68 $) at 110.6°F.

reactivity worth of an experiment - The reactivity worth of an experiment is the maximum absolute value of the reactivity change that would occur as a result of intended or anticipated changes or credible malfunctions that alter experiment position or configuration.

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

reactor operator - (RO) - An individual who is licensed to manipulate the controls of a reactor.

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 - A reactor is secured when:

1) It contains insufficient fissile material or moderator present in the reactor, adjacent experiments or control rods, to attain criticality under optimum available conditions of moderation and reflection, or

2) A combination of all of the following:

a) All neutron absorbing control rods are fully inserted and other safety devices are in shutdown position, as required by the technical specifications, and

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

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

d) No experiments are in or near the reactor.

reactor shutdown - The reactor is shut down if it is subcritical by at least one dollar in the reference core condition and the reactivity worth of all experiments is accounted for.

reference core condition - The condition of the core when the pool water temperature is between 60°F and 80°F.

regulating rod - A low-worth control rod used primarily to maintain an intended power level. Its position may be varied by operator action.

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

reverse trip - The electronic setting within the console instrumentation which will initiate a reverse system which will drive in an electromagnet when certain specified limits are exceeded.

safety-type rod - A rod that can be rapidly inserted by cutting off the holding current in its electromagnetic clutch. This applies to both control rods.

scram time - The time for the control rods (shim, regulating) acting under the force of gravity to change the reactor from a critical to a subcritical condition. This will be equal to or less than the drop time.

scram trip - The electronic setting within the console instrumentation which will activate scram circuits when certain specified limits are exceeded.

senior reactor operator - (SRO) - An individual who is licensed to direct the activities of a Reactor Operator (RO) and to manipulate the controls of a reactor.

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

shutdown margin - Shutdown margin shall mean the minimum shutdown reactivity necessary to provide confidence that the reactor can be made subcritical by means of the control and safety systems starting from any permissible operating condition although the most reactive rod is in its most reactive position, and that the reactor will remain subcritical without further operator action.

unscheduled shutdown - An unscheduled shutdown is defined as any unplanned shutdown of the reactor caused by actuation of the reactor safety system. operator error, equipment malfunction, or 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 LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 Safety Limits

The Manhattan College Zero Power Reactor (MCZPR) shall not operate at a steady power level in excess of 0.1 watt. No other Safety Limits need be specified since convective cooling is not required for this power level. This power level is sufficient to satisfy the educational and training purposes of the MCZPR.

2.2 Limiting Safety System Settings (LSSS)

2.2.1 Applicability

This specification applies to the setpoints of safety channels.

2.2.2 Objective

To assure that automatic trip action is initiated and that the operator is warned to take protective action to prevent a safety limit from being exceeded.

2.2.3 Specifications

The limiting safety system settings are the following:

A. The maximum steady state power level trip setpoints shall not exceed 0.1 watt.

B. When performing the high flux tests, the transient power level trip setpoints, shall not exceed 0.18 watt.

2.2.4 Bases

The trip setpoints provide adequate margins for the limits of operation. Both trip setpoints, A and B, initiate automatic scrams.

3.0 LIMITING CONDITIONS FOR OPERATION

3.1 Reactor Core Parameters

3.1.1 Applicability

These specifications apply to the parameters which describe the reactivity condition of the core.

3.1.2 Objective

To ensure that the reactor cannot achieve prompt criticality and that it can be safely shut down under any condition.

3.1.3 Specifications

The reactor shall not be made critical unless the following conditions exist:

A. The total core excess reactivity with or without the movable experiments of section 3.8.3 shall not exceed 0.44% $\Delta k/k$ (0.68$).

B. The minimum shutdown margin provided by control rods in the reference core condition shall not be less than 0.90% $\Delta k/k$ (1.40 $).

C. The lower limit of water resistivity based on the requirements for the corrosion protection system shall be set at 0.1 Megaohm-cm. There shall be no upper limit for the water resistivity.

D. Any change in the fuel loading pattern and experimental apparatus shall be approved by the Reactor Operations Committee.

3.1.4 Bases

Specification A is based upon the experimentally determined value for excess reactivity 0.44% $\Delta k/k$ (0.68$) at a reactor pool water temperature of 110.6°F.

Specification B is based upon the negative worth of the regulating rod: that is, the control rod with the smaller negative worth.

Specification C provides the minimum resistivity of water in the reactor tank. If the water resistivity is less than this level of 0.1 Megaohm-cm, the resin bed in the deionizer is replaced. The resistivity of the water has little or no bearing on the corrosive effects experienced or possible other than to offer some guarantee that catalyzing anions are excluded from the system. In the absence of the other protective mechanisms that are in place, corrosion will occur regardless of the resistivity of the water. The supplemental protective device selected for use is a dynamic cathodic protection system operating at 10 volts and an expected current density of 25 to 50 milliamps. The lower limit of 0.1 Megaohm-cm has been selected to allow this system to provide an electron saturated barrier layer over the entire internal surface of the tank thus preventing the development of any galvanic cells as a result of discrete areas becoming anodic.

Specification D limits the changes in core configuration to those approved by the committee charged with review and approval of experiments.

3.2 Reactor Control and Safety System

3.2.1 Applicability

These specifications apply to the reactor safety system and safety-related instrumentation.

3.2.2 Objectives

To specify the lowest acceptable level of performance or the minimum number of acceptable components for the reactor safety system and safety-related instrumentation.

3.2.3 Specifications

The reactor shall not be made critical unless the following conditions exist:

A. The reactor safety system shall be operable in accordance with Table 3-1.

B. There shall be two safety-type control rods:

A regulating rod with a negative worth of 0.90% $\Delta k/k$ (1.40$) and a shim rod with a negative worth of 2.50% $\Delta k/k$ (3.88$).

C. The drop time for either safety rod should not exceed 1.0 second; measurements of rod drop times shall be made once per semester.

D. The reactivity insertion rate for a single rod shall not exceed 0.10% $\Delta k/k$ (.154$) per second.

3.2.4 Bases

Specification A provides assurance that the reactor safety system which may be needed to shut down the reactor is operable. Each feature of the system is described in Table 3-1.

Specification B provides assurance that the reactor can be operated safely at the critical state because these negative worths make it possible to shutdown the reactor rapidly.

Specification C provides assurance that both reactor safety rods can be fully inserted into the core to decrease the power level within 1.0 second.

Specification D assures a safe rate of power change during startup and during power ascensions.

Table 3-1 Safety System

The following circuits shall be functioning whenever fuel is in the reactor and power is available to the control drives.

1. Scram Circuits

   A scram system shall be provided that will cause interruption of the magnet current to the electromagnets supporting the control rods whenever a scram trip is exceeded. Power to the magnets shall be available when the "reactor on" switch is on and there are no scram trip signals. A scram trip shall be provided for each of the conditions below, with the trip setting as specified.

   a. High neutron flux - Count Rate Channel electronic trip set for 180% or less of Full Power (Full power shall be equal to 0.1 watt).

   b. High neutron flux - Linear Channel electronic trip set for 180% or less of Full Power.

   c. High gamma activity - high level signal from either of the two Gamma Channels electronically set for 10mR/hr or less.

   d. Manual scram - operates upon actuation of the manual scram button on the console.

   e. Low water level - operates when the tank water level drops one foot below the tank full position. Tank full position is defined as seven feet above the bottom of the reactor vessel.

   f. Reactor key switch off - operates when the "REACTOR ON" switch is turned to the off position.

   g. Power failure - operates whenever the power supply to the console or to the nuclear instrumentation fails.

2. Reverse Circuits

   A reverse system shall be provided that will cause both control rod drives to drive the control rods into the reactor whenever a reverse trip is exceeded. The reverse action shall override any rod selection made by an operator and shall persist as long as a reverse trip is exceeded. Reverse trips shall be provided for each condition as below with the trip setting as specified:

Table 3-1 Safety System (continued)

a. A Cour. Rate Channel reverse trip shall occur for any of the following conditions:

(1) Count Rate recorder off.

(2) Count Rate recorder down scale - shall occur when the recorder indicates less than 2 counts per second.

(3) Count Rate recorder up scale - shall occur when the recorder indicates greater than 50,000 counts per second.

b. Linear Channel reverse trip shall occur for any of the following conditions:

(1) Linear recorder off.

(2) Linear recorder down scale - shall occur when the linear recorder is less than 5% of full scale.

(3) Linear recorder up scale - shall occur when the linear recorder is greater than 95% of full scale.

c. Gamma Channel reverse trip shall occur for any of the following conditions:

(1) Gamma recorder off.

(2) Gamma recorder down scale - shall occur when the recorder indicates less than 0.2 mR/hr. (It should be noted that the minimum reading on the recorder is 0.1 mR/hr while the minimum reading on the instruments on the Gamma Channels for Area Radiation Monitoring is .01 mR/hr).

(3) Gamma recorder up scale - shall occur when the recorder indicates greater than 95 mR/hr.

d. Any scram condition shall cause the control rod drives to drive in the electromagnets.

e. Manual run-in-trip shall occur upon actuation of the "Run-In" switch on the control console.

3. Bypass in Safety Systems

The only bypasses in the scram or reverse circuits shall be those described below. The bypasses shall be key operated switches located on the console.

Table 3-1 Safety System (continued)

a. A bypass to eliminate a reverse as a consequence of the gamma recorder being down scale may be utilized during startup until the gamma recorder reads on scale.

b. A bypass to eliminate a reverse as a consequence of the linear recorder being down scale may be utilized in the initial fuel loading while conducting experiments to determine subcritical multiplication.

3.3 Coolant System

Because of the low value of the maximum steady power level (0.1 watt), no recirculating cooling equipment or systems are required other than the pool of water maintained in the reactor tank. The total heat capacity of the pool is about 65 MJ/°C.

3.4 Confinement or Containment

No operations requiring confinement or containment are performed with the MCZPR.

3.5 Ventilation System

3.5.1 Applicability

This specification applies to the ventilation system within the MCZPR room.

3.5.2 Objective

To ensure that the air in the reactor room is always clean and free of dust.

3.5.3 Specifications

A. The MCZPR Laboratory shall contain a forced circulation ventilation system consisting of a blower and associated duct work. There shall be no connection between this system and any other part of the building.

B. A switch shall be provided in the reactor room to turn the ventilating system on and off.

3.5.4 Bases

Specification A shows that the ventilation system is independent of the building.

Specification B provides assurance that the ventilation system is controllable.

3.6 Emergency Power

No emergency power is supplied to the MCZPR. In the event of power failure while the reactor is operating, a scram trip shall occur.

3.7 Radiation Monitoring Systems

3.7.1 Applicability

These specifications apply to the radiation monitoring systems and to the limits on the radiation detection level of each channel.

3.7.2 Objective

To specify the minimum number of acceptable components or the lowest acceptable level of performance for the radiation monitoring systems.

3.7.3 Specifications

A. Two radiation monitoring channels shall be provided to measure gamma intensity. These channels shall also be used to monitor reactor operation and shall be used in the reactor safety system as described in Table 3-1. Each channel consists of a Gamma Detector and Gamma Indicator Unit. A common strip chart recorder shall be provided with a selector switch for recording the output of either channel.

B. Each Gamma Detector shall be a sealed unit containing a Geiger-Mueller tube, transistorized count rate amplifier, and check source. The output from the Detector shall be logarithmic with respect to the radiation level. The check source shall be exposed to the Detector by a solenoid which is actuated by a pushbutton on the control console.

C. One of the Detectors (Gamma 1) shall be located on the reactor platform directly over the core area while the other Detector (Gamma 2) shall be mounted on the side of the reactor tank.

D. The Gamma Indicator shall contain the power supply for the system, the alarm reset check source control, and the output connector for the Detector. Also contained on the front of the Indicator is a logarithmic meter relay for indication and alarm of the gamma level. The alarm shall be set to give audible annunciation whenever the radiation level exceeds 6mR/hr for Gamma 1 and 10 mR/hr for Gamma 2.

E. The range of both detectors shall be from .01 to 100mR/hr. The system shall be designed so that if the radiation intensity is greater than 100mR/hr, the detector shall indicate full scale.

3.7.4 Bases

Specification A provides the functions and components of two radiation monitoring channels and provides assurance that these two channels can also be used as safety-related channels.

Specification B provides the composition of each detector and provides assurance that each detector can function well by using the check source.

Specification C provides assurance that radiation in both radial and axial directions can be detected.

Specification D provides assurance that the safety alarm system will be activated when radiation exceeds the allowable limit.

Specification E provides the range and design configuration of the monitoring system.

3.8 Experiments

3.8.1 Applicability

These specifications apply to the experiments installed in the reactor.

3.8.2 Objective

To prevent damage to the reactor and release of radioactive material in the event of experiment failure, and to avoid exceeding any safety limit.

3.8.3 Specifications

Limitations on experiments and material irradiations in the reactor shall meet the following conditions:

A. No experiment shall be installed in the reactor in such a location that any part of the apparatus will touch or in any way interfere with the action of the control rods.

B. No experiment shall be installed in the reactor that can shadow the nuclear instruments, thereby giving erroneous or unreliable information to the reactor operator.

C. No experiment which has explosive properties shall be irradiated.

D. Experiments containing materials whose release to the water could result in a violent chemical reaction (e.g. Sodium) or would result in chemical or corrosive attack to the reactor components (e.g. Mercury) shall not be irradiated.

E. Experiments containing materials whose release could result in overexposure of personnel to gaseous or particulate radioactivity shall not be irradiated.

F. Each experiment, other than laboratory exercises defined in Item G shall receive the specific approval of the Reactor Operations Committee. In addition, all operations leading to the production of more than one millicurie of any radioisotope outside of fuel elements shall receive the approval of the Reactor Operations Committee.

G. Laboratory exercises - The following laboratory exercises, while not requiring the presence of a Reactor Supervisor, require the presence of a Reactor Operator. Laboratory exercises involving use of experiments (other than experiments used in the following exercises) shall be conducted in the presence of a Reactor Supervisor.

1. Startup and Operation of Manhattan College Zero Power Reactor: Approach to Criticality
2. Critical Mass Determination
3. Reactor Period and Reactivity
4. Void Coefficient Measurement
5. Flux Distribution in the Manhattan College Zero Power Reactor
6. Determination of Buckling
7. Measurement of Diffusion Length and Age
8. Temperature Coefficient of Reactivity
9. Gamma Ray Energy Spectrum in the Vicinity of the Reactor Core

H. A maximum of seven aluminum covered indium foils with a combined negative reactivity of -1.113×10^{-4} $\Delta k/k$ may be used in a laboratory exercise (Flux Distribution in the MCZPR). A void with a negative worth of -10.4×10^{-4} $\Delta k/k$ may also be used in a laboratory exercise (Void Coefficient Measurement).

I. A record of each material irradiation shall be included in the reactor log. The record shall include at least the following data:

Material irradiated
Position in core
Reactor Power
Irradiation time, time in, time out
Dose rate on contact at time of removal
Supervisor's signature

3.8.4 Bases

Specifications A, B, C, D, E, F, and I are based on requirements stated in the Standard for The Development of Technical Specifications for Research Reactors, ANSI/ANS-15.1-1982.

Specification G lists all the laboratory exercises that have been performed with the MCZPR for teaching and training purposes. There are no limiting conditions for these exercises except item 5 - Flux Distribution in the MCZPR.

With regard to Specification H, for the laboratory exercise involving the irradiation of the seven indium foils, the reactor is always scrammed before these foils are removed. Also, in the laboratory exercise for determination of the void coefficient, both control rods are fully inserted before the rod is fully removed.

3.9 Facility Specific LCO

No limiting conditions for operations (LCO) unique to the facility other than those listed above are necessary.

4.0 SURVEILLANCE REQUIREMENTS

Surveillance tests, except those specifically required for safety when the reactor is shutdown, may be deferred during reactor shutdown: however, they must be completed prior to reactor startup.

4.1 Reactor Core Parameters

No significant core configuration or control rod changes have occurred since the initial excess reactivity tests of 1966. Any significant changes must be approved by the Reactor Operations Committee (ROC) prior to the change. The Reactor Operations Committee meets semi-annually.

4.2 Reactor Control and Safety System

4.2.1 Applicability

These specifications apply to the surveillance activities required for the reactor control and safety system.

4.2.2 Objective

To specify the frequency and type of testing or calibration to assure that the reactor control and safety system conforms to the specification of section 3 of these Specifications.

4.2.3 Specifications

A. It is assumed that the worth of the control rods remains unchanged. However, the relative worths of the control rods shall be checked annually by comparing the criticality positions of the control rods with the criticality positions of previous years.

B. The rod withdrawal speeds shall be measured at least twice a year, and shall be such that the maximum speed is no greater than 12 inches per minute in the MCZPR.

C. The operability of the control rods and driving mechanism shall be tested daily when the reactor is operating.

D. An operability test, including trip action, of each safety channel listed in Table 3-1 that provides a scram function shall be completed prior to each reactor startup following a period when the reactor has been secured for more than 24 hours or at least weekly during continuous operating periods.

E. A calibration of the channels listed in Table 3-1 shall be performed at least annually and whenever any maintenance on a channel which may affect its performance is completed.

4.2.4 Bases

Specification A provides assurance that relative worths of the control rods will be checked annually.

The rod withdrawal and insertion time measurement intervals required in specification B verify the limits in specification 3.2.3 D and are appropriate to detect abnormal performance.

Specification C verifies the operability requirements in specification 3.2.3 C during each day of operation.

In specification D each channel capable of generating a scram signal is tested during the pre-critical procedure, prior to startup, so that the conditions of specification 3.2.3 A are satisfied.

Specification E requires calibration of safety and safety-related channels at an interval which is appropriate and justified by prior experience at this facility.

4.3 Coolant Systems

There is no coolant or coolant system in this facility other than the pool water. Water in the MCZPR lost due to evaporation is replenished with New York City water. The water from the city system is passed through a filter, a demineralizer, an electrically controlled check valve, and a short flexible hose over the top of the reactor tank. The check valve insures no back flow of water from the reactor in case of pressure loss in the water supply system. The flexible hose is removed from the reactor tank when the hose is not in use. The water level in the reactor pool is maintained at about seven feet from the tank bottom and is checked every day that the reactor is operated.

4.4 Confinement or Containment

There is no confinement or containment system.

4.5 Ventilation Systems

4.5.1 Applicability

This specification applies to the surveillance activities required for the reactor ventilation system.

4.5.2 Objective

To specify the frequency and type of testing to assure that the ventilation system conforms to the specifications of section 3.5 of these Specifications.

4.5.3 Specification

The blower and switch of ventilation system shall undergo testing for normal operation at least once per year.

4.5.4 Bases

This specification requires that the blower and switch of ventilation system be tested to verify that they can be operated when needed. The testing interval is adequate to verify operability,based on experience at this facility.

4.6 Emergency Power

This specification does not apply to this facility since there is no emergency power supply.

4.7 Radiation Monitoring System

4.7.1 Applicability

These specifications apply to the surveillance activities required for the radiation monitoring system.

4.7.2 Objective

To specify the frequency and type of testing to assure that the radiation monitoring system conforms to the specification of section 3.7 of these Specifications.

4.7.3 Specifications

These surveillance activities are required for safety.

A. A calibration of the two radiation monitoring channels shall be performed at least annually and whenever any maintenance on a channel which may affect its performance is completed. This calibration shall be performed by comparing the readings of these instruments with those on a portable beta-gamma survey meter. The latter shall be calibrated annually by a recognized diagnostic laboratory.

B. An operability test, including source checks, of the radiation monitoring channels shall be performed at least quarterly (and recorded in the reactor checkout sheets).

C. Readings of the radiation levels of all instruments shall be recorded hourly during operation with the reactor being critical.

D. The environmental film badge and smear surveys in and around the reactor enclosure shall be performed at least twice a year.

E. An ALARA program shall be established and monitored by a Radiation Safety Officer (RSO).

4.7.4 Bases

Based on experience at this facility and the average usage pattern of the reactor, specifications A-E are adequate to verify that the operations conform to the specifications of 3.7.3. The usage pattern will be subject to review by the Reactor Operations Committee.

4.8 Experiments

4.8.1 Applicability

These specifications apply to the surveillance activities required for experiments installed in the reactor.

4.8.2 Objective

To specify the frequency and type of testing to assure that the experiments conform to the specifications of section 3.8 of these Specifications.

4.8.3 Specifications

A. The identification and location of all installed experiments shall be recorded prior to each reactor startup.

B. Other specific surveillance activities shall be established during the review and approval process specified in section 6.0.

4.8.4 Bases

Specification A requires that the reactor operator verify that the installed experiments are approved.

Specification B recognizes that detailed surveillance requirements will vary among experiments, and that the Reactor Operations Committee specifies the appropriate type and frequency of surveillance.

4.9 Facility Specific Surveillance

No Facility Specific Limiting Conditions for Operations are provided in section 3.9.

5.0 DESIGN FEATURES

5.1 Site and Facility Description

The Manhattan College Zero Power Reactor (MCZPR) is located in the Leo Engineering Building of Manhattan College at 3825 Corlear Avenue, Bronx, New York.

The laboratory room where the reactor is located is considered a restricted area as defined in paragraph 20.3(a), 14, of 10 CFR 20.

The principal activities carried on within the site are those related to the educational program of Manhattan College. The reactor may be utilized in this program for instructional use and may be used in laboratory exercises for teaching and training purposes.

The Leo Engineering Building of Manhattan College is a four story, brick building providing space for Engineering and Science Laboratories. The building provides classrooms, computer facilities, and laboratories for an estimated 1800 students at any one time, as well as office space for the Dean of the School of Engineering, chairmen, and faculty members using the building.

The laboratory housing the Manhattan College ZPR is completely separated from the remainder of the Reactor Laboratory as shown in figure 5-1. Security locked doors provide the only access to the Reactor Laboratory.

The MCZPR laboratory has the following penetrations:

a. Electrical conduits
b. Air circulation system
c. Door (secured with locks and a security system)
d. Window (sealed with plywood)

The MCZPR is located in the laboratory as shown in figures 5-2 and 5-3. The reactor tank rests on a concrete slab in the first floor and extends upward through the second floor. The first floor room housing the reactor has concrete walls extending from the floor to the ceiling on three sides and a metal partition from the retainer wall to the ceiling on the fourth side. The

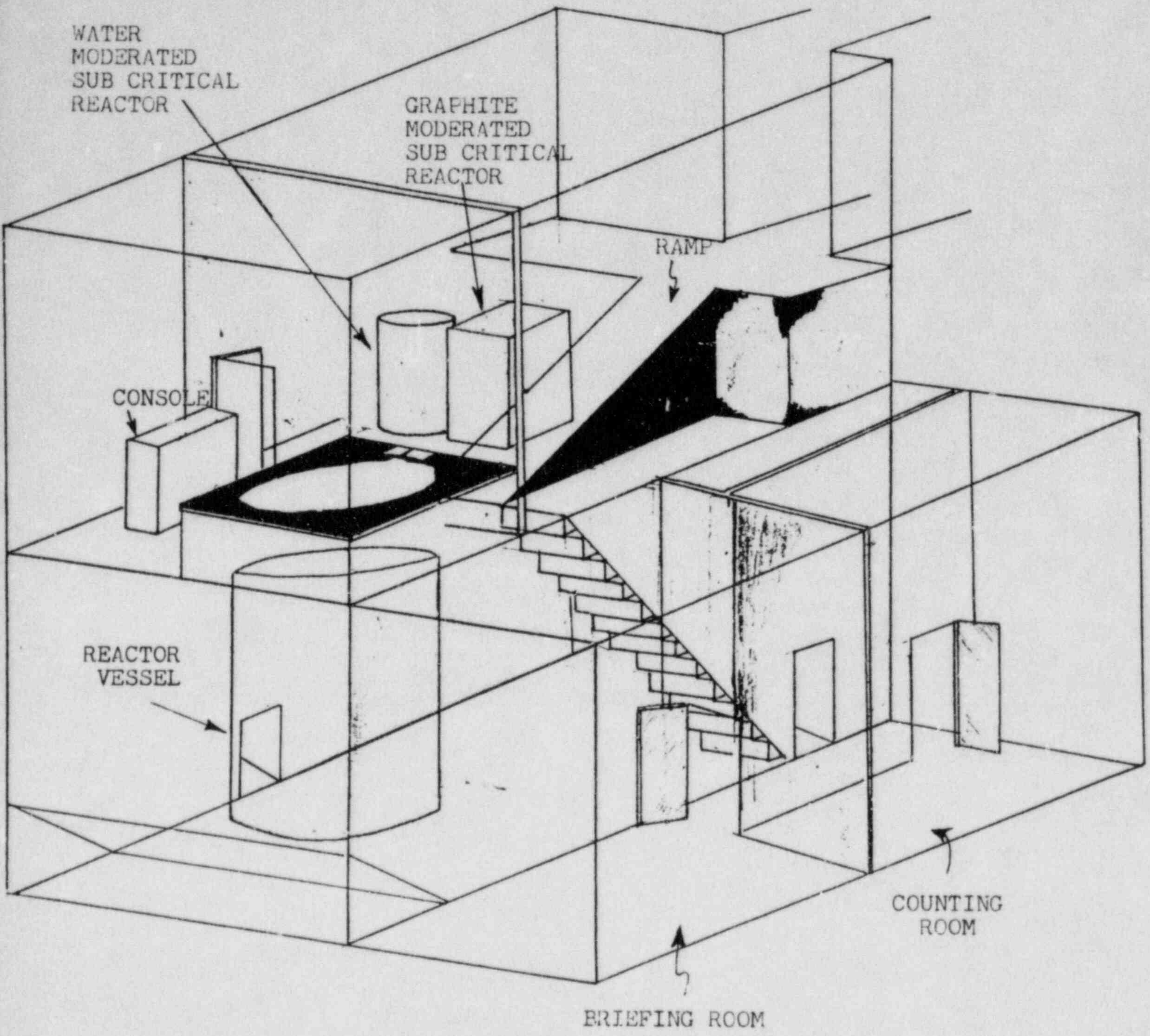

Figure 5-1, Cutaway of MCZPR Facility

PLAN (ON FIRST FLOOR OF LEO ENGINEERING BUILDING)

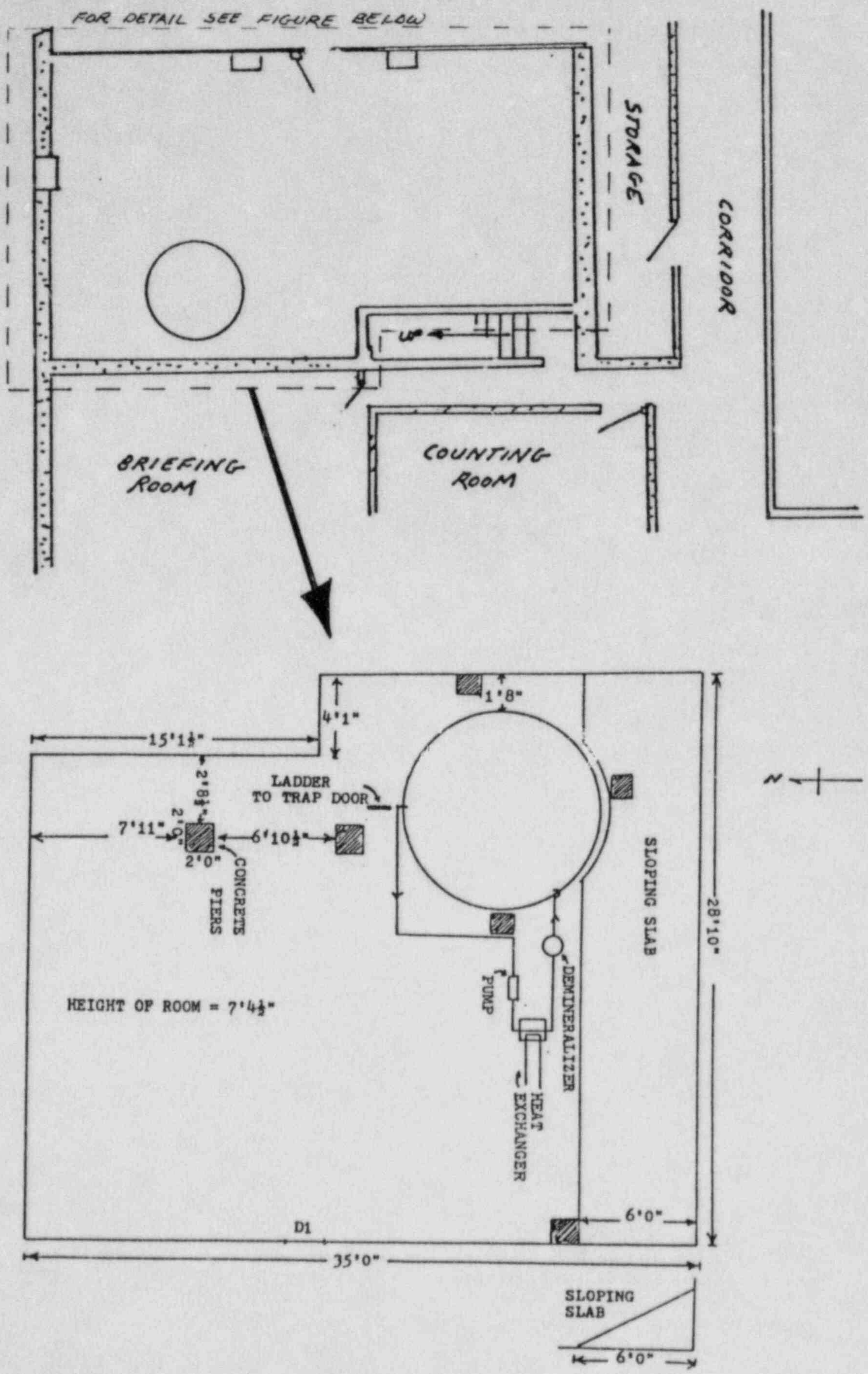

Figure 5-2, Plan of First Floor of MCZPR

PLAN (ON SECOND FLOOR OF LEO ENGINEERING BUILDING)

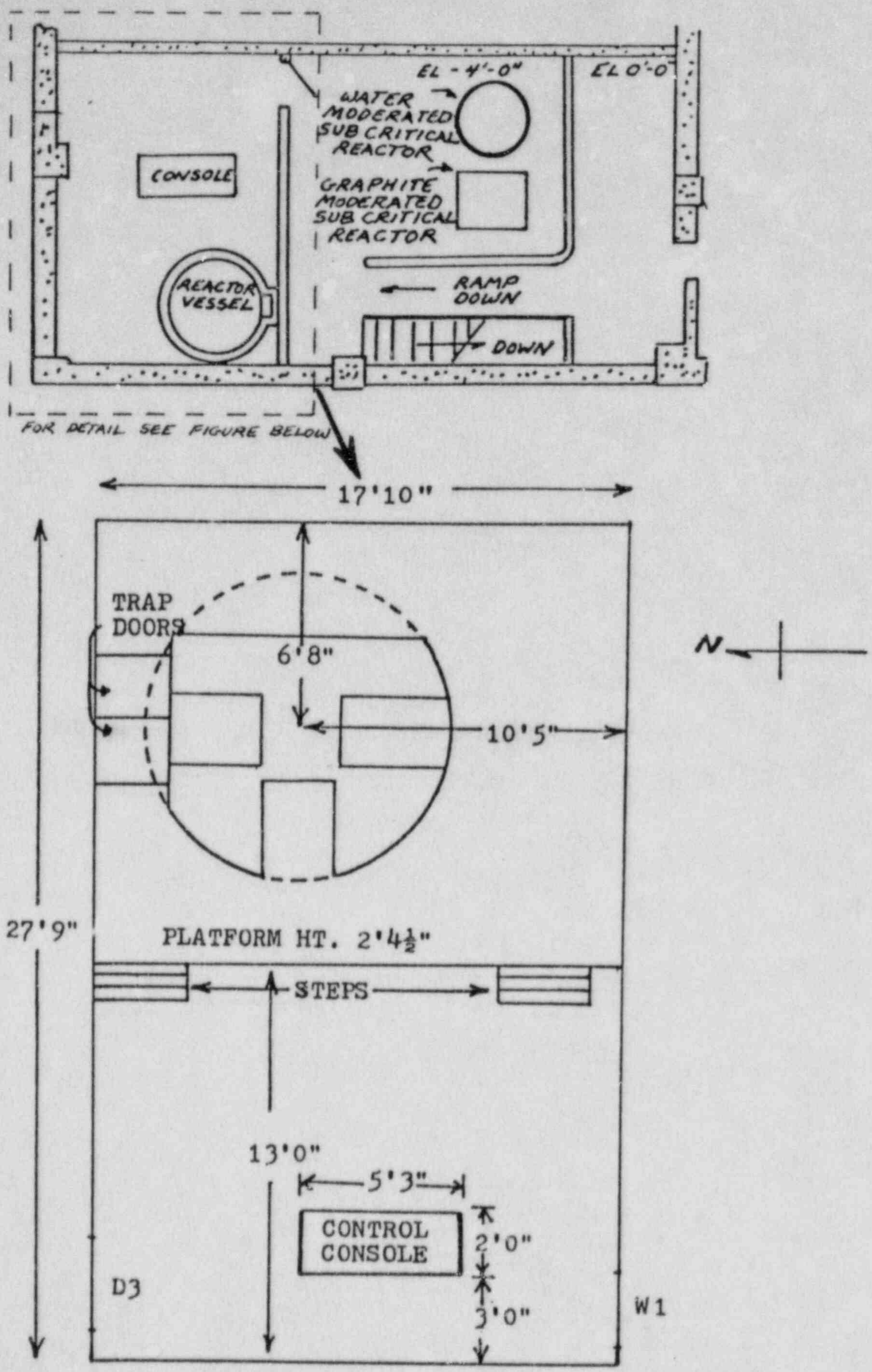

Figure 5-3, Plan of Second Floor of MCZPR only access to the reactor from the first floor is through a metal door which penetrates the metal partition as shown in figure 5-2. The metal door is kept locked at all times when there is fuel in the reactor. The only unlocked access to the first floor of the MCZPR room when fuel is in the reactor is from the second floor through a trap door in the reactor platform and down a vertical steel ladder adjacent to the reactor tank as shown in figure 5-3.

The reactor platform is located on the second floor above the tank whenever fuel is located in the reactor. The platform is surrounded by a link fence to prevent personnel from inadvertently approaching the open areas in the platform.

In addition to the concrete walls extending from floor to ceiling on three sides of the first floor room housing the reactor, a concrete berm has been constructed on the fourth side sufficiently high to contain all the water in the reactor tank.

The window to the MCZPR Laboratory has a window guard that has been sealed to prevent unauthorized entry into the room. The door into the facility is locked whenever a reactor operator is not in attendance in the room.

During times when an operator is not in attendance in the MCZPR Laboratory, the MCZPR Laboratory is under electronic surveillance.

The reactor vessel consists of a cylindrical aluminum tank eight feet high and ten feet in diameter. The tank wall is one quarter of an inch thick. The only tank wall penetration is a 3/4 inch diameter aluminum coupling located near the tank bottom with a 3/4 inch diameter short nipple and a 3/4 inch aluminum gate valve. The inlet to the demineralizer is connected to this gate valve. The outlet of the demineralizer feeds into a pipe which rises vertically and forms a gooseneck loop over the edge of the tank.

The reactor vessel is located as in figure 5-2 and is held in place by five aluminum brackets welded to the sides of the tank near the bottom. These brackets are bolted to the concrete floor.

5.2 Reactor Coolant System

There is no reactor coolant or coolant system other than the reactor pool.

5.3 Reactor Core, Fuel, and Safety System

5.3.1 Reactor Core

A grid plate stand as shown in figures 5-4 and 5-5 is welded to the bottom of the reactor tank.

A grid plate is bolted to the grid plate stand. The design of the plate including attachments thereto are as shown in figure 5-6. Fuel element hold down rods are threaded into the grid plate unless an approved program requires their removal. The holes in the support cylinders for the in-core fuel elements are plugged.

The shafts of these hold-down rods are made partly of aluminum and partly of lucite as shown in figure 5-7. The lucite portion consists of a solid rod one inch in diameter. The threaded base of the hold-down rod is made of aluminum tubing having a one eighth inch wall thickness. The broad top of the hold-down rod, which extends over the top of the fuel element is also made of aluminum. The aluminum portions of the hold-down rod are securely fastened to the lucite by aluminum pins and epoxy cement.

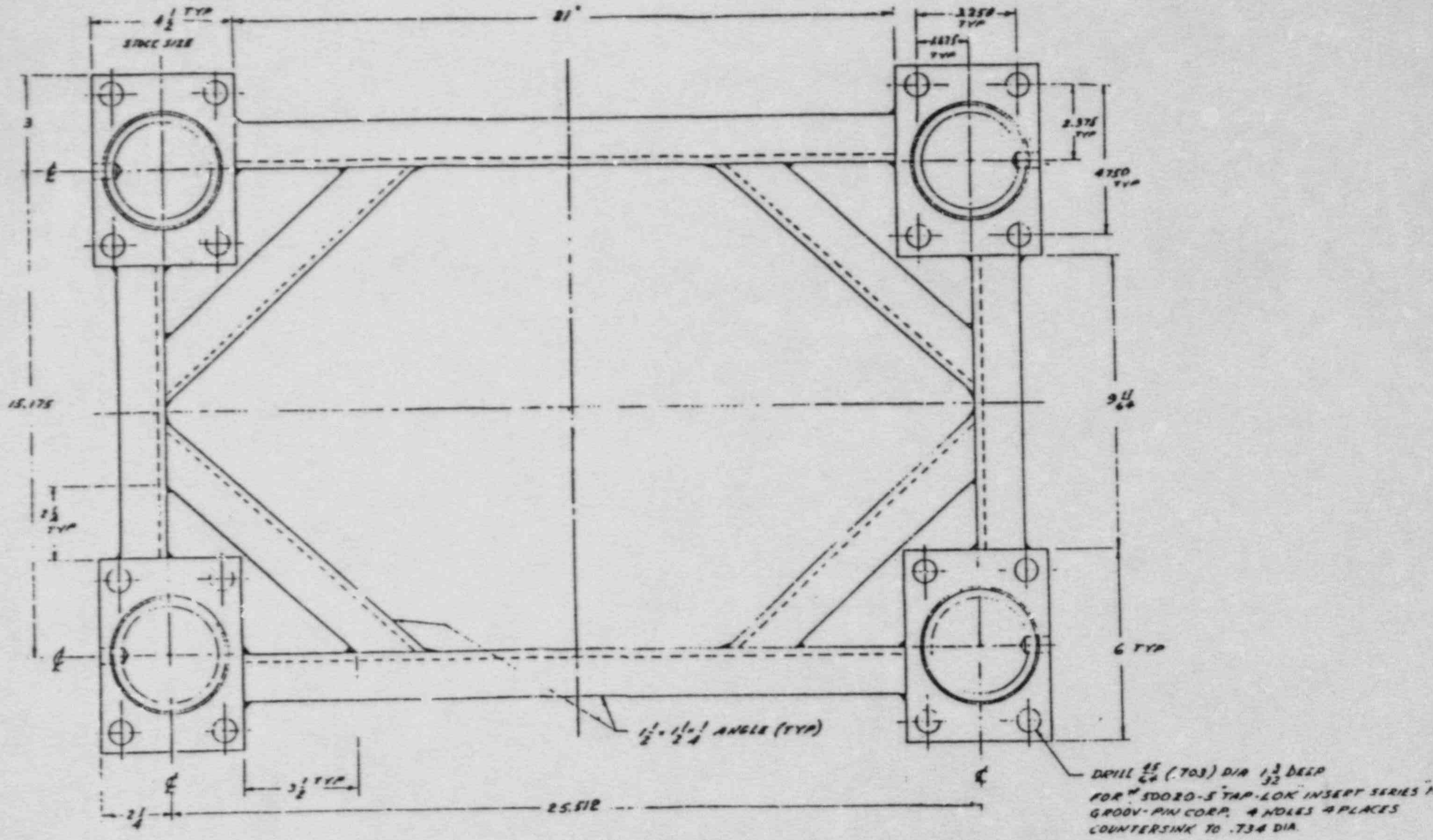

Figure 5-4, Grid Plate Stand (Plan View)

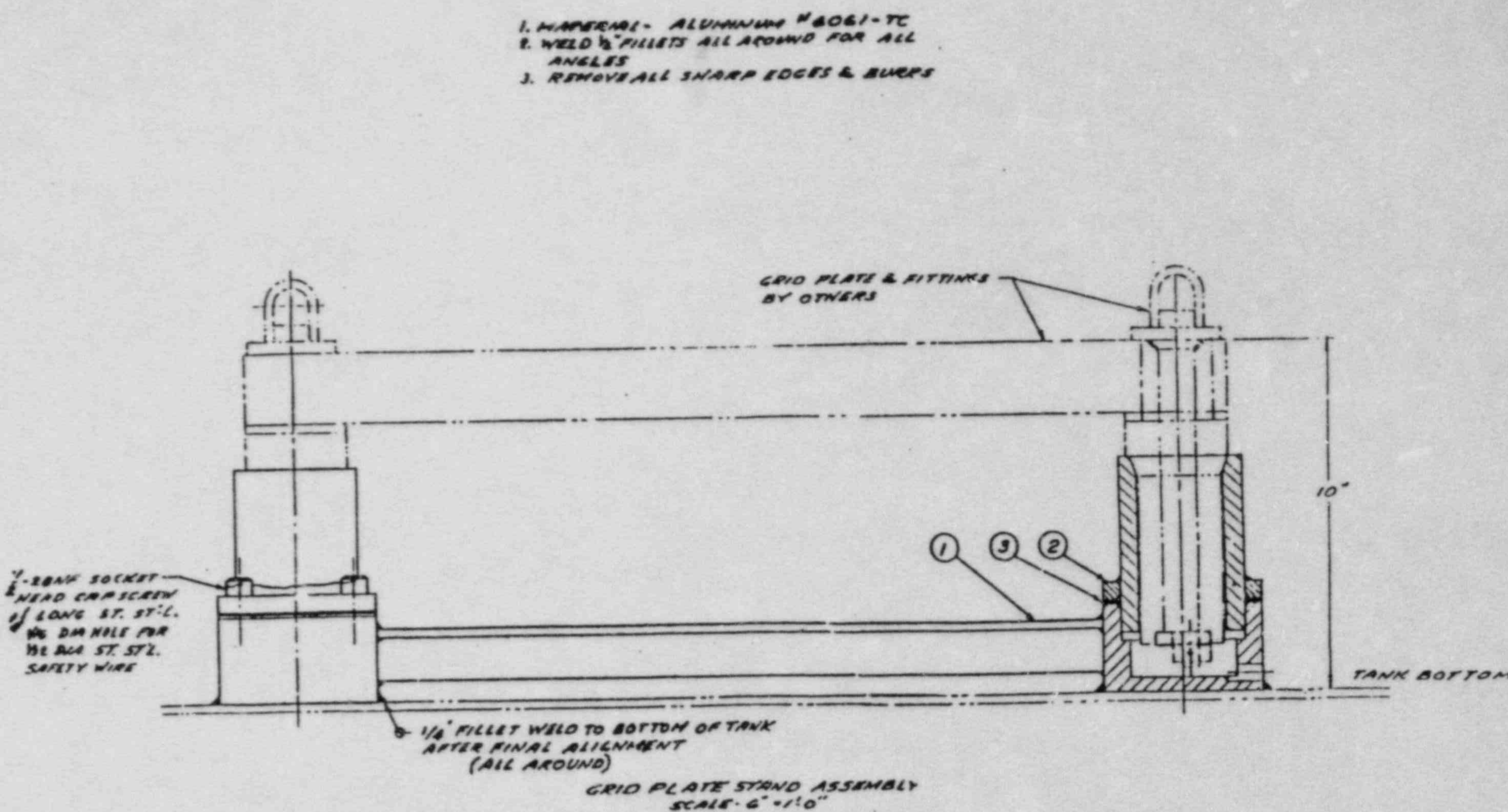

Figure 5-5, Grid Plate Stand (Section View)

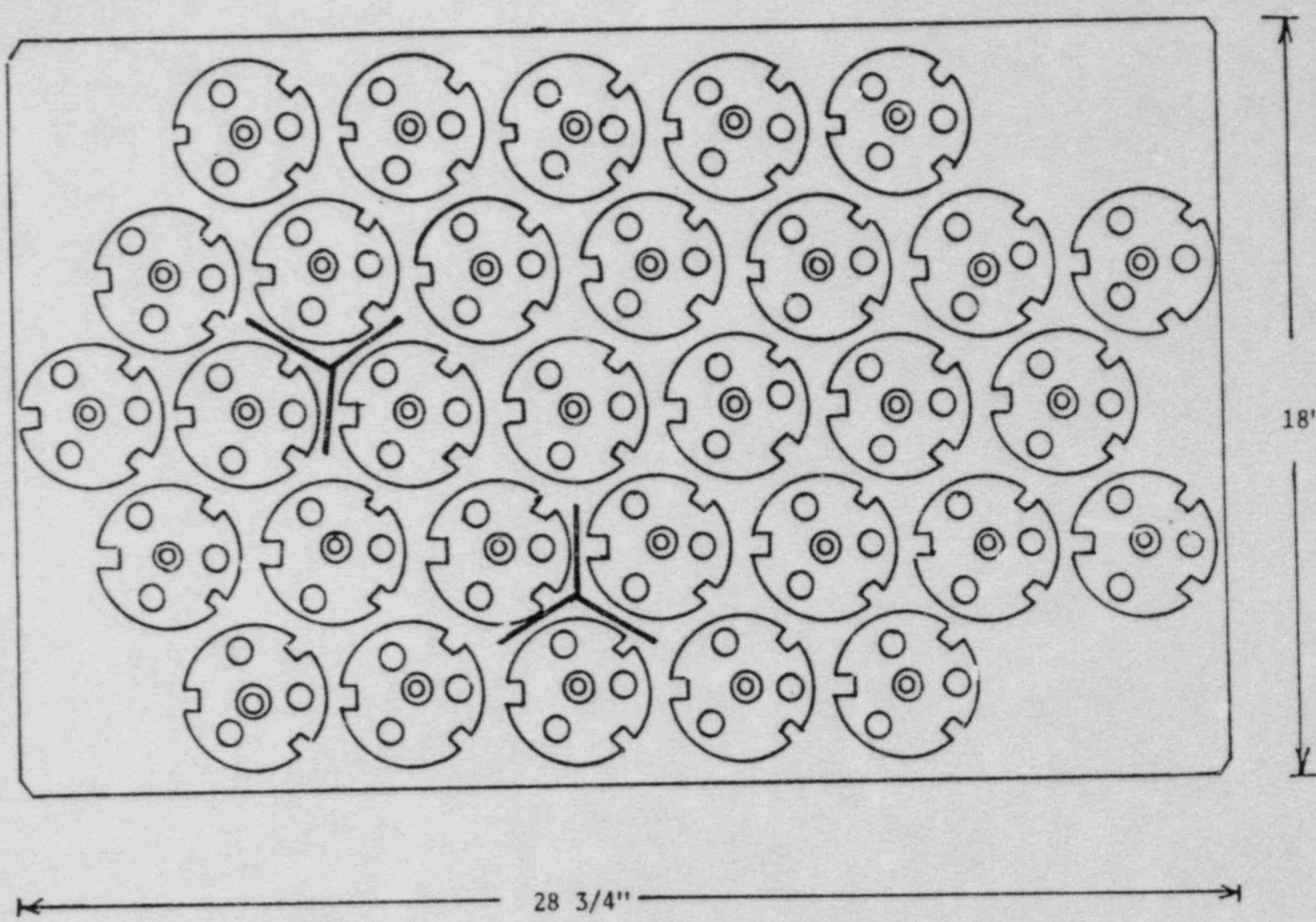

Figure 5-6, Grid Plate

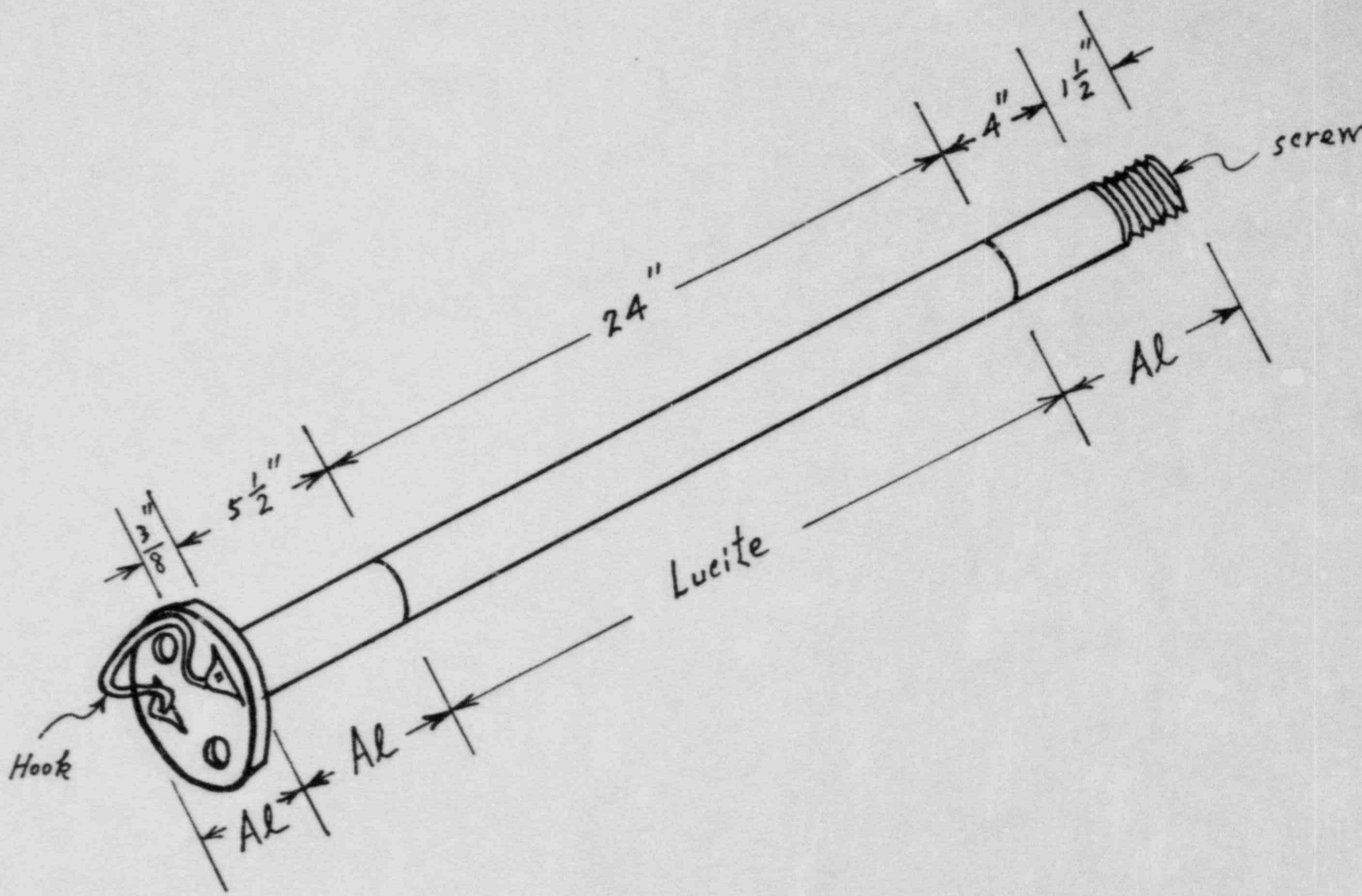

Figure 5-7, Lucite Holddown Rod

5.3.2 Reactor Fuel

The design of a fully loaded element is as shown on figure 5-8. The fuel portion of such elements consists of six concentric cylinders formed by mechanically joining and positioning eighteen curved fuel plates within grooves of 3 spacer webs. The fuel plates are mechanically held on the grooves by roll bonding: the bonding provides joint strengths of at least 200 pounds per linear inch. The fueled portion of the element is 24 inches long and is located within a 1/8 inch thick, 3.51 inch OD support cylinder which is 37 inches long. The support cylinder extends 6-1/2 inches beyond the fueled region on either end: this axial position is maintained by 3 plug welds joining the spacer webs and the support cylinder. Three lugs are provided on the inside of the support cylinder at each end. At one end, these lugs position the cylindrical fuel element in the slots in the "positioning lug" attached to the grid plate and at the other end are used to mate with a fuel handling tool. Partially loaded elements, except for the number of fuel plates, are designed in accordance with this paragraph.

The cylindrical fuel plate consists of 0.020 inch thick U-Al alloy of 92% enriched uranium, clad on both sides with 0.015 inches of aluminum making the total plate thickness 0.050 inches. The nominal U-235 content of each full fuel element is 200 grams. The inner diameter of the innermost cylinder is about 1.25 inches and the spacing between adjacent cylinders (water channel width) is 0.118 inches. A maximum of 15 fuel elements plus one partial fuel element, which may have some fuel plates missing, is used in the facility. The weight of a complete fuel element is 4.505 kg, and the weight of the partial fuel element is 2.527 kg.

In each full fuel element, the weight percent of U-235 is 4.45%, and in the partial fuel element, the weight percent of U-235 is 0.95%. These are percentages of the entire element including the uranium-aluminum alloy, the aluminum casing, and the aluminum cladding.

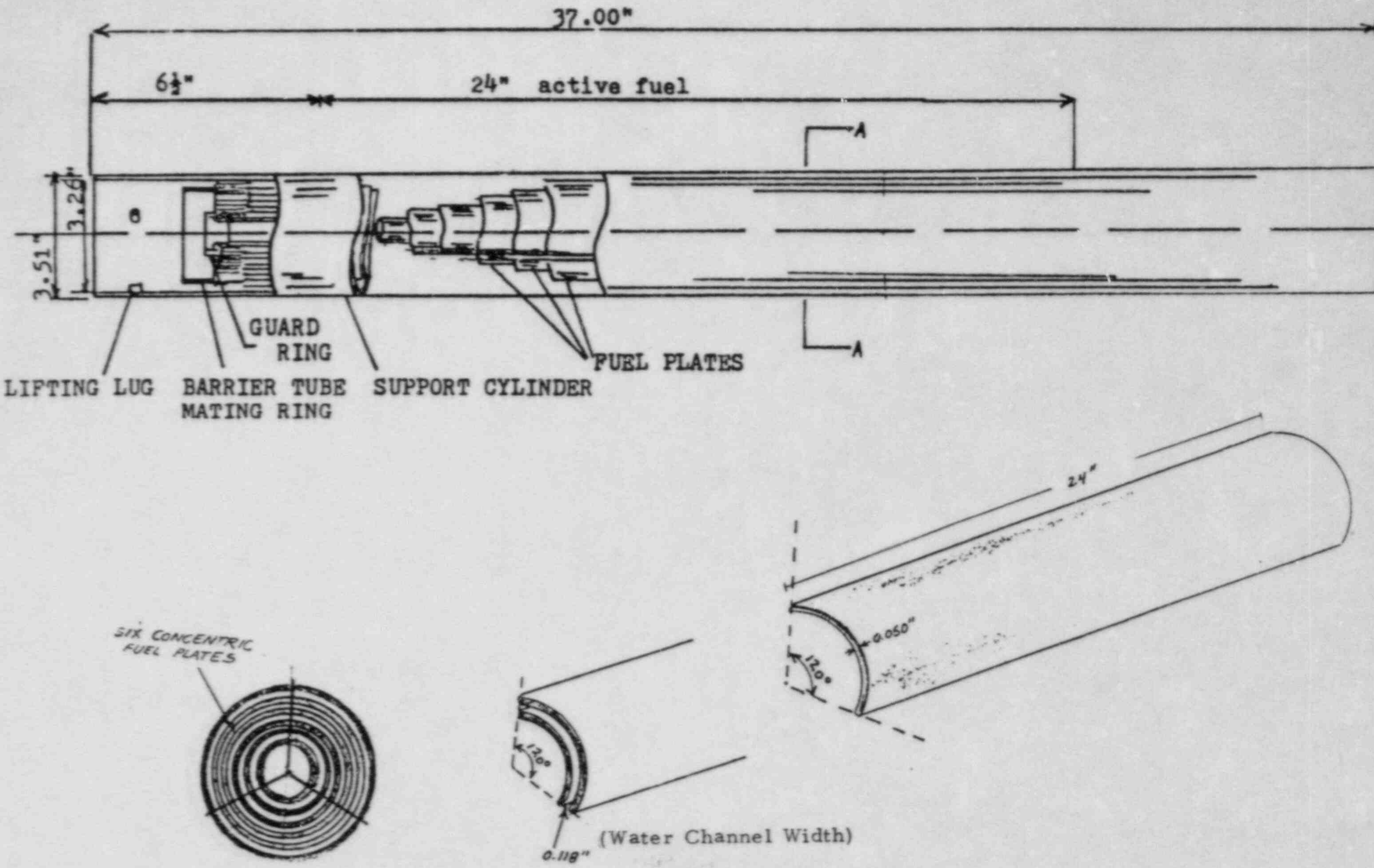

Figure 5-8, Fuel Element

5.3.3 Reactor Safety System

The critical assembly is controlled by two Y-shaped control blades which pass in the clearance between adjacent fuel elements. Construction details and dimensions are as shown in figure 5-9. One control rod (the shim rod) is constructed so that the blades are formed by sandwiching a 1/16 inch sheet of cadmium between 1/16 inch layers of stainless steel. The other control rod is an all stainless steel regulating rod. Either one of these control rods is capable of preventing the reactor from becoming critical.

Each control blade is guided by a guide assembly for the full length of the control rod stroke. These guide assemblies prevent any bearing of the control blades on the fuel elements. The guide assemblies, which are positioned on the grid by pins, also act as sway bracing for the guide tubes. Details of the guide assembly, the methods for positioning on the grid plate, and the method for connection to the guide tube are as shown in figure 5-10. The guide tube is bolted at the upper end to the control rod drive units.

Each control rod is attached to its associated drive mechanism by an electromagnet and falls by gravity to the least reactive position upon decrease of magnet current as a result of scram action. A system is provided to give indication at the control console that a control rod is in contact with the magnet.

A reactor platform is located over the reactor tank on the second floor of the ZPR laboratory. The platform is bolted to the concrete floor of this room. The neutron and gamma-ray detectors are suspended from this platform. The control rod drive mechanisms as shown in figure 5-10 are bolted to the structural members of the reactor platform.

The control rod drive system is designed in accordance with these specifications. Each control rod drive system is a cantilever drive with a design drive speed no greater than 12 inches per minute. Rod motion is controlled from the console by individual momentary contact toggle switches having an IN-OFF-OUT selection. Driving the control rods into the core by a reverse action as described in section 3.2.3 overrides any manual selection. Each drive also has position indication from the "full-in" to the "full-out" position.

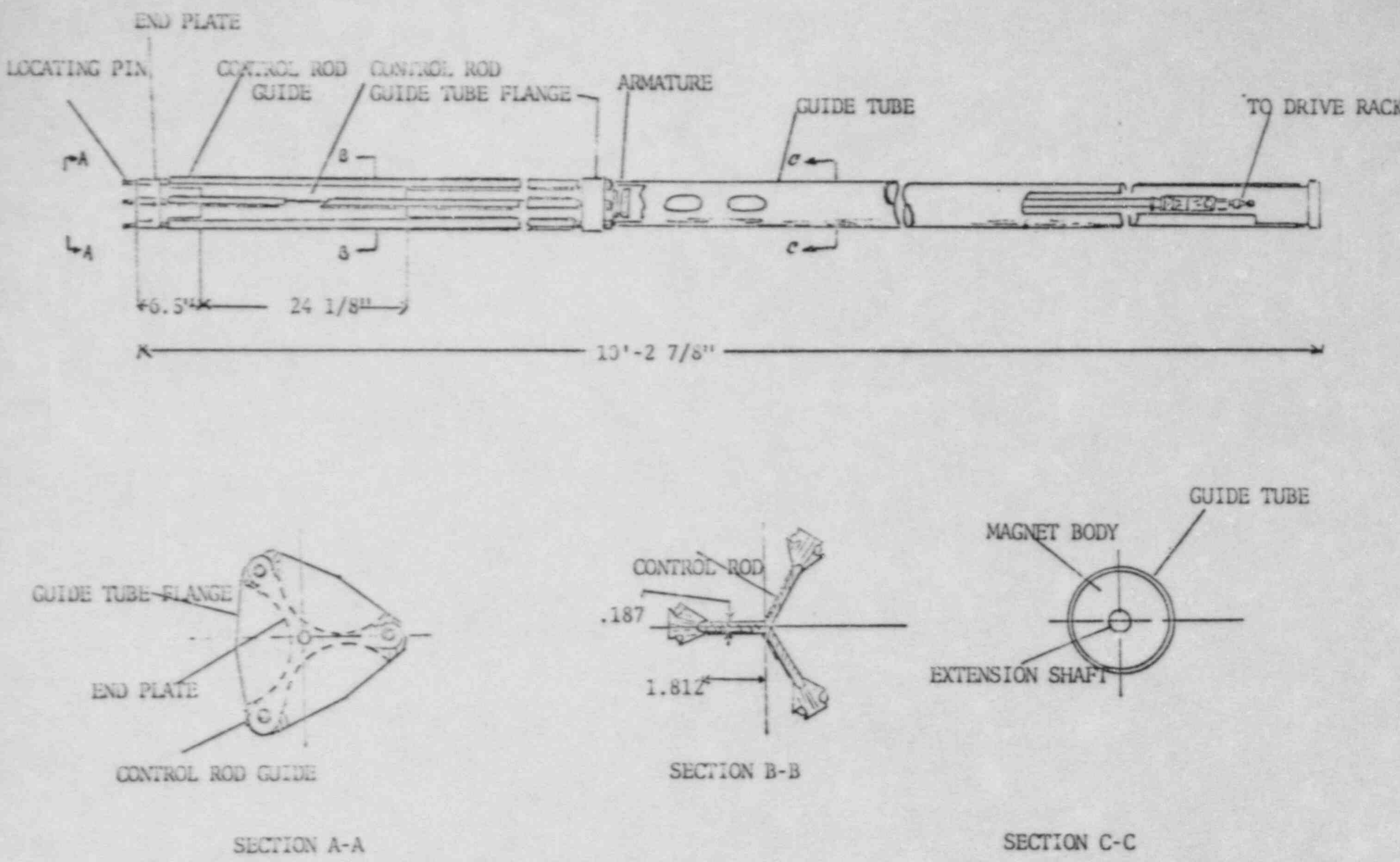

Figure 5-9, Control Rod Assembly

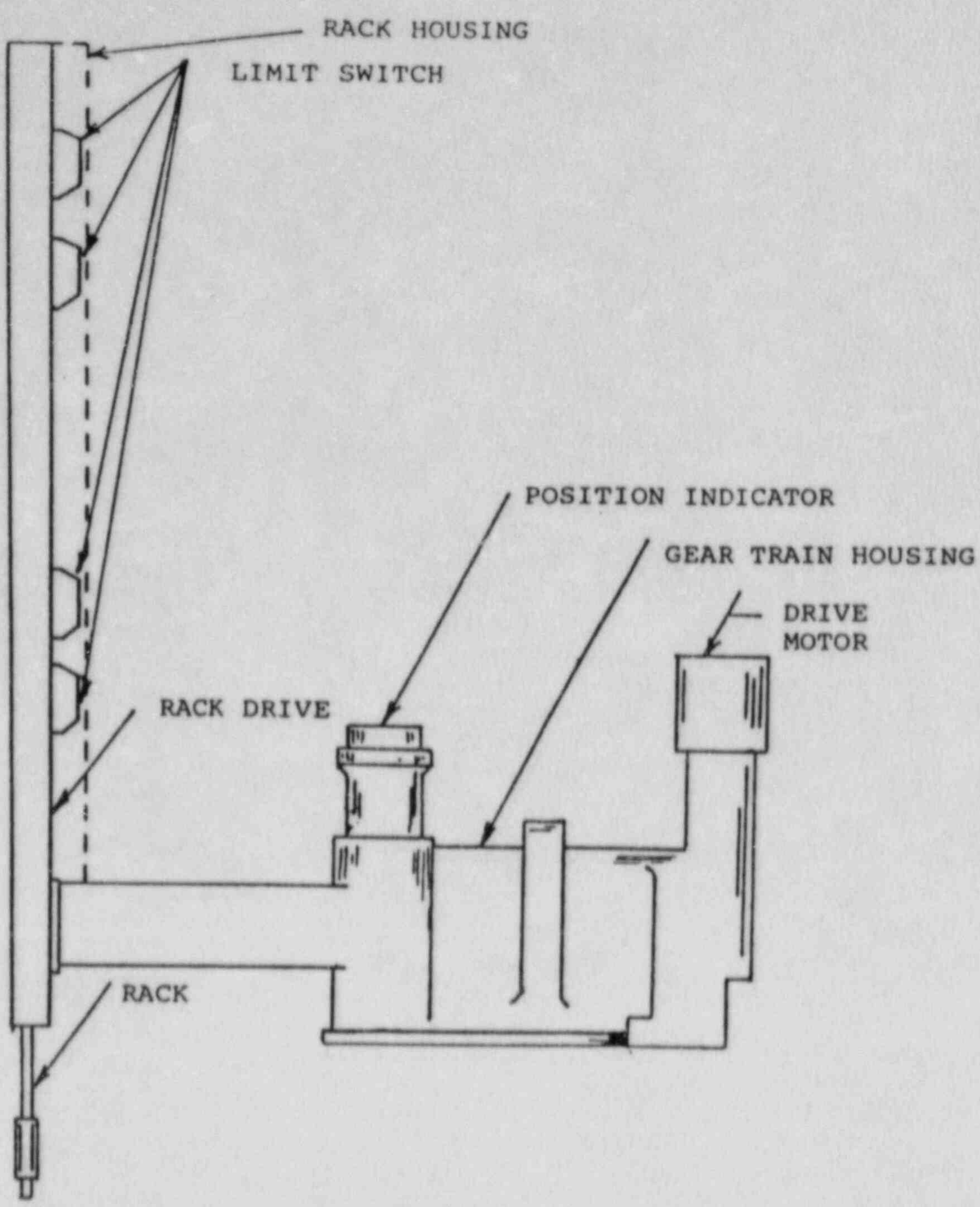

Figure 5-10. Rod Drive Mechanism

The position sensing element is a potentiometer located in each rod drive mechanism. Coarse position readout is provided on the control console in the form of two indicators reading from 0% (full-in) to 100% (full-out). The system indicates rod position with an accuracy of 2%. A fine position indication system is also provided to indicate rod position with an accuracy of 0.1%.

The control console for the reactor is located as shown on figure 5-1. The control console contains all the necessary switches, lights, and indicating instrumentation required to operate the reactor. Motion of the control rods out of the reactor is possible only by actuation of console control switches. A moderator demineralizer system is located on the first floor of the MCZPR laboratory. The system is a closed loop containing a pump and demineralizer. The flow rate through the demineralizer bed is valve controlled to be between 5 and 20 gallons/min/ft^2.

The startup source is a Pu-Be source encapsulated in tantalum. The minimum source strength is one (1) curie (approximately 10^6 neutrons per second).

5.4 Fissionable Material Storage

Fissionable Material Storage Fuel elements are permanently stored on the reactor grid plates with the exception that three fuel plates are permanently stored in a locked steel container fastened to the floor of the first floor of the MCZPR Laboratory.

6.0 ADMINISTRATIVE CONTROLS

6.1 Organization

6.1.1 Structure

The organization for the management of the reactor facility shall be structured as shown in figure 6.1. Levels of authority indicated divide responsibility as follows:

Level 1: Responsible for the facility license and site administration.

Level 2: Responsible for the reactor facility operation and management.

Level 3: Responsible for daily operations

The Reactor Operations Committee shall be appointed by the Reactor Administrator and shall be responsible to him for the review and evaluation of all proposed operations and procedures in order to insure that the reactor facility shall be operated in a safe and competent manner.

6.1.2 Responsibility

Individuals at the various management levels shown in Figure 6-1, in addition to having responsibility for the policies and operation of the 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 the Technical Specifications.

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

The detailed description of duties of each individual in Level 2 and Level 3 are as follows:

A. The Reactor Administrator will provide final policy decisions on all phases of reactor operation and on regulations for the facility as a whole. He will be advised in all matters concerning the safe operation of the reactor by the Reactor Operations Committee. The Reactor Administrator shall be responsible for the overall administration and supervision of the reactor

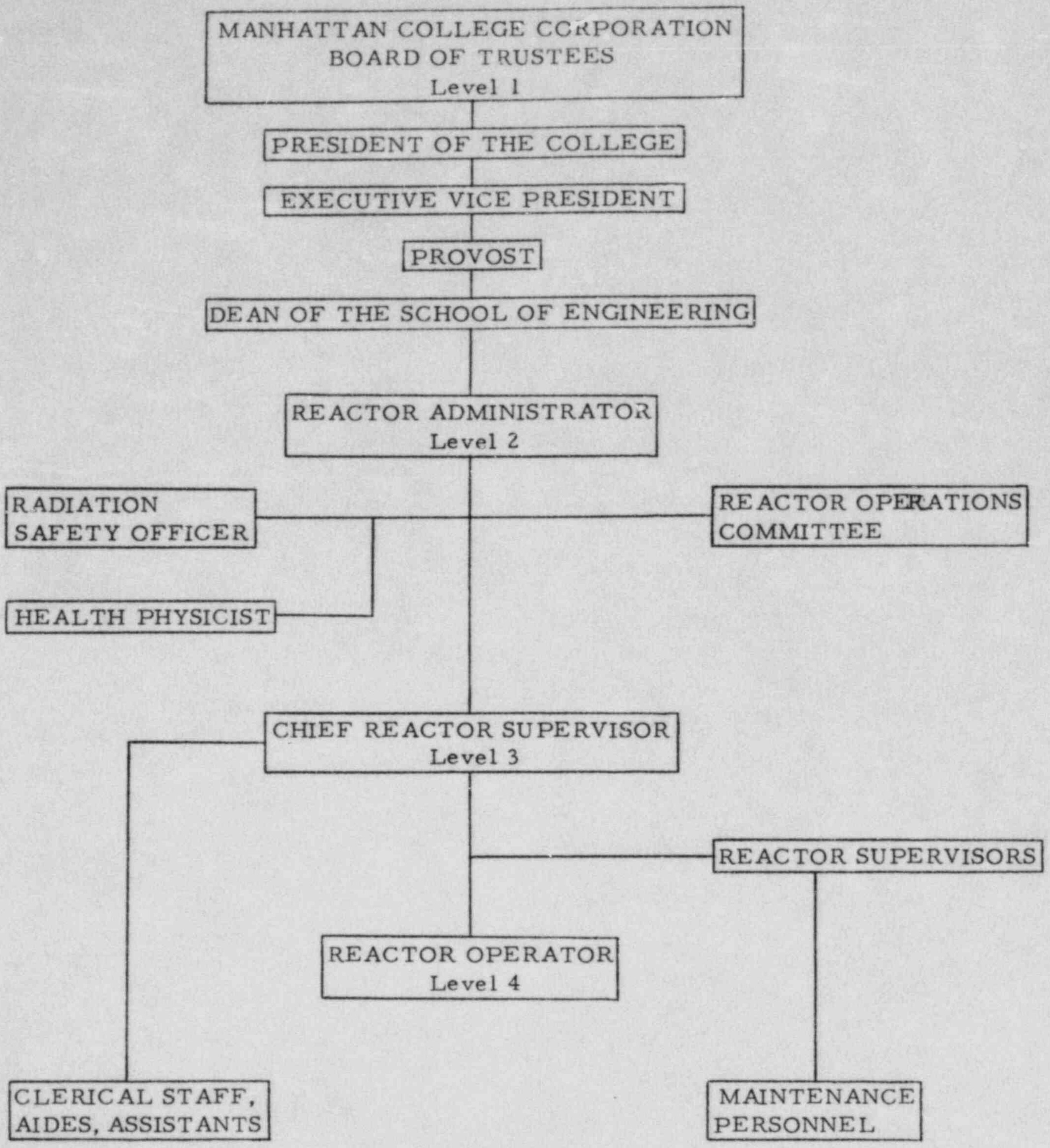

Figure 6-1, Table of Organization

facility. He shall appoint qualified members to the Reactor Operations Committee from time to time as necessary. He shall designate Reactor Supervisors, name the Chief Reactor Supervisor, and appoint the Radiation Safety Officer. The Reactor Administrator shall approve and promulgate all regulations, instructions, and procedures governing the operation of the reactor facility. The Reactor Administrator shall be appointed by the Provost of Manhattan College.

B. The Reactor Operations Committee shall be responsible to the Reactor Administrator for the review and evaluation of all proposed operations and procedures in order to insure that the reactor facility shall be operated in a safe and competent manner. Particular emphasis shall be placed on the examination of new and untried operations and procedures, and the Committee shall take action on proposed new experiments. The Committee shall review and evaluate all proposed changes in the reactor system. The Reactor Operations Committee shall advise on and be available for advice and assistance on any problems relative to the safe operation of the reactor facility.

C. The Radiation Safety Officer shall be responsible for the promulgation and enforcement of rules, regulations and operating procedures which conform with the regulations set forth in 10 CFR, Part 20. The Radiation Safety Officer in conjunction with the Reactor Operations Committee shall approve suggested procedures for the purchase, possession, storage, use ,and disposition of all radioisotopes, consistent with general or specific licenses for use of by-product material issued to Manhattan College. The Radiation Safety Officer in conjunction with the Reactor Operations Committee, shall be available for advice and assistance on problems involving radiological safety arising from the operation of the reactor facility. The Reactor Operations Committee shall evaluate and approve all proposed procedures leading to the production of radioisotopes with a half life longer than one (1) hour. All operations leading to the production of more than one (1) millicurie of radioactivity, with any half life, must receive prior approval of the Reactor Operations Committee.

D. The Health Physicist shall be responsible for monitoring records of exposure on film badges, maintenance of a log on radiation tests and exposure records. He also shall review the reactor log. Periodic radiation surveys of the critical reactor laboratory, the subcritical laboratory and the counting room, and other areas where radioactive materials are being used, shall be made by the Health Physicist under the direction of the Chief Reactor Supervisor. The Radiation Safety Officer shall be notified if an abnormal radiation problem is encountered. Results of these surveys shall be recorded or filed in the log. The Health Physicist shall also be responsible for proper disposal of samples and radioactive materials. The Health Physicist shall be appointed by the Reactor Administrator after consultation with the Reactor Operations Committee.

E. The Reactor Supervisors shall be appointed by the Reactor Administrator. These individuals shall have general competence in reactor technology and associated fields. Each supervisor shall hold a Senior Operator's License issued by the Nuclear Regulatory Commission. The Reactor Supervisors shall be responsible to the Reactor Administrator, through the Chief Reactor Supervisor, for the preparation and submission of complete detailed proposed procedures, regulations and administrative rules to insure the maintenance, safe operation, proper and competent use, and security of the reactor equipment. Appointment as a Reactor Supervisor shall in all cases be accompanied by appointment to the Reactor Operations Committee.

The Reactor Supervisors shall be responsible for the preparation and submission of operating schedules of the reactor facility, and shall insure that all activities and experiments involving the facility conform to both local and Commission regulations. They shall establish in coordination with the Reactor Operations Committee, procedures for activities to be performed with the reactor. They shall establish procedures and be responsible for the keeping of adequate, complete and currently accurate records for the operation and maintenance of the facility.

A Reactor Supervisor shall be in charge of the facility and shall witness the startup and intentional shutdown procedures. In addition, he shall be responsible for prompt execution of emergency procedures.

F. The Chief Reactor Supervisor shall hold a valid Senior Operator's License issued by the Commission. He shall be responsible for the promulgation and enforcement of administrative rules, regulations and operating procedures. He shall inform the Reactor Operations Committee of any unusual operations proposed to be performed on the reactor, or any proposed changes in procedure. He shall not authorize the operation or proceed with the proposed changes until appropriate evaluation and approval has been made by the Reactor Operations Committee, and authorization given by the Reactor Administrator. The Chief Reactor Supervisor shall have the authority to authorize any activities or procedures which have received prior approval of the Reactor Operations Committee. He shall be directly responsible for enforcing operating procedures and insuring that the reactor facility is operating in a safe, competent and authorized manner at all times. In addition, he shall be directly responsible for the preparation, authentication and storage of all prescribed logs and operating records.

G. The Reactor Operators shall hold a valid Operator's License issued by the Commission. They must conform to the rules, instructions and procedures for the start-up, operation, and shut-down of the reactor facilities. They must also conform to the specifications of the Emergency Plan. Within the constraints of the administrative and supervisory controls outlined above, a reactor operator shall be in charge of the control console at all times that the reactor is operating The reactor operator shall be required to maintain complete and accurate records of all reactor operations in the operational logs.

H. All other personnel using the facility shall be instructed in the hazards involved, and given a copy of the laboratory regulations concerning use of radioactive material. All personnel working in the vicinity of the reactor shall wear film badges.

6.1.3 Staffing

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

   a. A licensed Reactor Operator in the control room.
   b. A licensed Senior Reactor Operator present in the Leo Engineering Building.
   c. A health physics - qualified individual contactable by phone.

2. Operating Personnel Requirements

a. The controls of the reactor shall be operated only (the reactor controls are to be regarded as operating if the "Reactor-On" switch is turned to "ON" and fuel is present in the core tank) with the specific authorization of a Reactor Supervisor. The Reactor Operator shall be responsible for obtaining the authorizing signature of a reactor supervisor at the top of the checkout sheet. The Reactor Supervisor signing the authorization is the supervisor "in charge".

b. Whenever the reactor controls are operated, a licensed Reactor Operator shall be present and in the immediate vicinity of the console. An up-to-date list of licensed reactor operators will be posted near the reactor console. A person is considered "present" if he is in the console room within view of the instruments on the console.

c. A Reactor Supervisor shall be present in the Leo Engineering Building at all times that the reactor controls are operated and shall be cognizant of the reactor operation at all times. If the supervisor in charge of the operation must leave the building, the reactor controls must either be turned off and locked or another supervisor must accept responsibility. The Reactor Operator shall be informed of such a transfer of authority. A list of Reactor Supervisors will be posted near the reactor console.

3. Personnel Requirements for Fuel and Experimental Loading

a. Any movement of fuel elements or of material into or out of the reactor core can be done only on specific written authorization of or in the presence of a Reactor Supervisor.

b. At least two persons, one a licensed Reactor Operator, shall be in the ZPR laboratory when any fuel elements or any experiment is moved in the reactor core. One person shall be at the reactor console.

c. Whenever the final fuel element necessary for attainment of criticality is transferred into the core, a Reactor Supervisor shall be present.

d. A Reactor Supervisor shall be present in the ZPR room during the loading of an experiment into the core for the first time, or its removal from the core. A Supervisor shall be present in the ZPR room or give his written authorization for repetitive insertions of an experiment.

6.1.4 Selection and Training of Personnel

The selection, training, and requalification of operators personnel shall meet or exceed the requirements of American National Standard for Selection and Training of Personnel for Research Reactors ANSI/ANS 15.4 - 1967, or its successor, and be in accordance with the Requalification Plan approved by the Nuclear Regulatory Commission.

6.2 Review and Audit

The Reactor Operations Committee shall perform the independent review and audit of the safety aspects of reactor facility operations.

6.2.1 Composition and Qualifications

The Reactor Operations Committee shall be composed of the Reactor Administrator and the Health Physicist, both ex officio, and at least three other members having expertise in reactor technology. Committee members shall be appointed by the Reactor Administrator.

6.2.2 Charter and Rules

1. The Reactor Operations Committee shall meet at least semiannually and more frequently as circumstances warrant, consistent with effective monitoring of facility activities. Written records of its meetings shall be kept.

2. The Reactor Operations Committee may appoint one or more qualified individuals to perform the audit function.

6.2.3 Review Function

The following items shall be reviewed:

1. Determination that proposed changes in equipment, systems, tests, experiments, or procedures do not involve an unreviewed safety question.

2. All new procedures and major revisions thereto having safety significance and 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 the Technical Specifications or the Operating License.

5. Audit reports.

6.2.4 The Audit Function

The Audit Function shall include selective (but comprehensive) examination of operating records, logs, and other documents. The following items shall be audited:

1. Facility operations for conformance to the Technical Specifications and applicable Operating License conditions, at least once a year.

2. The retraining and requalification program for the operating staff.

3. The results of action taken to correct those deficiencies that may occur in the reactor facility equipment, systems, structures, or methods of operation that affect reactor safety, at least once per calendar year.

4. The reactor facility - Emergency and Physical Security Plans and implementing procedure at least once every other calendar year.

6.3 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 Reactor Operations Committee and approved by the Reactor Administrator. The following activities, not already described in the Technical Specifications, may be included in a set of procedures.

1. Startup, operation, and shutdown of the reactor.
2. Fuel loading, unloading and movement within the reactor.
3. Routine maintenance of major components of systems that could have an effect on reactor safety.
4. Surveillance tests and calibrations required by the Technical Specifications or those that may have an effect on reactor safety.
5. Personnel radiation protection consistent with applicable regulations.
6. Administrative controls for operations and maintenance and for the conduct of irradiations and use of experiments that could affect reactor safety or core activity.
7. Implementation of the Emergency and Physical Security Plans.

6.4 Experimental Review and Approval

Approved laboratory exercises shall be carried out in accordance with established and approved procedure.

1. All new exercises shall be reviewed by the Reactor Operations Committee and approved by the Reactor Administrator prior to initiation.

2. Substantive changes to previously approved experiments shall be made only after they are reviewed by the Reactor Operations Committee and approved by the Reactor Administrator.

6.5 Required Actions

6.5.1 Action to be Taken in Case of Safety Limit Violation

1. The reactor shall be shut down and reactor operations shall not be resumed until authorized by the Nuclear Regulatory Commission (NRC).

2. The safety limit violation shall be promptly reported to the Reactor Administrator or a designated alternate.

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

4. A safety limit violation report shall be prepared. The report, and any follow-up report shall be reviewed by the Reactor Operations Committee and shall be submitted to the Nuclear Regulatory Commission when authorization is sought to resume operation of the reactor. 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.

6.5.2 Action to be Taken in the Event of an Occurrence of the Type Identified in 6.6.2-1.b and 6.6.2-1.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 Reactor Administrator or a designated alternate.

2. Occurrence shall be reported to the Reactor Administrator or a designated alternate and to the Nuclear Regulatory Commission.

3. Occurrence shall be reviewed by the Reactor Operations Committee at its next scheduled meeting.

6.6 Reports

6.6.1 Operating Reports

Internal reports are kept as minutes of the semiannual meetings of the Reactor Operations Committee.

Reports to the Nuclear Regulatory Commission (NRC) are made in response to reports made after inspection by NRC to the Reactor Administrator. Reports to the Nuclear Regulatory Commission may include:

1. A narrative summary of reactor operating experience.
2. A description of unscheduled shutdowns including where applicable, corrective action taken to preclude recurrence.
3. Tabulation of major preventive and corrective maintanance operations having safety significance.
4. Tabulation of major changes in the reactor facility and procedures, and tabulation of new tests or experiments, or both, that are significantly different from those performed previously and are not described in the Safety Analysis Report, including conclusions that no unreviewed safety questions were involved.
5. A summarized result of any radiation surveys performed by the facility personnel.
6. A summary of exposures received by facility personnel and visitors where such exposures are greater than 25 percent of that allowed or recommended.

6.6.2 Special Reports

1. There shall be a report not later than the following working day by telephone and confirmed in writing by telegraph or similar conveyance to Nuclear Regulatory Commission to be followed by a written report that describes the circumstances of the event within 14 days of any of the following:

   a. Violation of safety limits (see 6.5.1).

   b. Release of radioactivity from the site above allowed limits (see 6.5.2).

4) An unanticipated or uncontrolled change in reactivity greater than the licensed excess reactivity, or one dollar, whichever is smaller.

5) Abnormal and significant degradation in reactor fuel, or cladding, or both which could result in exceeding prescribed radiation exposure limits of personnel or environment, or both.

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

2. A written report within 30 days to the Nuclear Regulatory Commission concerning the following:

a. Permanent changes in the organization involving the Reactor Administrator, Chief Reactor Supervisor, or Radiation Safety Officer.

b. Significant changes in the transient or accident analysis as described in the Safety Analysis Report.

c. Any of the following (see 6.5.2):

1) Operation with actual safety system settings for required systems less conservative than the limiting safety system settings specified in the Technical Specifications.

2) Operation in violation of limiting conditions for operation established in the Technical Specifications unless prompt remedial action is taken.

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

6.7 Records

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

1. Normal reactor facility operation (but not including supporting documents such as checklists, log sheets, etc., which shall be maintained for a period of at least one year).
2. Principal maintenance operations.
3. Reportable occurrences.
4. Surveillance activities required by the Technical Specifications.
5. Reactor facility radiation and contamination surveys where required by applicable regulations.
6. Laboratory exercises performed with the reactor.
7. Fuel inventories, receipts, and shipments.
8. Approved changes in operating procedures.
9. Records of meetings and audit reports of the Reactor Operations Committee.

6.7.2 Records to be Retained for at Least One Training Cycle

Retraining and requalification of licensed operators: Records of the most recent complete cycle shall be maintained at all times the individual is employed.

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

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

1. Gaseous and liquid radioactive effluents, if any, released to the environs.
2. On-site environmental monitoring surveys required by the Technical Specifications.
3. Radiation exposure for all personnel monitored.
4. Drawings of the reactor facility.