

**ATTACHMENT TO LICENSE AMENDMENT NO. 5**

**FACILITY OPERATING LICENSE NO. R-93**

**DOCKET NO. 50-185**

**Revised Appendix A Technical Specifications in their entirety.**

**APPENDIX A**  
**TECHNICAL SPECIFICATIONS**  
**FOR THE**  
**MOCK-UP-REACTOR (MUR)**  
**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**  
**DOCKET NO. 50-185**  
**LICENSE NO. R-93**

**January 1997**

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## 1. Introduction

### 1.1 Scope

These Technical Specifications apply to portions of the facility which contain a nonoperable research reactor, its support facilities, and its inventory of radioactive material generated as a result of previous operations. The Mock-Up Reactor (MUR) was shut down in 1973 after approximately 200 kilowatt-days of operation. The MUR contains no fuel and no special nuclear material. Therefore, these Technical Specifications apply only to systems, components, or areas which are radioactive, contaminated, or are needed to maintain a protected safe storage condition.

### 1.2 Definitions

#### 1.2.1 General

Authorized Entry - Entry by people authorized by management with a legitimate need to enter the PBRF who have knowledge of the conditions, the hazards, and procedures of the facility or who are accompanied by someone with this knowledge.

Kept Dry - The condition of an area which is normally dry, or drained and mopped dry as soon as practical when becoming inadvertently wet.

Nonoperable - The condition of a component or system which has been intentionally disabled to prevent it from performing its intended function.

Protected Safe Storage - The custodial state of undefined duration characterized by physical and procedural access control and periodic monitoring, maintenance and inspection.

Shall - The word "shall" is used to denote a requirement.

Surveillance Frequency - Unless otherwise stated in these specifications, periodic surveillance tests, checks, calibrations, and examinations shall be performed within the specified surveillance intervals. In cases where the elapsed interval has exceeded 100% of the specified interval, the next surveillance interval shall commence at the end of the original specified interval. Allowable surveillance intervals, as defined in ANSI/ANS 15.1 (1982) shall not exceed the following:

1. Annual (interval not to exceed 15 months)
2. Semiannual (interval not to exceed seven and one-half months).
3. Quarterly (interval not to exceed four months)
4. Monthly (interval not to exceed six weeks)

#### 1.2.2 Radioactive Materials

Contaminated Materials - Irradiated or non-irradiated items containing particles of radioactive materials on their surfaces.

Radioactive Material - Items which have been activated as a result of previous reactor operations. These items may also be contaminated.

#### 1.2.3 Radiological Control Zones

Magenta Zone - For purposes of contamination control, levels will be as low as reasonably achievable but can exceed the magenta-yellow limit. For purposes of direct radiation control, a magenta zone is any area which could expose major portions of the body to direct radiation levels of 100 mrem/hr or more.

Magenta-Yellow Zone - For purposes of contamination control, levels will not exceed 100 dpm alpha/100 cm<sup>2</sup> and 10,000 dpm beta-gamma/100 cm<sup>2</sup> transferable; 2,500 dpm alpha/100 cm<sup>2</sup> and 8,000 dpm beta-gamma fixed. The magenta-yellow zone, for

purposes of direct radiation control, is any area which could expose major portions of the body to direct radiation levels from 2.5 to less than 100 mrem/hr.

White Zone - Is an area with contamination levels below 20 dpm alpha/100 cm<sup>2</sup> and 1,000 dpm beta-gamma/100 cm<sup>2</sup> transferable; 500 dpm alpha and 1,500 depm beta-gamma fixed. In this area, direct radiation levels to major portions of the body shall be less than 2.5 mrem/hr and no protective clothing is required.

## 2. Requirements

### 2.1 Access

Applicability - This specification applies to location and protection of the facility.

Objective - The objective is to prevent unauthorized entry and provide protected safe storage.

#### Specification:

- a. The Plum Brook Reactor Facility (PBRF) access shall be controlled through two fences. The outer fence surrounds the Plum Brook Station (PBS). An inner fence surrounds the PBRF within the Station.
- b. The MUR shall be located in Canal H (a reinforced concrete pool 21 x 21 x 25 feet deep). Canal H is located outside the containment vessel for the Plum Brook Test Reactor in the southeast corner of the Reactor Building.

#### Bases:

Specification 2.1.a. provides two physical barriers of security before gaining access to the locked buildings of the PBRF. The MUR is located inside the locked Reactor Building. Specification 2.1.b provides a protected safe storage area.

## 2. Canal H

Applicability - The specification applies to protected safe storage for the Mock-Up Reactor located in Canal H.

Objective - The objective is to provide conditions for protected safe storage of the MUR.

### Specification:

- a. Canal H shall be cleaned, drained, and kept dry. The Canal H drain shall be covered and the drain valve locked shut.
- b. The Canal H re-circulation system shall be cleaned, drained, and valves shall be locked shut.
- c. The deionized water service supply to Canal H shall be isolated and valves locked shut.
- d. MUR components may be stored in the fuel storage basket, which shall be locked.

### Bases:

Specification 2.2.a. provides a clean, dry canal for the MUR.

Specification 2.2.b and c. prevent the entry of process water.

Specification 2.2.d. provides additional locked storage.

## 2.3 Control Areas

Applicability - This specification applies to protected safe storage for the MUR.

Objective - The objective is to prevent unauthorized entry to the MUR.

### Specification:

Personnel access to both the MUR Control Room and Canal H shall be controlled by fence and locked doors to prevent unauthorized entry.

Bases:

This specification controls access to the MUR.

2.4 Designated Storage Area for the MUR

Applicability - This specification applies to the radioactive material storage at the MUR

Objective - The objective is to identify the area for radiological control.

Specification:

Radioactive material associated with the MUR shall be stored in the bottom of Canal H. Canal H shall be properly posted.

Bases:

These specifications define the MUR radioactive material storage area and controls.

2.5 Access to Radiological Control Zones

Applicability - This specification applies to the radiological control zone at the MUR.

Objective - This objective is to provide access controls for this zone.

Specification:

Access to magenta-yellow zones shall require health physics monitoring and control and use of personnel dosimetry.

Bases:

This specification defines the requirement.

2.6 Procedures

Applicability - This specification applies to procedures that help administer the protective safe storage condition..

Objective - The objective is to list the important procedures



Specification:

Detailed procedures shall be in effective covering the following areas:

- a. Entrance to Canal H area
- b. Canal H area radiological monitoring
- c. Emergencies such as fire, floods, and tornadoes
- d. Facility Changes

These procedures shall be approved by the PBRF Safety Committee.

Bases:

This specification ensures that protected safe storage procedures are provided.

2.7 Inspection and Surveys

Applicability - This specification applies to selected inspections, and surveys used to preserve a protected safe storage condition.

Objective - The objective is to provide a minimum inspection and survey program for the continued protected safe storage.

Specification:

The following inspections and surveys shall be performed:

	<u>Frequency</u>
a. PBS Fence Integrity Inspection	Quarterly
b. PBRF Fence Integrity Inspection	Monthly
c. Reactor Building Locks Inspection	Monthly
d. Canal H Area General Condition Inspection	Monthly
e. Canal H Area Radiological Survey	Quarterly

The PBRF Engineer shall review the results of the inspections and surveys and assure necessary corrective actions are taken to preserve the protected safe storage condition.

Bases:

This specification ensures that protected safe storage inspections and surveys are provided.

3. Administrative Controls

3.1 Organization

The MUR is owned by the National Aeronautics and Space Administration (NASA), which shall be responsible for maintaining the protected safe storage condition as required by these Technical Specifications. NASA shall provide whatever resources are required to maintain the MUR in a condition that poses no hazard to the general public or to the environment. Figure 1 charts the generic organization.

3.1.1 Level 1 Directorate

The Directorate Head shall be responsible for assuring compliance with the reactor facility's license and providing regulatory reports and correspondence. He or she shall have overall responsibility for the protected safe storage of the MUR.

This Directorate shall provide the resources to maintain the MUR in protected safe storage.

3.1.2 Internal Audit

The annual internal audit shall be performed at the PBRF and will include the MUR. The audit shall be performed by an audit committee. Special attention shall be given to compliance with procedures, the NRC licenses, regulations, and record keeping. The auditor shall submit a report on each audit for the Executive Safety Board. Reported discrepancies shall be resolved by the

PBRF Engineer. The PBRF Safety Committee shall review and insure the proper disposition of each discrepancy.

#### 3.1.3 Radiation Safety Officer (RSO)

The RSO shall organize, administer, and direct the radiological control and monitoring program, as required by these Technical Specifications. The RSO shall assure the program is adequately performed. The RSO shall be responsible for providing on-site advice, technical assistance and review in all areas related to radiological safety. The RSO shall be a person specifically trained in the radiation health sciences and appropriately experienced in applying this knowledge to the management of the radiation protection program. The RSO shall have a bachelor's degree in physical science or biological science, or the equivalent, with a minimum of two years of applied health physics experience in a program with radiation safety considerations similar to those associated with the PBRF/MUR program.

#### 3.1.4 Executive Safety Board (ESB)

The ESB serves as a Lewis Research Center (LeRC) safety policy and decision making board, and is responsible to the Center Director for the overall direction of the Lewis Safety Program. The ESB establishes a system of safety committees to conduct detailed third party reviews of specified Center operation.

#### 3.1.5 PBRF Safety Committee (PSC)

The PSC was chartered by the ESB to conduct safety reviews of all matters with safety implications relative to maintaining protected safe storage of the Plum Brook Reactor Facility and the MUR. The purpose of the reviews is to assure that operations, written procedures and future plans comply with NRC licenses

and regulations, do not involve un-reviewed safety questions, and provide protection to the workers, the facility, and the environment. A prime consideration in the PSC activities is to ensure that all public and employee radiation exposures are maintained as low as reasonably achievable. Items of review shall include routine operation, proposed changes, new and revised procedures, facility changes in Technical Specifications, and audit reports.

The PSC shall consist of a minimum of four persons and shall meet at least twice each year. The PSC shall have at least one member with nuclear background and one other member familiar with the conditions of the facility. In addition, the Radiation Safety Officer shall also be a member. A quorum of the PSC shall be two-thirds of the members, but no less than three members, whichever is greater. In specific instances, the PSC may designate the Chair to act in its stead, and the Chair will report his or her actions to the committee at its next regular meeting. Meeting minutes will be distributed to all members and be retained on file.

#### 3.1.6 Plum Brook Station Management Office (PBMO)

The Chief, PBMO, shall be knowledgeable of the Station activities that may affect the protected safe storage condition at the MUR. The Chief, PBMO, is responsible for administering a program to ensure that proper operation, control, and safeguards are maintained for the Station. This includes a key control system. Keys for the MUR are authorized by the Chief, PBMO, on a "need-to-have" basis to persons having knowledge of the conditions, the hazards and procedures of the MUR. Implementation is by authorization letter issued to the key

distributor. PBMO shall provide for the services of Plant Security, Inspection, Health Physics, and Maintenance as necessary at the MUR.

#### 3.1.7 PBRF Engineer (Reactor Manager)

The PBRF Engineer shall be appointed to manage and assure the protected safe storage condition is maintained in accordance with these Technical Specifications. The PBRF Engineer shall have the following qualifications:

- a. A bachelor's degree in engineering or a related physical science.
- b. Be knowledgeable in radiation hazards and radiation protection.
- c. Have successfully completed the training class for familiarization with the duties of the Reactor Manager.

The PBRF Engineer shall assure protected safe storage conditions are maintained and necessary inspections are performed with records to support the inspection. He or she shall train and/or qualify personnel to maintain protected safe storage conditions. He or she shall review maintenance procedures and results to assure buildings and grounds remain in an acceptable quality condition. The PBRF Engineer shall assure unusual occurrence reports, facility changes, and new or revised procedures are prepared, approved, and issued. He or she shall approve all PBRF and MUR facility changes, and new or revised procedures. He or she shall approve all major material or equipment transfer in and out of the PBRF. The PBRF Engineer shall prepare license change requests for submission to the NRC.

### 3.2. Procedures

All new or revised procedures will be reviewed by the PBRF Safety Committee and approved by signature of the PBRF Engineer and the Chairman of the PSC.

### 3.3. Reports

Reports required under license and applicable regulations shall be provided. In addition, the MUR shall be included in the annual report of the PBRF.

### 3.4. Records

NASA shall keep records required by applicable licenses and regulations including the following:

- a. Records of radiation levels in the Canal H areas.
- b. Equipment maintenance records (EMRs) of non-routine maintenance operations involving substitution or replacement of vital components.
- c. The end condition statements and the procedures used to place the facility in the shutdown condition. These procedures shall reflect the condition of the facility in the Possession-Only status.
- d. Up-to-date facility drawings.

## 4. References

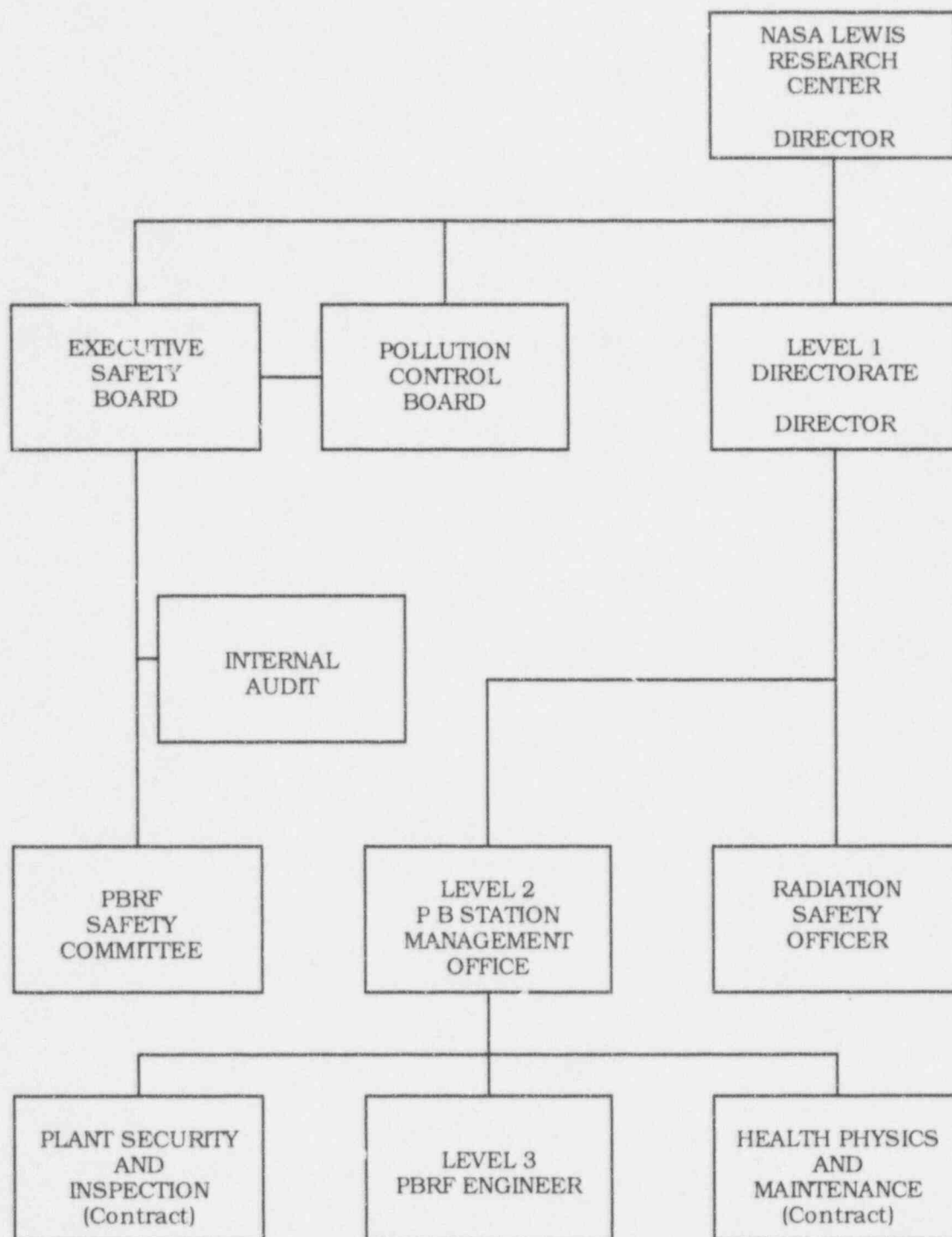
- (1) Code of Federal Regulations, Title 10, "ENERGY", Government Printing Office, Washington, D. C.
- (2) "American National Standard for the Development of Technical Specifications for Research Reactors," ANSI/ANS 15.1-1982 American Nuclear Society, LaGrange Park, Illinois.

## Attachments

- Figure 1      Generic Organization Chart
- Figure 2      Plot Plan of Plum Brook Reactor Facility
- Figure 3      Reactor Building and Hot Laboratory
- Figure 4      Verticle Section of MUR Facility



## GENERIC ORGANIZATION CHART



### RESPONSIBILITIES:

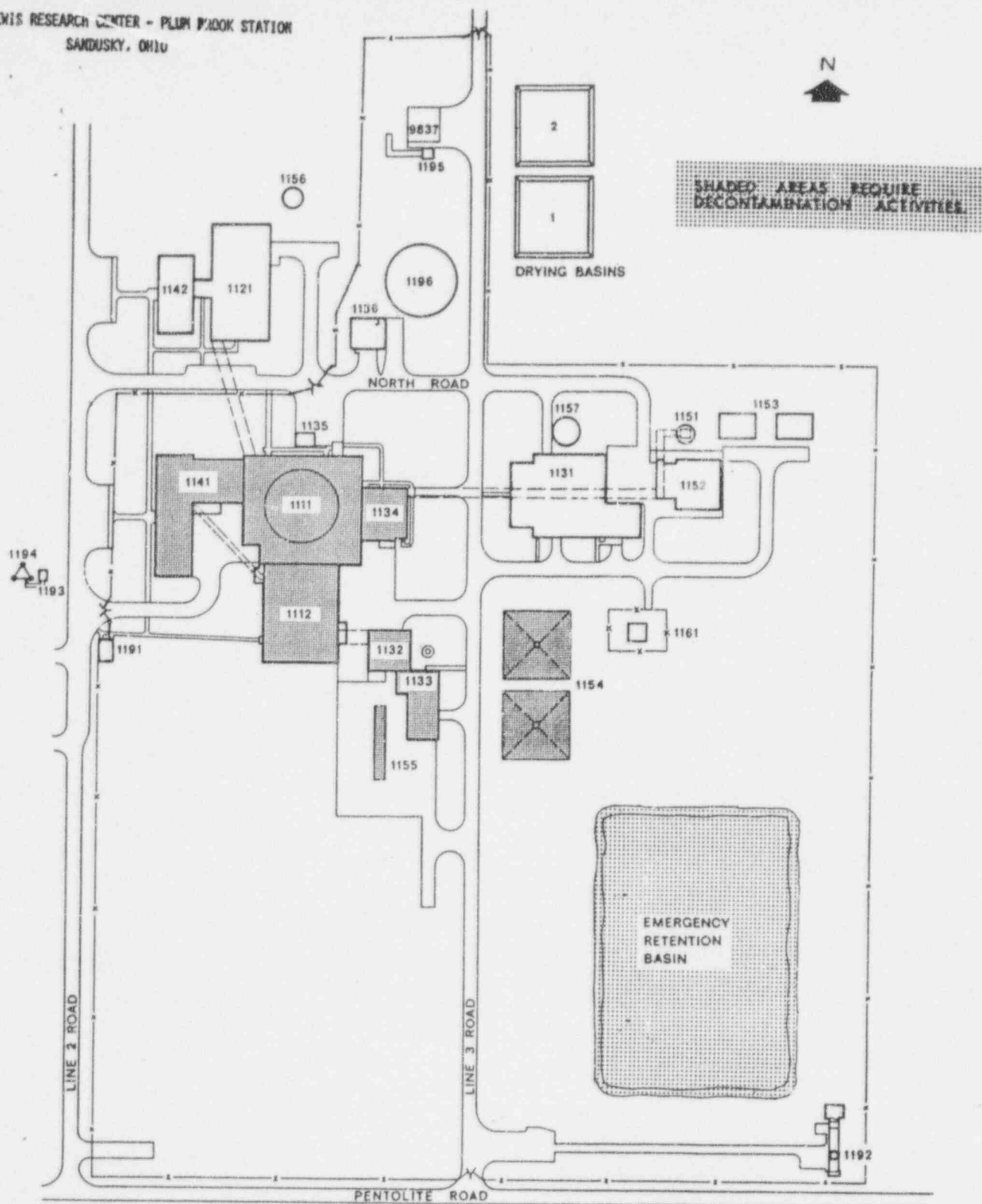
**LEVEL 1 - Compliance**

**LEVEL 2 - Surveillance and Maintenance**

**LEVEL 3 - Day-to-Day Oversight**

**FIGURE 1**





1111	REACTOR BUILDING	1154	REACTOR COLD RETENTION BASINS
1112	REACTOR HOT LABORATORY	1155	REACTOR HOT RETENTION BASINS
1121	REACTOR ASSEMBLY TEST AND STORAGE BUILDING	1156	REACTOR ATs WATER STORAGE TANK (200K GAL)
1131	REACTOR SERVICE EQUIPMENT BUILDING	1157	REACTOR PRECIPITATOR
1132	REACTOR FAN HOUSE	1161	REACTOR SUBSTATION (E)
1133	REACTOR WASTE HANDLING BUILDING	1191	REACTOR SECURITY BUILDING
1134	REACTOR PRIMARY PUMP HOUSE	1192	REACTOR EFFLUENT METERING STATION
1135	REACTOR GAS SERVICES BUILDING	1193	REACTOR RADAR AND WEATHER TOWER HOUSE
1136	REACTOR COMPRESSOR BUILDING	1194	REACTOR RADAR AND WEATHER TOWER
1141	REACTOR OFFICE AND LABORATORY	1195	REACTOR CRYOGENIC AND GAS SUPPLY SYSTEM
1142	REACTOR OFFICE BUILDING	1196	REACTOR GAS STORAGE STRUCTURE
1151	REACTOR WATER TOWER (F)	9837	GHE FARM AT REACTOR
1152	REACTOR COOLING TOWER		
1153	REACTOR SLUDGE BASINS		

FIGURE 2 - Plot Plan of Plum Brook Reactor Facility

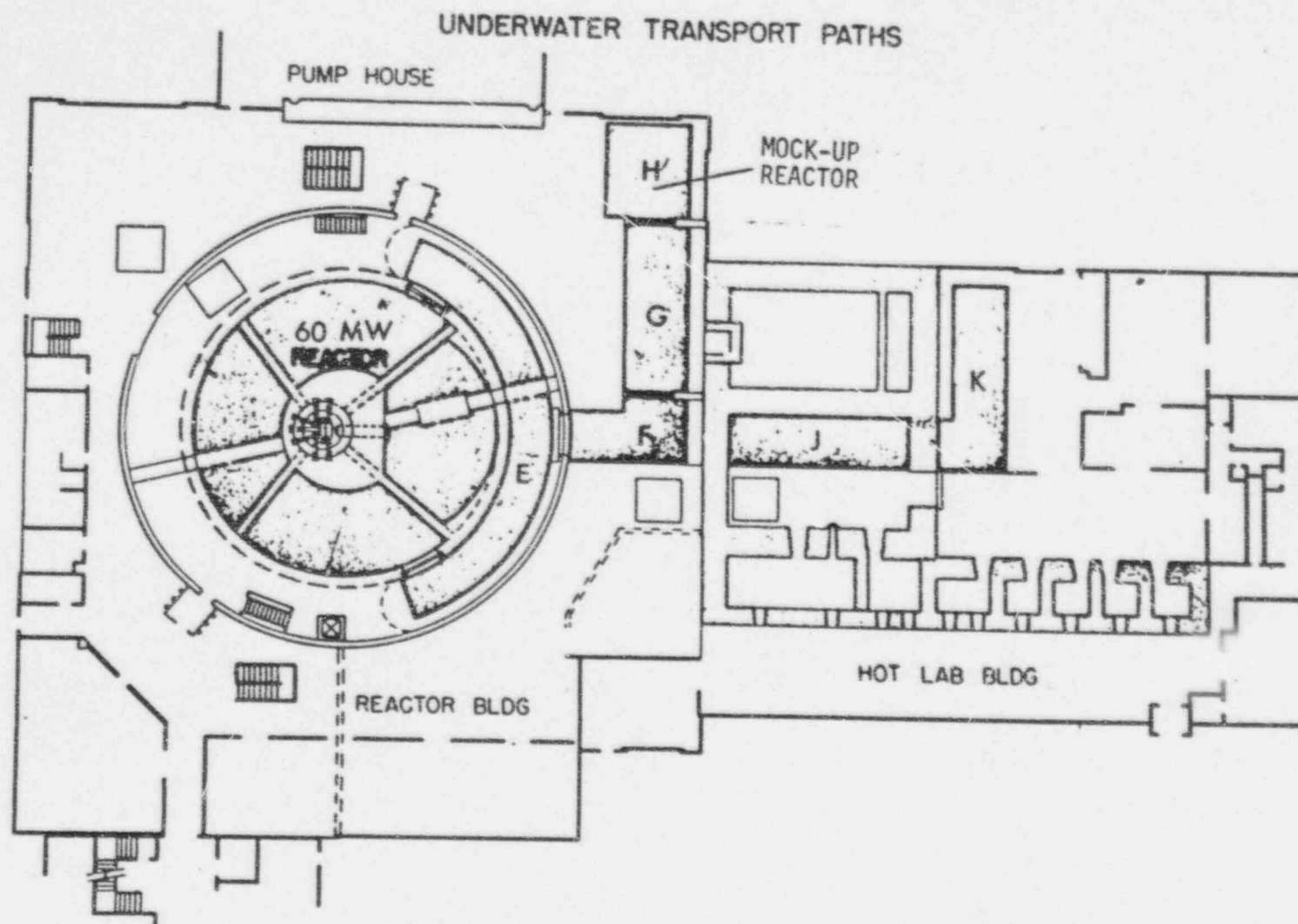


FIGURE 3 - Reactor Building and Hot Laboratory



**BASES AND SAFETY ANALYSES  
FOR  
PLUM BROOK MOCK-UP REACTOR  
PROTECTED SAFE STORAGE CONDITION  
ATTACHMENT 1  
TO SUPPORT REQUEST FOR AMENDMENT TO  
LICENSE NO. R-93  
DOCKET NO. 50-185**

## 1. INTRODUCTION

The revised Technical Specifications submitted with this application define the basis for maintaining the protected safe storage condition of the NASA Plum Brook Mock-Up Reactor. The following definitions are applicable to these analyses:

### General

Authorized Entry - Entry by people authorized by management with a legitimate need to enter the PBRF who have knowledge of the conditions, the hazards, and procedures of the facility or who are accompanied by someone with this knowledge.

Non-operable - A condition of a component or system which has been intentionally disabled to prevent it from performing its intended function.

Protected Safe Storage - A custodial state of undefined duration characterized by physical and procedural access control and periodic monitoring, maintenance and inspection.

### Radioactive Materials

Contaminated Material - Irradiated or non-irradiated items containing particles of radioactive materials on their surface.

Radioactive Material - Items which have been activated as a result of previous reactor operations. These items may also be contaminated.

### Radiological Control Zones

Magenta Zone - For purposes of contamination control, levels will be as low as reasonably achievable but can exceed the magenta-yellow limit. For purposes of direct radiation control, a magenta zone is any area which could expose major portions of a body to direct radiation levels of 100 mRem/hr or more.

Magenta-Yellow Zone - For purposes of verifying contamination control, levels will not exceed 100 dpm alpha/100 cm<sup>2</sup> and 10,000 dpm beta-gamma/100 cm<sup>2</sup> transferable; 2,500 dpm alpha/100 cm<sup>2</sup> and 8,000 dpm beta-gamma fixed. Magenta-yellow zone, for purposes of direct radiation control, is any area which could expose major portions of the body to direct radiation levels from 2.5 to less than 100 mRem/hr.

White Zone - Is an area with contamination levels so low that no protective clothing is required. This area will have direct radiation levels less than 2.5 mRem/hr.

## 2. GENERAL INFORMATION

The Mock-Up Reactor consists of a non-operable research reactor, its support system, and its inventory of radioactive material generated as a result of previous operations. All reactor fuel, special nuclear material, and waste byproduct material were removed from the MUR.

## 3. LOCATION

The Plum Brook Station (PBS), a federal reservation of several thousand acres controlled by the National Aeronautics and Space Administration (NASA), is located near Sandusky, Ohio. It is surrounded by a security fence which is patrolled daily. The PBS Communication Center, which is manned 24 hours each day, is at the main gate and provides controlled entrance to the Station. The Plum Brook Reactor Facility (PBRF) within the federal reservation, is an area of approximately 27 acres which is surrounded by its own security fence. Gates in both fences are locked or continuously manned. Access doors and windows of the Reactor Building containing the MUR will be locked except during authorized entrance. A third fence controls access to the Mock-Up Reactor area around Canal H. It will be locked except for entrance by authorized personnel. These controls will deter unauthorized entry. Penetration of these controls will not be a hazard since accessible areas outside and inside the buildings are white zones.



## 4. CANAL H

### 4.1 End Condition and Bases

The ground level of the Canal H area is decontaminated to a white zone. All liquid process lines which enter the Canal H area are blank-flanged or capped. Canal H is clean to the extent practical and completely drained. The Canal H drain is capped and non-operable. The reactor is defueled and the control rods are non-operable. The core box is adequately protected by a cover to prevent entry of foreign material. The access ladder to Canal H has been removed. The Canal H shutdown end conditions are designed to prevent unauthorized entry and to prevent flooding. These precautions are selected because of the radioactive material stored in Canal H.

### 4.2 Safety Analysis

Two hazards are considered credible for the Canal H area during the protected safe storage condition. They are a radiological hazard and an industrial-type accident. Unauthorized entry could result in uncontrolled exposure to direct radiation and contaminated materials. Airborne radioactivity is not a problem since 22 years' experience has shown the stored material has no significant gaseous decay radioisotopes and the solid contamination does not become airborne. Personnel entering the Canal H area are subject to potential accident conditions, such as falls, sudden illness, etc. Each of the credible accidents, radiological and industrial, is covered separately below.

Radiological Hazard - All radioactive materials stored in Canal H are decontaminated to at least the level of a magenta-yellow zone. None of the materials stored in Canal H has accessible unshielded direct radiation levels above 100 mRem/hr. The 22-year interval since the MUR was last operated has resulted in substantial decay of short and intermediate lived isotopes. No significant radioactive gas release is expected from any of the stored materials. The direct radiation level at the control fence to Canal H is less than 2.5 mRem/hr. and is within

the limits for a white zone. Airborne radiation levels, both alpha and beta-gamma, are below the detection limit.

The remaining radiological hazard is associated with flooding and the resulting spread of contamination by water. The only credible way for water to enter the Canal H is by storm water entering through a leak into the Reactor Building. The Reactor Building and the Canal H area are inspected periodically and also after a heavy storm. Water discovered in the Canal will be sampled and disposed of under health physics' control. It is not credible that more than a few inches of water could enter Canal H during any one storm.

Industrial Accidents - Entry into the Canal H area is controlled by written procedure. Railing around Canal H is designed to prevent accidental falls into the Canal. If a tour does not end within a prescribed time, the Communication Center initiates a search request to check the situation. These practices minimize the risk of an industrial-type accident to an acceptably low level.

It is concluded that the degree of hazard associated with the Canal H end condition is acceptable.

## 5. SAFETY ANALYSIS FOR EMERGENCIES

Considerations appropriate to the Canal H area involving tornadoes and severe storms, flooding, earthquakes, fire, sabotage, and bombing are given in Section 18 of the Reference. The consequences of any of these emergencies at the Canal H area are extremely low in hazard potential because of the low amount and fixed nature of the radioactive material at Canal H. We can identify no credible emergency situation that presents a significant hazard.



## 6. REFERENCE

Attachment 4, "Bases and Safety Analyses for Plum Brook Reactor Protected Safe Storage Conditions, Attachment 1 to Support Request for Renewal Amendment to License TR-3, Docket No. 50-30" of letter from NASA Plum Brook Reactor Facility to U.S. Nuclear Regulatory Commission, Division of Licensing, Attn: Mr. C. O. Thomas. Subject: Request for Amendment to Operating License TR-3, Docket No. 50-30.